2004 Storm Drainage Master Plan

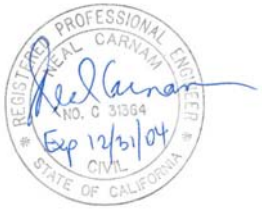
City of Fort Bragg California

October 2004

This plan was prepared using State Community Development Block (Grants #01-STBG-1677 and #02-STBG-1777)

Prepared for:

City of Fort Bragg
416 North Franklin St.
Fort Bragg, CA 95437



Prepared by:

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03-1843-02015

2004 STORM DRAINAGE MASTER PLAN CITY OF FORT BRAGG, CALIFORNIA

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CHAPTER 1 – SUMMARY

1.1 Purpose

This 2004 Storm Drainage Master Plan has been prepared as an update to the City of Fort Bragg's (City) 1985 Storm Drainage Master Plan. Its purpose is to provide a detailed overview of the adequacy of the major storm drainage facilities serving the City. The 2004 Storm Drainage Master Plan provides the following review and update of the hydrology and hydraulics of the watershed:

- A comprehensive description and mapping of the City's storm drain system and facilities;
- Update of the City's Utility Map that shows the locations of existing public storm drains and facilities, size of pipelines, and pipe material in electronic format;
- An assessment of the capacity of the existing creeks, channels, culverts and closed conduits having diameters 12 inches and larger;
- Identification of existing and future system deficiencies;
- Recommendations on upgrades required;
- Opinion of the probable cost of these upgrades, and financing options;
- A creek and channel maintenance program.

1.2 Methodology

This 2004 Storm Drainage Master Plan began with an updated identification of the study area and drainage boundaries defined in the 1985 Storm Drainage Master Plan, as well as the development of critical hydrology parameters, such as design storms, land use patterns, and soil type distributions. Included in this study were the waterways that flow through or adjacent to the City. The study area was defined as the Sphere of Influence, which was established in the 2002 Fort Bragg General Plan.

Land use mapping was obtained from the City of Fort Bragg. Soils data was obtained from the Natural Resources Conservation Service (NRCS). The design storms used in the study were established based upon the intensity/duration/frequency (IDF) curves for Fort Bragg, which the County of Mendocino obtained from the California Department of Transportation in June 2000, and are based on their IDF32 software package. These study area characteristics are described in Chapter 3.

Hydrologic modeling was performed using the Rational Method, and provided the design flows for this Master Plan update. The 1985 analysis was updated to reflect the changes in land use as identified by the current General Plan, and a conservative, yet more realistic approach to modeling runoff was used. Hydraulic modeling of major open channels was performed using HEC-RAS. Closed-conduits were modeled using Haestad Methods' StormCAD. Chapter 4 is devoted to a description of the design criteria used in the hydrologic and hydraulic study, and Chapter 5 contains a detailed discussion of hydraulic results.

1.3 Proposed Improvements

The analysis indicates that 55 drainage structures within the City of Fort Bragg are undersized for the design flow. The specific recommendations, including figures and opinion of probable costs, are discussed in detail in Chapter 5. Winzler & Kelly's opinion of the total probable cost of correcting these deficiencies is approximately $5,100,000. It should be noted that, where appropriate, alternatives for the proposed improvements are also included and reflected in the total cost. The reason for the alternatives is to achieve the same purpose of relieving the existing system and increasing the capacity to contain the 10-year flow, but at less cost. Rather than replacing an undersized pipe with a larger one, the alternatives achieve design capacity by installing new storm conduits parallel to existing undersized conduits. The total estimated cost of and need for correcting the 55 deficient drainage structures in Chapter 5 provides a prioritization of these improvements.

1.4 Recommendations

It is recommended that this Storm Drainage Master Plan be adopted as a guide for construction of future drainage improvements. The Capital Improvement Program, outlined in Chapter 5, provides a prioritized ranking of the recommended projects, and outlines the components of each project and the total project cost. Due to the importance of some projects over others, it is suggested that projects are completed in the order recommended in the Capital Improvement Program. Methods of financing the proposed projects are discussed in Chapter 6.

It should be noted that the recommended drainage facilities are based on the 2002 revision of the Land Use Plan, along with suggested changes from the City staff. Should future development be planned that will significantly change the land use, appropriate measures should be taken to design and size those drainage facilities that may be effected. They must have the capacity needed for the modified land uses, without causing or increasing existing drainage problems for downstream property and the existing storm drain system.

Winzler & Kelly Consulting Engineers (Winzler & Kelly) recommends a channel maintenance program to maintain the capacity of the City's drainage ditches and channels. The channel maintenance program is discussed in more detail in Chapter 5.

1.5 Acknowledgement

The input and feedback from David Goble, Director of Public Works, Laura Parsons, Engineering Technician, and Mike Cimolino, Superintendent of Public Works, on this document was extremely valuable in completing this document. Thank you all for your assistance.

CHAPTER 2 – INTRODUCTION

2.1 Project Background and Purpose

2.1.1 Background

The City of Fort Bragg is located on the California North Coast, 150 miles north of San Francisco. The City contains Noyo River Harbor, which is the only improved harbor of commercial importance between Bodega Bay, 87 miles to the south, and Humboldt Bay, an equal distance to the north. The City encompasses approximately 1,800 acres and is essentially bounded on three sides by water. A location map of the City is shown in Figure 2-1. The dominant physiographic features of Fort Bragg are the Noyo River on the south side, Pudding Creek on the north side, and the Pacific Ocean on the west side. The majority of the City lies between the two rivers, with only small areas extending beyond the rivers along California State Highway 1. The City is largely rural in character with a central downtown commercial and business district surrounded largely by residential lands.

The City of Fort Bragg's downtown storm drainage system consists primarily of reinforced concrete pipe (RCP) and asbestos-cement pipe (ACP) with diameters ranging from 8" to 54". Since the mid-1980's, several subdivisions have been constructed with storm drains consisting of RCP, corrugated metal pipe (CMP), and high-density poly-ethylene (HDPE) pipe with diameters ranging from 12 to 30 inches.

The primary natural waterways in Fort Bragg, the Noyo River and Pudding Creek, are primarily in their natural, unchannelized state. Alder Creek, which historically drained the central Fort Bragg area, was altered in the late 1800's and early 1900's, and now flows in a closed conduit system beginning at the intersection of Oak Street and Whipple Street and draining to the Georgia-Pacific log pond. In the rural areas, the storm drainage system consists largely of roadside ditches and culverts. The City's stormwater flows by gravity to 7 discharge points on Pudding Creek, 10 discharge points on the Noyo River, and 3 ocean outfalls (refer to Figures 5-2 through 5-21 for discharge locations).

2.1.2 History

Historically, the City of Fort Bragg has experienced flooding problems in certain areas during somewhat minor storms due to an undersized storm drainage system. Beginning in 1898, combined sanitary and storm systems were installed in Main and Franklin Streets. Additions were made over the years as the City grew.

In 1971 the City had a general plan prepared. The plan emphasized perimeter conservation and natural resource uses. There were recommendations to increase the water and sewer services because of the expected growth rate for Fort Bragg. At the time of the report, the sanitary and storm drain systems were still combined.

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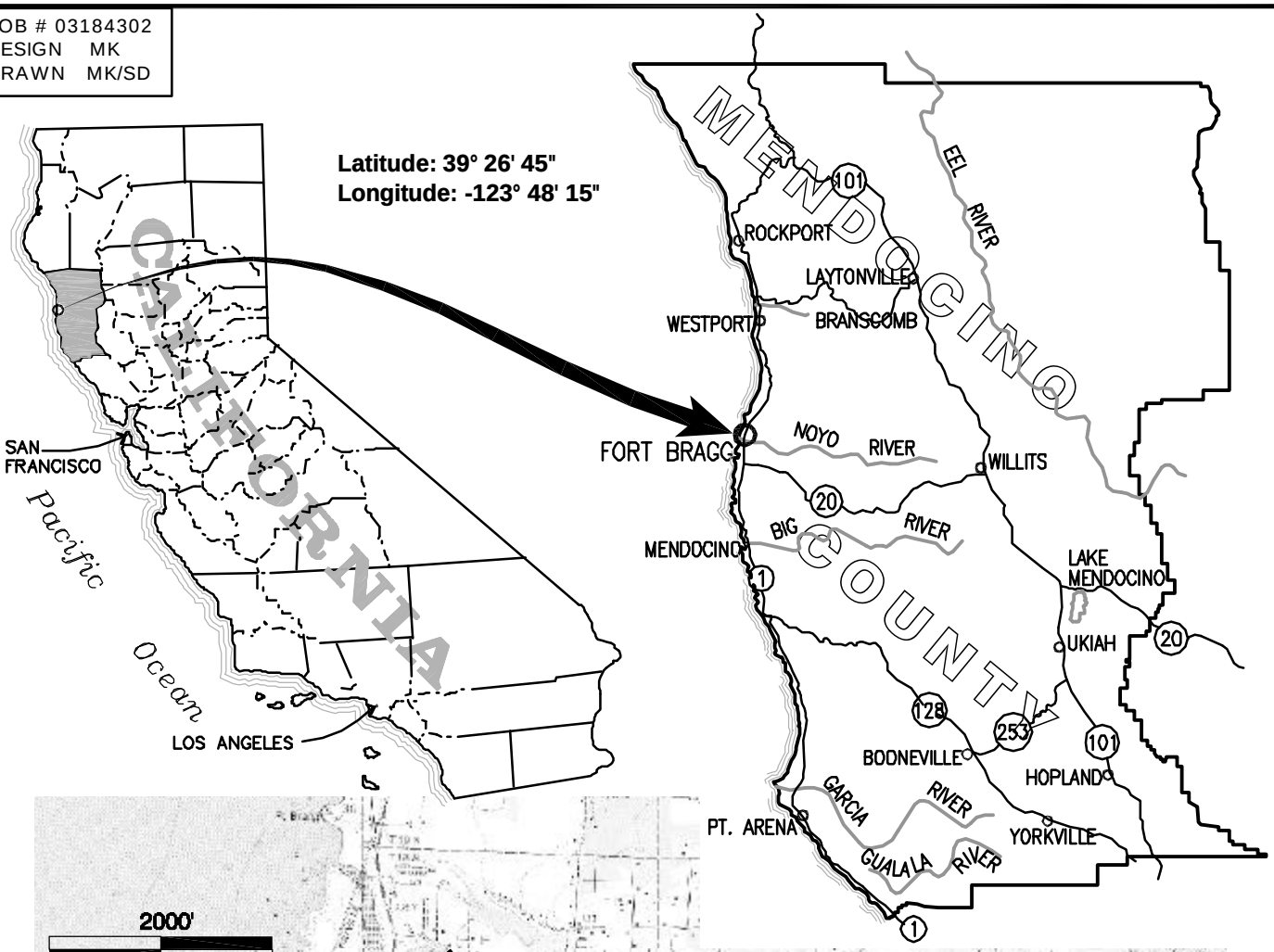

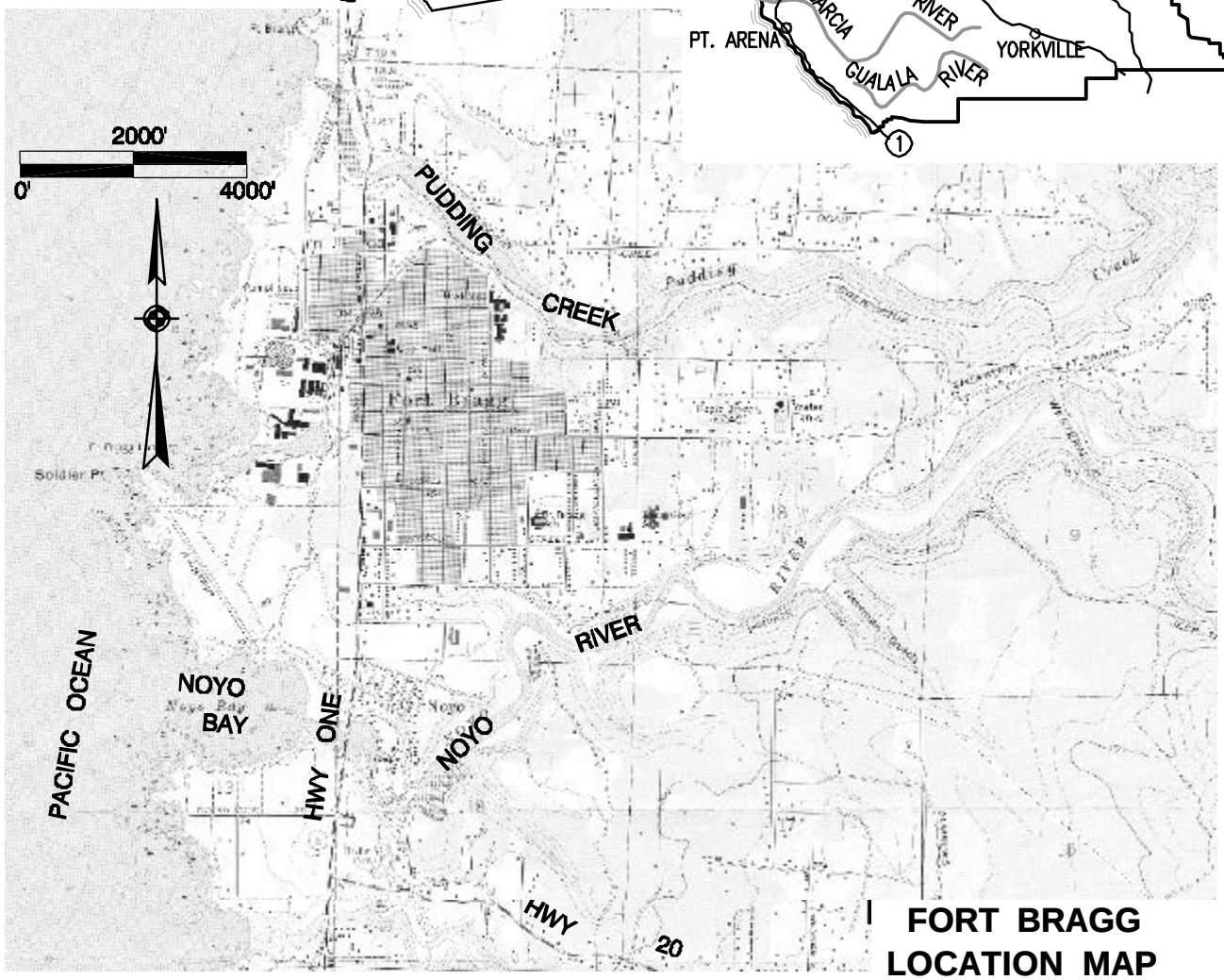

FORT BRAGG LOCATION MAP

FIGURE 2-1

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

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In 1973, J. Warren Nute was contracted by the City of Fort Bragg to prepare a technical compliance report for the City in response to the 1972 California Water Quality Plan for Ocean Waters. One of the conclusions of this study was to separate the sanitary and storm sewers in the northern part of town. This was completed by March 1979 and was the beginning of Fort Bragg's storm drainage system. Following the completion of this project, the City continued installing storm drainage facilities to meet existing drainage needs the needs of the growing community.

The City contracted to have a general plan produced, which was completed in 1980 by Robert Williams Associates/More Research. This plan placed emphasis on a limited phase growth plan for Fort Bragg, indicating the community goals and objectives of the community included a well regulated land use plan and limited city growth. This plan was intended to be a guide for City action and policy through the year 1995.

In 1985 Winzler & Kelly completed a Storm Drainage Master Plan to aid the City in solving the existing stormwater drainage problems and to plan for expanded growth within the City and outlying areas. Many of the recommendations in the 1985 Storm Drain Master Plan have been completed, along with storm drain improvements for subdivisions and other developments. These improvements have addressed most of the City's existing drainage problems.

The most recent general plan for the City was completed in 2002 by the environmental and planning consulting firm of Leonard Charles and Associates in collaboration with PAS & Associates and with technical assistance from The Crane Transportation Group and Illingworth & Rodkin, Inc. This General Plan is an update of the 1980 General Plan, the 1992 Housing Element, and the 1992 Circulation Element. The mission of this plan is to preserve and enhance the small town character of Fort Bragg and improve economic diversity. This plan is intended to address development concerns through the year 2012.

The City would like to solve the remaining stormwater drainage problems as well as plan for expanded growth in the City's outlying areas. To accomplish this, the City of Fort Bragg has contracted with Winzler & Kelly to develop a Storm Drainage Master Plan Update with a 10-year Capital Improvement Program.

2.1.3 Purpose

This drainage plan takes into account the land use element of the current General Plan as well as the existing and proposed zoning and the Sphere of Influence in developing the stormwater runoff calculations. The objectives of this Storm Drain Master Plan are to:

- Provide a comprehensive description and mapping of the City's storm drain system including creeks, channels and ditches;
- Update the City's Utility Map that shows locations of public storm drains and facilities, size of pipelines, pipe material and flow directions;
- Create a computerized hydraulic model of the storm drain system that has the City's Utility Map as its base;
- Evaluate the storm drain and channel systems in order to identify existing and future deficiencies;

- Evaluate deficiencies in the channel maintenance program;
- Recommend appropriate Best Management Practices (BMPs) so that stormwater discharges are managed in accordance with the City-wide Phase II National Pollutant Discharge Elimination Standards (NPDES) permit;
- Prepare the City's 10-year Capital Improvement Program (CIP) for the storm drain system, differentiating between replacement and growth related projects.

2.1.4 Scope of Work

The Scope of Work for the 2004 Storm Drainage Master Plan included the following tasks:

Review of Existing Data/Establish Critical Parameters: Winzler & Kelly gathered and reviewed existing information, determined critical factors that were expected to influence the hydrology and hydraulic modeling analyses, and identified local conditions that may impact the ability of the storm drainage system to alleviate flooding. Previous reports, as-built records, construction reports and O&M data were reviewed, as available. Historical rainfall information, channel flow capacities, stream flow records, and Natural Resource Conservation Service (NRCS) soil mapping data for the study area was also obtained. Based upon the findings of the data review, Winzler & Kelly performed a preliminary delineation of subwatersheds and defined the critical modeling parameters.

Mapping and Field Verifications: Winzler & Kelly conducted field investigations to verify existing storm drain systems, typical cross-sections of waterway channels, roadside ditches and culverts, and evaluated the condition of major drainage structures. Flow directions of pipelines and overland runoff were verified where the existing data was questionable. To maximize the value of work already completed by the City, the AutoCAD Utility Map prepared by City staff was updated and used to develop the base map required for this study. The updated Utility Map contains the following:

- City Land Use Designations from the 2002 General Plan;
- Locations of public storm drains and facilities, size of lines and pipe material;
- Locations of creeks and stormwater channels;
- Elevations of selected facilities and structures, as surveyed by Winzler & Kelly or obtained from as-built records.

Hydrologic and Hydraulic Modeling: Winzler & Kelly used the hydrologic analysis completed as part of the original Storm Drainage Master Plan to provide design flows for this Master Plan update. The original hydrologic analysis was revisited to verify where runoff may have changed based on any changes in land use as identified by the current General Plan. The City's storm drain system was modeled using Haestad Methods' StormCAD for closed-conduit segments, and the Hydrologic Engineering Center's (HEC's) HEC-RAS for open-conduit segments. The following data served as input to the hydraulic models:

- City topographic data was used to estimate water channel invert elevations and slopes;
- As-built records and the City Utility Map were used to obtain manhole rim elevations, drop inlet grate elevations, and invert elevations;

- Elevations for select manholes and drop inlets were collected by Winzler & Kelly;
- Channel and roadside ditch cross-section measurements were obtained during the field investigations.

Identification of System Deficiencies: Hydraulic structures are sized to convey the maximum anticipated runoff of an area, which occurs when the building density of upstream areas reach "build-out conditions", the maximum development allowable within the zoning designation. In this study, the design flow calculations were based upon the assumption that the upstream drainage area has reached build-out conditions. Hydraulic capacity was modeled using StormCAD or HEC-RAS. From the modeling efforts hydraulic deficiencies within the storm drain system were identified. Each deficiency was evaluated to determine if the model result was realistic. For drainage facilities identified as undersized, the drainage area upstream of the structure was evaluated to determine whether build-out capacity has been attained. Undersized structures that are located in areas that have reached build-out capacity were given a higher priority for improvement than those located in areas where more development is anticipated.

Prepare Capital Improvement Program: Winzler & Kelly prepared a Capital Improvement Program (CIP) based on recommended system improvements identified during field investigations and hydraulic modeling efforts. The CIP is also based on improvements identified by City maintenance staff. The CIP identified storm system replacement projects and growth-related projects, and included a prioritized listing of each of the projects. Replacement projects are considered those located in areas with little or no anticipated future development. Growth-related projects are considered those resulting from the increased runoff associated with future development. The CIP should become a tool that is used by the City to plan subsequent work, and includes the following key elements:

- Accurate identification of all required improvement projects;
- Prioritization of projects according to an established set of criteria that is acceptable to City staff;
- Our opinion of probable construction costs, based on real-world data obtained from similar public works projects;
- Recognition of potential future regulatory changes that impact management of the storm drainage system.

Financing Plan: Winzler & Kelly presents the City with a wide range of options for funding the improvements. In addition to fees, assessments, and bonds, some of the funding sources that were evaluated include Rural Development loan/grant combinations, Community Development Block Grants, Economic Development Administrative Grants, and State Revolving Fund loans.

Phase II Stormwater Best Management Practices (BMP): Fort Bragg is subject to the requirements of the NPDES Phase II regulations as a State-designated municipal separate storm sewer system (MS4). The City of Fort Bragg has recently completed a Phase II Stormwater Management Program, which contains the NPDES General Permit, recommended BMPs, and six required Minimum Control Measures.

Prepare Storm Drainage Master Plan Update: Winzler & Kelly will gather the evaluations, analyses and recommendations performed in the previous tasks and document them in a Draft 2004 Storm Drainage Master Plan Update. After review by the City staff and then by the City Council the 2004 Storm Drain Master Plan Update Report will be finalized for City adoption.

CHAPTER 3 – STUDY AREA CHARACTERISTICS

3.1 Introduction

The purpose of this chapter is to describe pertinent physical, demographic, environmental, and economic characteristics of the study area to provide a basis for the update of this 2004 Storm Drainage Master Plan. This chapter defines the study area and drainage boundaries needed for the hydrologic analysis. It also develops the land use and soils information used to calculate runoff coefficients, and it outlines the hydrologic patterns that form the basis for the selection of intensity-duration-frequency curves. Included are descriptions of the geographical setting, economic activity, population, environmental setting, and institutions within the study area. In addition, this chapter includes a description of the significant changes in land use within the study area since the 1985 Storm Drainage Master Plan.

3.2 Study Area Boundaries and Composition

The project study area is located within the Noyo River and Pudding Creek drainages in Mendocino County, as shown in Figure 3-1. The project study area is the City Planning Area, which is defined in the City of Fort Bragg General Plan as lands within the City and the City's designated Sphere of Influence. The Sphere of Influence represents areas that may be annexed to the City and for which urban services may be provided. The project study area encompasses approximately 2,700 acres including the City of Fort Bragg and outlying areas within the drainage boundaries that affect the City of Fort Bragg.

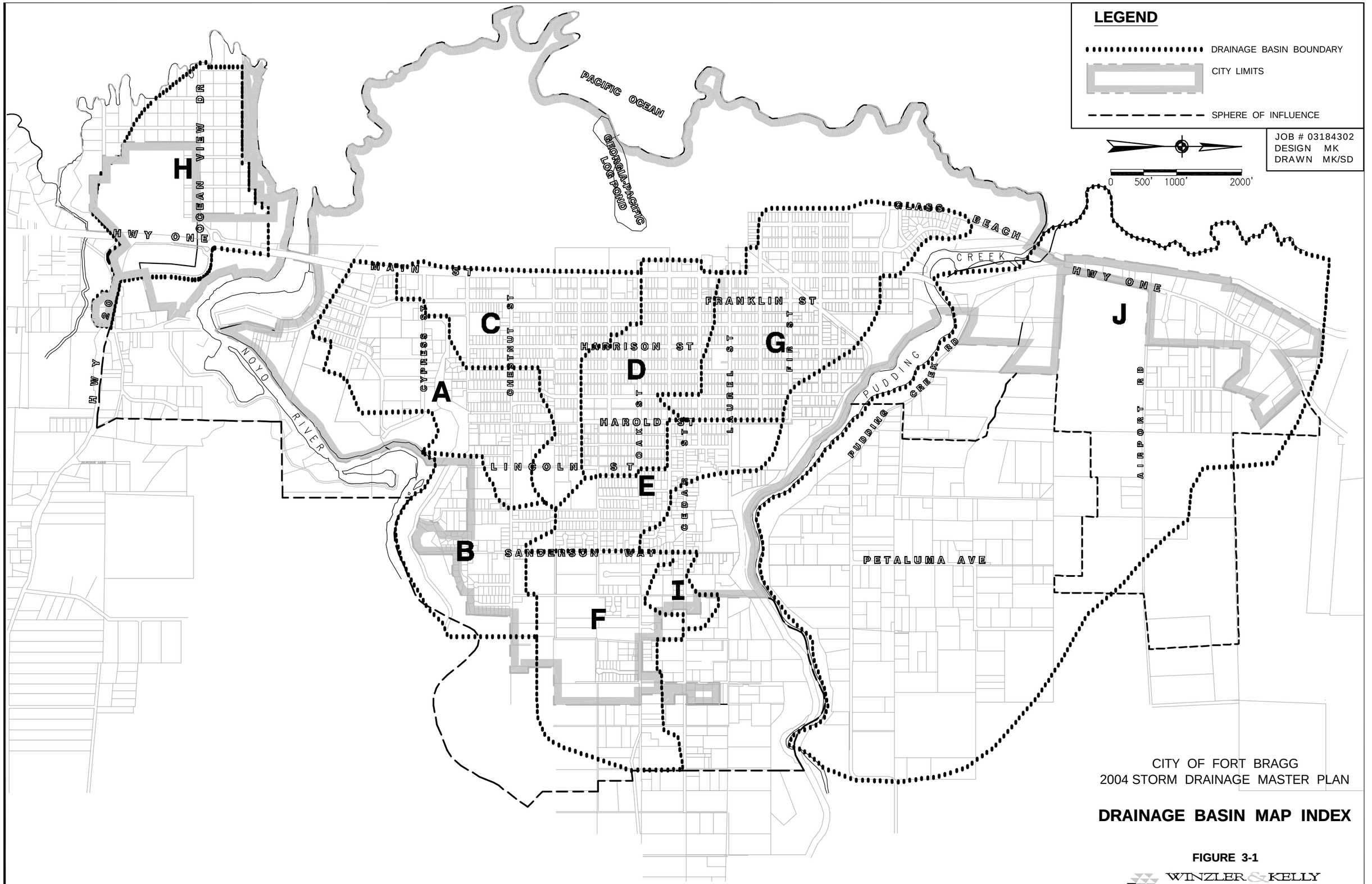
The City of Fort Bragg between the Noyo River and Pudding Creek is divided into 10 drainage basins, designated as A through J. The drainage basin for the Todd Point area south of the Noyo River is designated as H, and the drainage basin north of Pudding Creek is designated as J. A new drainage area, designated as Basin I, was added for this Storm Drainage Master Plan Update to address flooding and drainage problems in the Cedar Street/Sanderson Way area. The drainage basin boundaries are shown in Figure 3-1. Each drainage basin is served by a separate storm drain system.

3.3 Geographical Setting

3.3.1 Topography and Drainage

The elevation of the project area varies from 0 feet mean sea level (MSL) along the coast, the Noyo River and Pudding Creek to over 183 feet to the east. The majority of the City is located on a gradually sloping plain ranging between 183 feet on the east to 70 feet along Main Street. The north and south sides of the center section of the City drop off sharply, creating steep undeveloped cliffs bordering both the river and the creek.

The area on the north side of Pudding Creek also gradually slopes down toward the west, ranging from 170 feet on the eastern side to 60 feet along Highway 1.



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CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

DRAINAGE BASIN MAP INDEX

FIGURE 3-1

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The major natural drainages in the project area include Pudding Creek along the north side of the City, and the Noyo River along the south side of the City.

There are a number of other small natural channels in the study area. Within the City limits these channels either parallel existing roads or run from the ends of streets down the steep slopes to the rivers. Outside of the City limits, on the north side, there is a major channel essentially parallel to Pudding Creek, 1500 feet north of it, running from Petaluma Avenue to the Pacific Ocean.

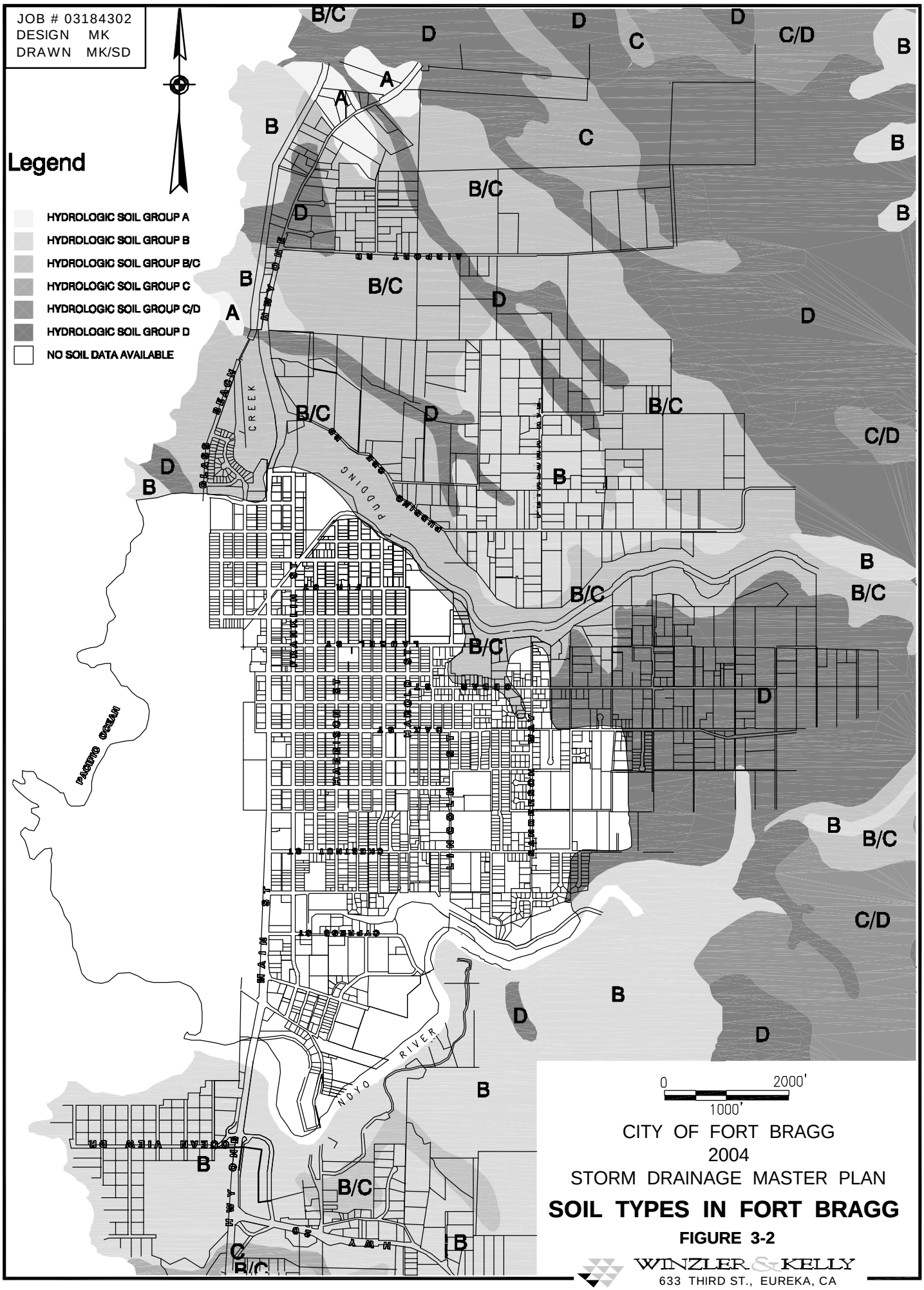
3.3.2 Soils

The underlying soil types in the study area are used to assist in the development of the runoff coefficient in the hydrologic model. For this project, the Natural Resources Conservation Service (NRCS) Soil Survey of Mendocino County, California, Western Part was used to determine soil type. The study area contains four distinct hydrologic soil groups, and includes fifteen distinct types of soils. Hydrologic Soil Group A has high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission. Hydrologic Soil Group B has moderate infiltration rates when thoroughly wetted, and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. Hydrologic Soil Group C consists predominantly of soils with high clay content, including clay loams and some shallow sandy loams, which have slow infiltration rates when thoroughly wetted. This soil group consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission. Hydrologic Soil Group D consists of heavy, plastic clays. These soils have very slow infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission. The soil types are illustrated in Figure 3-2. Unfortunately, the majority of the soils within the Fort Bragg City limits are classified by the NRCS as Urban Land. Unlike other hydrologic soil classifications, this type does not have an assigned Hydrologic Soil Group because soil properties are extremely variable due to development-related activities. Therefore, runoff properties in this area could not be evaluated based on the Hydrologic Soil Group.

3.3.3 Vegetation

At present, a woodland prairie vegetative community characterizes the major portion of the undeveloped property in Fort Bragg. The immediate hills are generally grassy with timber farther to the north and east.

The plateau area north of Pudding Creek is characterized by pastureland with riparian woodlands and dense berry thickets and brush along the streams.



CITY OF FORT BRAGG
2004
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SOIL TYPES IN FORT BRAGG

FIGURE 3-2

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3.4 Climate

The climate is moderate with the predominant weather factor being the moist air masses from the Pacific Ocean. Average annual rainfall in Fort Bragg is approximately 41 inches, with the major portion falling between October and April (Table 3-1).

TABLE 3-1 AVERAGE MONTHLY CLIMATE[1]

Month	Precipitation (inches)	Maximum Temperature (F)	Minimum Temperature (F)	Average Temperature (F)
January	7.73	55.3	39.9	47.7
February	6.37	56.6	40.8	48.7
March	5.78	57.5	41.6	49.5
April	2.85	59.1	43.0	51.1
May	1.34	61.5	45.6	53.5
June	0.45	63.7	48.2	55.9
July	0.10	64.8	49.2	57.0
August	0.34	65.3	49.8	57.5
September	0.62	65.9	49.3	57.6
October	2.53	63.6	46.7	55.2
November	5.51	59.5	43.5	51.4
December	7.24	55.7	40.3	48.0

[1]Period of record (7/1/1948-3/31/2003); from the Western Region Climate Center, National Climatic Data Center Station Historical Listing for National Weather Service Cooperative Network, Fort Bragg, California, Department of Commerce, NOAA, 2003.

The daily temperature extremes range from the mid-twenties to the high eighties, with an annual mean temperature of 52.8°F.

3.5 Hydrology

Stormwater master planning and the design of drainage facilities are highly dependent on the selection of the "design storm." This storm, typically expressed in terms of its expected *recurrence interval* (e.g., 10 years), is used to determine rainfall intensity. The recurrence interval, also called a *return period* or *event frequency*, is the length of time expected to elapse between rainfall events of equal or greater magnitude. For example, a 10-year recurrence interval represents a storm event that is expected to occur once every 10 years, on average. This does not imply that two storm events of that same size will not occur in the same year, nor does it mean that the next storm event of that size will not occur for another 10 years. Rather, a 10-percent chance of occurrence exists in any given year. The length of the design storm also affects storm flows and runoff. In this study intensity-duration-frequency (IDF) curves are used to determine rainfall intensities for expected recurrence intervals and durations.

3.6 Land Use and Planning

Land use patterns also affect stormwater master planning efforts because the rate at which stormwater runs off, as opposed to the amount that percolates into the soil, is proportional to the amount of impervious area in a watershed. For long-term planning efforts, it is important to look not only at current development, but also at ultimate land use according to the City's 2002 General Plan. Storm drain infrastructure is intended to provide service for 50 to 100 years, and facilities must be designed to accommodate future development in a watershed.

3.6.1 Land Use

Land uses within the project study area are representative of a rural community with a downtown area located in the city center including light industry and residential shopping.

The City of Fort Bragg 2002 General Plan establishes policies for all land within the Fort Bragg City limits and its existing Sphere of Influence, also called the Planning Area. The main goal of the 2002 General Plan is to preserve and enhance the small town character while improving the economic diversity of the City to ensure that it has a strong and resilient economy. The land use policies outlined in the Land Use Element of the 2002 General Plan provide for limited, phased growth by maintaining the existing pattern of land uses within the City while anticipating and providing for future growth and development. The land use map, shown as Figure 3-3, describes the desired types and intensity of land use for the City and its Sphere of Influence.

Commercial land uses in the City are located along the Highway 1 and Franklin Street corridors. The central business district is located between Oak and Pine Streets, while industrial lands are located on the Georgia-Pacific timber mill property west of Highway 1, on North Franklin Street immediately north of the central business district, and on Highway 1 north of Pudding Creek. Residential neighborhoods are located east of the commercial core and in the west Fort Bragg neighborhood. The most significant policy change in the General Plan is the reclassification of the Georgia-Pacific industrial lands west of Highway 1 between Noyo River and Elm Street. These lands, which were classified in the 1980 General Plan as Heavy Industrial, are now classified as Timber Resource Industrial and is intended to support the continued use of this area for timber processing activities and to establish a clear planning process for the transition of this land to other uses. The City is currently undergoing a reuse plan that may change this land use zoning. Any improvements of the Georgia Pacific site need to be evaluated in the context of its effect on storm drainage (refer to Section 5.6). Other changes include the reclassification of the residential and commercial land use designations, and the redesignation of parks, agriculture and open space.

Discussions with the City staff indicated that increased growth in the areas east of the City limits, both inside and out of the Sphere of Influence, is beginning to affect drainage within the City. This growth, and additional future growth, is taken into account when developing projected stormwater flows.

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PACIFIC OCEAN

GEORGIA-PACIFIC LOG POND

0 500' 1000' 2000'

HWY ONE
OCEAN VIEW DR
MAIN ST
HWY 20
NOYO RIVER
CYPRESS ST
CHESTNUT ST
HARRISON ST
FRANKLIN ST
FIR ST
LAUREL ST
OAK ST
HAROLD ST
CEDAR ST
LINCOLN ST
SANDERSON WAY
GLASS BEACH
CREEK
PUDDING CREEK RD
PETALUMA AVE
AIRPORT RD

LAND USE DESIGNATIONS

Residential Land Use Designations

RR5		Large Lot Rural Residential (1 unit per 5 acres)
RR2		Medium Lot Rural Residential (1 unit per 2 acres)
RR1		Rural Residential (1 unit per acre)
SR		Suburban Residential (1-3 units per acre)
R1		Low Density Residential (3-6 units per acre)
R2		Medium Density Residential (6-12 units per acre)
R3		High Density Residential (6-15 units per acre)
R4		Very High Density Residential (6-24 units per acre)

Commercial Land Use Designations

CBD		Central Business District
C1		Neighborhood Commercial
C2		General Commercial
C3		Highway Visitor Commercial
C4		Office Commercial

Industrial Land Use Designations

LI		Light Industrial
HI		Heavy Industrial
TRI		Timber Resources Industrial

Other Designations

HD		Harbor District
PR		Parks and Recreation
PF		Public Facilities and Services
OS		Open Space
A		Agriculture

City Boundary

Sphere of Influence

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

2002

FORT BRAGG LAND USE MAP

FIGURE 3-3

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

3.6.2 Economic Activity

Historically, unemployment in Mendocino County has averaged about 2.5 percent above the state average, and is presently around 1 percent above the state average. Fishing, agriculture, tourism, timber and government form the economic backbone of the area. However, with the closing of the Georgia-Pacific mill in November 2002 and new fisheries management regulations, the economic influence of the timber and fishing industries is dwindling, and their future is uncertain.

In spite of a shifting economic base, the City serves as the commercial, educational, medical and professional service center for much of the surrounding area. Tourism is steadily becoming an increasingly important part of Fort Bragg's economic base, and according to state employment projections, services, retail trade, and tourism will have the largest growth during the forecast period. One of the goals of the General Plan is to improve the economic diversity of the City to ensure that it has a strong and resilient economy which supports its residents.

3.6.3 Population and Population Characteristics

3.6.3.1 General

According to California Department of Finance estimates, Mendocino County has a population of approximately 88,200 (based on 2000 U.S. Census Bureau data). Approximately 7.8 percent of the County resides within the incorporated area of Fort Bragg, totaling 6,850 people. The population within the study area is somewhat higher due to development outside the City limits.

3.6.3.2 Growth and Population Projections

According to the Fort Bragg General Plan, the estimated annual growth rate for Fort Bragg is about 1-2 percent per year. Much of the population growth is attributed to in-migration, especially of people from the larger metropolitan areas located to the south.

Based on the report *Interim County Population Projections* made by the California Department of Finance Demographic Research Unit, the estimated population growth for Fort Bragg through the year 2020 are given in Table 3-2. These estimates are scaled from population projections for Mendocino County and assume approximately 7.8 percent of the county lives in Fort Bragg.

TABLE 3-2 POPULATION PROJECTIONS WITHIN THE INCORPORATED AREA OF FORT BRAGG

Year	Estimated Population
2000	6,850
2005	7,417
2010	8,015
2015	8,520
2020	9,063

3.6.4 Institutions Within the Project Study Area

3.6.4.1 Municipalities

The study area consists of the City of Fort Bragg and surrounding outlying areas. Urban services within the project service area are divided between two agencies: the City of Fort Bragg and the Fort Bragg Municipal Improvement District No. 1. The Municipal Improvement District was formed in 1969 and provides sewer services within the City. The City of Fort Bragg is responsible for the potable water system and storm drain system.

3.6.4.2 Planning Agencies

Planning within the service area is provided by the following agencies:

- City of Fort Bragg Community Development within City limits.
- Mendocino County Planning and Building Services outside the City limits.
- California Coastal Commission.

The City of Fort Bragg is responsible for establishing current zoning within the majority of the study area.

3.7 Summary

The following Table 3-3 summarizes the primary characteristics of each of the 10 drainage basins designated in this Master Plan.

TABLE 3-3 SUMMARY OF DRAINAGE BASIN DATA

Basin	Area (acre)	Hydrologic Soil Group	Land Use	Receiving Water Body
A	140	Urban Land	R1, R2, R3, R4, C2, C3, C4, PF	Noyo River
B	104	D, Urban Land	R1, R2, R3, RR1, PF, SR, A	Noyo River
C	130	Urban Land	R1, R2, R4, C1, C2, PF, HI	Ocean Outfall
D	104	Urban Land	R1, R2, R4, PF, C1, CBD	Ocean Outfall
E	76	B/C, Urban Land	R1, PF, PR	Pudding Creek
F	144	D, Urban Land	R1, RR1, PF	Pudding Creek
G	174	B/C, Urban Land	R1, R4, C2, C3, PF, PR, CBD, TRI, HI	Ocean Outfall, Pudding Creek
H	142	B	R2, R3, C2, C3, RR1, PR, PF, OS	Ocean Outfall, Noyo River, Hare Creek
I	17	D, Urban Land	R1	Pudding Creek
J	983	A, B, B/C, C, D	R4, RR5, C3, RR2, LI, PR, HI, OS	Ocean Outfall, Pudding Creek

CHAPTER 4 – STUDY METHODOLOGY

4.1 Introduction

One of the primary purposes of this study is to develop and update criteria applicable to the design of the drainage facilities. This chapter reviews existing data including previous design and construction reports, improvements completed since the 1985 Storm Drainage Master Plan, mapping and planning documents, and establishes pertinent design criteria. Chapter 5 discusses the hydraulic modeling results and highlights deficient drainage systems. Chapter 5 also presents the recommended storm drainage improvements and the Capital Improvement Program (CIP).

4.2 Land Use Classifications

4.2.1 Existing Land Use

The existing land use within the study area is characteristic of a developing urban center surrounded by residential development (refer to Figure 3-3). The outlying area is generally less developed with large portions to the west controlled by Georgia-Pacific.

The most densely populated area occurs between Pudding Creek and the Noyo River along Main Street and part of Franklin Street. There is substantial commercial development within this core area, which serves as the major shopping center for the region. East of the downtown core area, development moderates to medium density residential and finally light density residential. To the north of Pudding Creek and the south of the Noyo River, development is light.

The entire area west of Main Street is currently owned by Georgia-Pacific. Georgia-Pacific maintains their own drainage facilities; therefore, the drainage facilities for this area will not be considered in this study. However, there is a log pond located in the center of the property which collects the runoff from two of the City's major drainage areas. The drainage facilities discharging to the log pond have been analyzed to determine their existing capacity and to propose any recommended improvements. It should be noted that Georgia-Pacific intends to sell this property in the near future. Any plan to develop this property should include a drainage facilities plan that can incorporate the results of this report as directed by the City.

4.2.2 Future Land Use

Future land use should follow the land use plan outlined in the Fort Bragg 2002 General Plan with a trend toward increasing densities in the north, south and east outlying areas (refer to Figure 3-3).

4.3 Drainage Basin Delineation

Drainage basins provide the basis for all hydrologic calculations in this study. The drainage basins that were delineated in the 1985 Storm Drainage Master Plan are also used in this 2004 Storm Drainage Master Plan Update. The basin boundaries were adjusted prior to performing any analyses so they reflect current drainage conditions and include any new areas impacting the existing and future drainage. Basin areas for this 2004 Master Plan were adjusted using

information obtained from field investigations and topography based on the USGS 1:24,000 series Quadrangle map for Fort Bragg (10-foot contour intervals).

4.4 Data Review

The 1985 Storm Drainage Master Plan and the City Utility Map was used as a starting point for analyzing the existing drainage facilities. Previous drainage studies and as-built plans for improvements made to the storm drain system since 1985 were obtained from City staff and from the California Department of Transportation. Table 4-1 summarizes the drainage improvement projects that have been completed since 1985. Drainage facilities and their contributory watersheds in the County land were identified from USGS mapping.

TABLE 4-1 STORM DRAIN IMPROVEMENTS

Drainage Basin	Project Name	Year	City Project Number
F	Sherwood Park Subdivision (Hocker Lane)	1985	P-35
A	Cypress Ave. & Kemppe Way Street Improvement Project	1985	1985-05 (P-66)
H	College of the Redwoods Mendocino Coast Center Todd Point Phase I Site Improvements	1986	P-9
C	Walnut Apartments	1986	1984-05
J	Highway 1 Culvert Replacements (Caltrans)	1988	
E	Willow Street Improvement Project	1989	1988-07
H	Intersection State Highway 1 & Ocean View Drive	1991	1989-06
A	Cypress Terrace Subdivision (Susie Court)	1991	P-52
A & C	Cypress Street Storm Drain Improvements	1992	1991-09
G	Holmes Lumber Yard Project (Glass Beach)	1993	1993-01
B	Deer Meadows Subdivision (Lonnie Way)	1994	1994-01
F	Howland Court Subdivision	1994	
None	Glass Beach Storm Drain Interceptor and Outfall	1995	1995-01
C	Street Improvements at Chestnut Street	1995	1995-03
E	Cedar Street Storm Drain Repair	1996	1996-06
A	South Harold Street Storm Drain	1997	1997-00
A, C, D, G, H	Construction on State Highway in Mendocino County in and Near Fort Bragg from Hare Creek Bridge to Pudding Creek Bridge	1999	
G	Pine and Fir Streets Reconstruction Project	2001	2001-01
G	CA Western Railroad at Pine Street Crossing	2001	2001-02
D	Street Overlay Project Phase II	2002	2002-04
A	Olsen Lane Drainage Project	2002	2002-05

4.5 Field Investigations

Once the map and data review was complete, the identified drainage facilities and their contributory watersheds were verified in the field and through conversations with City staff. The maps presented in Chapter 5 of this 2004 Master Plan reflect the results of the field review effort.

Several of the drainage channels were photographed during the field investigations. The dimensions of the channels were measured at critical areas. Detailed information was compiled for use in developing Manning's "n" values for the subsequent modeling effort.

4.6 Design Criteria

In the 1985 Storm Drainage Master Plan the City requested the design of the stormwater facilities to be such that they will pass the 10-year storm while maintaining all flows in the gutters. The system must also pass the 100-year storm while maintaining all flows in the streets, resulting in no major flooding damage. The 10-year design storm has a minimum average recurrence interval of ten years, or a ten percent chance (on average) of occurring in any given year. This design criterion is also used in this updated 2004 Storm Drainage Master Plan.

4.7 Flood Zones

Flood zones are not considered in this study due to their irrelevance to the storm drainage system. The Noyo Harbor area is located within the Special Flood Hazard Area Inundated by the 100-Year Flood, as per the FEMA Flood Insurance Rate Map, June 1992. Other hazardous flood zones in Fort Bragg include narrow strips along both sides of the Noyo River and Pudding Creek, as well as Virgin Creek to the north and Hare Creek to the south. These other areas are undeveloped and flooding does not pose a potential risk. Refer to the Safety Element of the Fort Bragg General Plan for more information on Flood Zones in and around the City.

There are areas within the City limits that are subject to potential flooding during severe storm events. Since the terrain of Fort Bragg is generally flat, a 100-year storm may exceed the capacity of the City's storm drain system to move runoff water to outfalls into natural drainages and the Pacific Ocean. Such an event may result in localized flooding and standing water in low areas.

The Federal Emergency Management Agency (FEMA) requires the City to set the minimum standards for development in the 100-year floodplain. No development is allowed in the actual floodway, which is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment in order that a 100-year flood may be carried without substantial increases in flood height. In addition, any development in the floodway fringes cannot cause more than a one foot rise in flood heights, and any such development requires that the "habitable floor" of any structure be at least one foot above the 100-year peak flood elevations. The majority of the City is situated above the 100-year and the 500-year floodplains.

4.8 Hydrology Model

The hydrology model predicts the volume of flow generated at any point in the watershed from the defined rainfall event. Nodes were located at critical drainage facilities. A node represents a location where runoff rates were calculated. All nodes were designated based on the drainage basin tributary to them. For example, Node A-1.1 is in Drainage Basin A, and node F-1.3.1 is in Drainage Basin F. Each drainage basin in the study area was divided at nodes into sub-basins. The drainage basin boundaries were presented in Figure 3-1. Sub-basin boundaries are shown with the hydraulic modeling results in Figures 5-1 through 5-21.

4.8.1 Rational Method

The Rational Method is the most widely used method in this country for computing quantities of stormwater runoff. It allows consideration of local conditions and relates runoff directly to rainfall by the following equation:

$$Q = C \cdot i \cdot A$$

where: Q = peak runoff rate in cubic feet per second.

C = runoff coefficient, the ratio of the peak runoff rate for particular surface types and permeabilities to the average rainfall rate for a period known as the time of concentration.

i = average rainfall intensity in inches per hour for a period equal to the time of concentration.

A = drainage area in acres.

The Rational Method makes the following assumptions:

1. The rainfall intensity is uniform over the entire drainage area during the entire storm duration.
2. The maximum runoff rate occurs when the rainfall lasts as long or longer than the time of concentration.
3. The time of concentration is the time required for the runoff from the most remote part of the watershed to reach the drainage outlet or point under design.

4.8.2 Runoff Coefficient

Because runoff is directly proportional to the value assigned to “C”, the proper selection of this value is critical for stormwater runoff calculations. Care should be exercised in selecting its value as it incorporates all of the hydrologic extractions, surface imperviousness and antecedent conditions.

As development increases, the amount of runoff also increases. Runoff coefficient "C" values selected for this report are based on the land use designations described in the City of Fort Bragg 2002 General Plan (See Figure 3-3), and are listed in Table 4-2. The values of the runoff coefficients "C" for each land use type have been updated to reflect the most recently approved land use zoning.

The values for "C" listed in Table 4-2 are somewhat conservative because they assume maximum build-out in the associated zone. Substantial portions of rural and low-density areas may or may not develop to full potential. However, it is difficult to determine where growth will or will not occur. Because the costs of stormwater drainage systems are very expensive, it is generally preferable to size the system for the maximum development rather than upsizing later at additional cost. Less than maximum development, for example to a level of 80-percent, would have a relatively minor effect in overall storm flows. As an example, it can be expected that the case of 80-percent development could result in up to a one pipe size reduction for that area.

TABLE 4-2 RUNOFF COEFFICIENTS "C"

Land Use Designation	Runoff Coefficient "C"
Residential	
RR5—Large Lot Rural Residential (1 unit per 5 acres)	0.35
RR2—Medium Lot Rural Residential (1 unit per 2 acres)	0.35
RR1—Rural Residential (1 unit per acre)	0.40
SR—Suburban Residential (1-3 units per acre)	0.40
R1—Low Density Residential (3-6 units per acre)	0.55
R2—Medium Density Residential (6-12 units per acre)	0.70
R3—High Density Residential (6-15 units per acre)	0.75
R4—Very High Density Residential (6-24 units per acre)	0.85
Commercial	
CBD—Central Business District	0.85
C1—Neighborhood Commercial	0.85
C2—General Commercial	0.85
C3—Highway Visitor Commercial	0.85
C4—Office Commercial	0.85
Industrial	
LI—Light Industrial	0.85
HI—Heavy Industrial	0.90
TRI—Timber Resources Industrial	0.90
Other	
HD—Harbor District	0.85
PR—Parks and Recreation	0.25
PF—Public Facilities	0.35
OS—Open Space	0.20
A—Agricultural	0.30

The land use zoning used in this study is assumed to be the most dense that could occur in the future under the Land Use Element of the 2002 General Plan. It is important that during the actual design stage, the then current land use zoning for the specific site in question should be re-evaluated.

4.8.3 Rainfall Intensity and Duration

An accurate measure of rainfall intensity and its duration for an expected recurrence interval is necessary to determine stormwater flows for a particular area. Long-term precipitation data for Fort Bragg are available from the Western Region Climate Center (refer to Table 3-1). Rainfall intensity-duration-frequency (IDF) curves have been developed from available data by the California Department of Transportation (Caltrans) and the California Department of Water Resources. The IDF curves are available from Caltrans in the form of a computer program called *IDF32—Intensity-Duration-Frequency Rainfall Program for California*. The IDF323 program generated the IDF curves for the 10-year and 100-year events from precipitation data for the City of Fort Bragg used in this study. These curves are shown in Figure 4-1.

4.8.4 Time of Concentration

The time of concentration, "t_c", is defined as the flow time required for water to flow overland from the most remote point in the drainage area to the point in question, or the inlet point of the drain in question. For this reason, time of concentration is often referred to as the inlet time. Inlet time was determined from estimated velocities for overland flow or pipe flow. Pipe velocities were calculated using Manning's equation for a fully flowing pipe:

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

where: V = Velocity (ft/s)

n = Friction Factor (also known as Manning's "n")

R = Hydraulic Radius (ft)

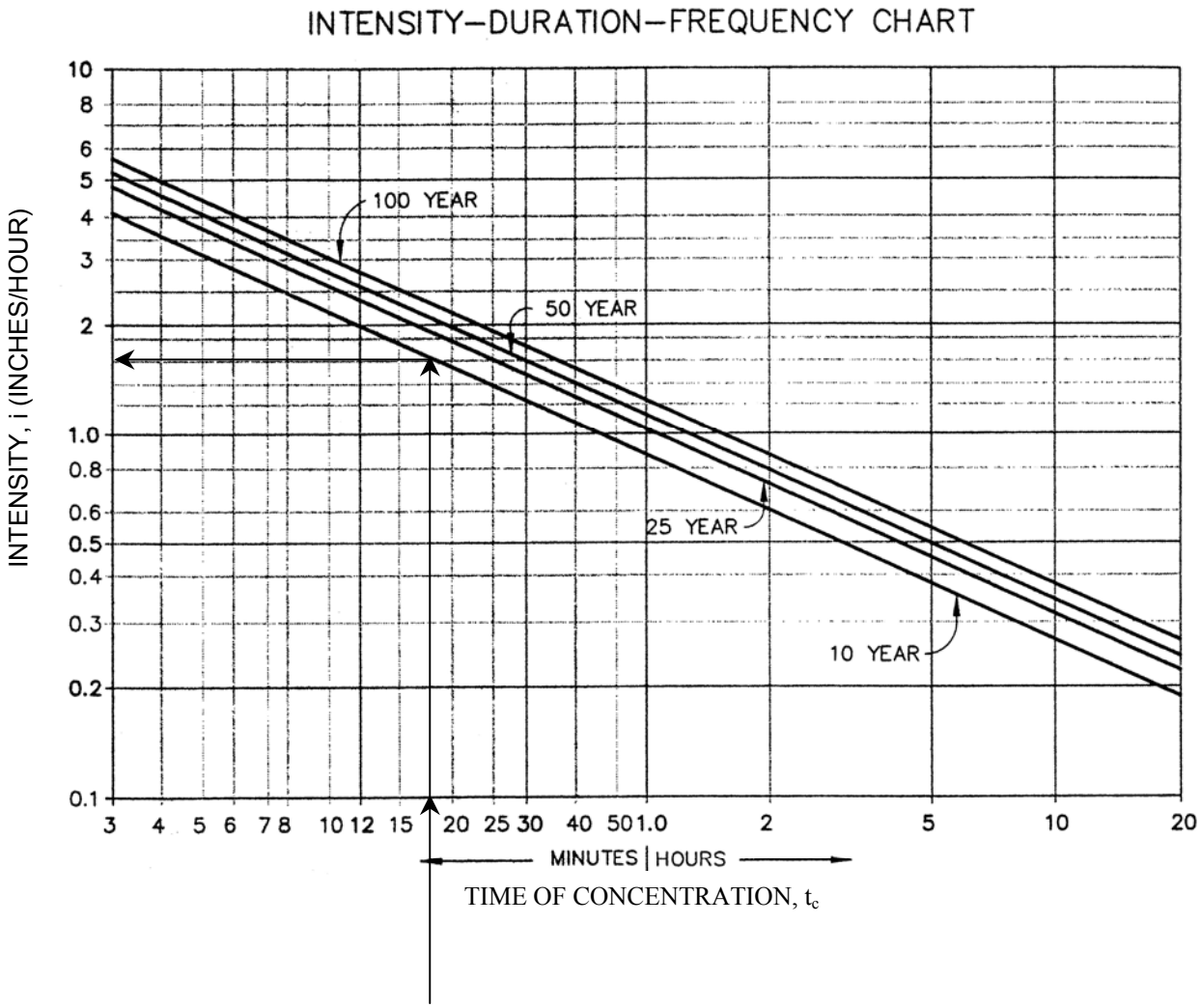
S = Channel Slope (ft/ft)

Overland flow velocities were computed using the following equation for channel flow in a natural waterway:

$$V = 5.46 \cdot S^{0.486} \cdot Q^{0.3287}$$

where: Q = Estimated Flow Rate (cfs)

The flow rate was estimated by assuming 1 cubic feet per second (cfs) of runoff from each contributing acre in the drainage area. Watershed slopes and pipe slopes were determined from topographic maps and known drainage elevation data. With the velocity and length known, the inlet time was calculated (t_c = distance/velocity). In drainage basins with more than one contributing area, the time of concentration increases as water flows downstream toward the



Example:

- Calculated t_c = 18.75 minutes
- 10-year recurrence interval intensity: 1.6 inch/hour

STATION DATA	
LONGITUDE:	123.807
LATITUDE:	39.446
ALTITUDE:	80
YEARS OF DATA:	1940–1985

Note: These Intensity/Duration/Frequency curves are based on actual precipitation data for the City of Fort Bragg, and were obtained from the California Department of Transportation in June, 2000, and are based on their IDF32 software package, which is noted as follows:

IDF32
Caltrans Rainfall Intensity Program
Copyright 1998
Department of Transportation
State of California

Figure 4-1

watershed outlet. At each point of concentration the time required for water to travel from the upstream point of concentration to the downstream point of concentration is added to the previous inlet time to obtain the new inlet time for that area. The highest inlet time is always carried through to the next downstream area. This cumulative inlet time is the time of concentration for the entire upstream area contributing to the flow at that point of concentration. The known inlet times for each point of concentration were used to determine the 10-year and 100-year precipitation intensities from the IDF curves. Flows at each point of concentration were then calculated using the precipitation intensity from Figure 4-1, cumulative runoff coefficient and area ($Q = C \cdot i \cdot A$). This method of calculating hydrology flows is a modification of the method used in the 1985 Storm Drainage Master Plan, where flows were computed for each contributing area and summed downstream. This new method results in moderately less conservative yet more realistic flow estimates. An example calculation using this method is included in Appendix B of this report.

Inlet time for improved areas can vary widely and accurate values are difficult to obtain. Values between 5 and 30 minutes are used for developed areas with steep slopes or closely spaced inlets. 10 to 15 minute periods are common for similar areas with flatter slopes and for areas with widely spaced inlets or very gentle slopes, inlet times of 20 to 30 minutes are normally used. A minimum inlet time of 10 minutes was used in the 1985 Storm Drainage Master Plan, and is also used for all areas in this study.

4.9 Hydraulic Models

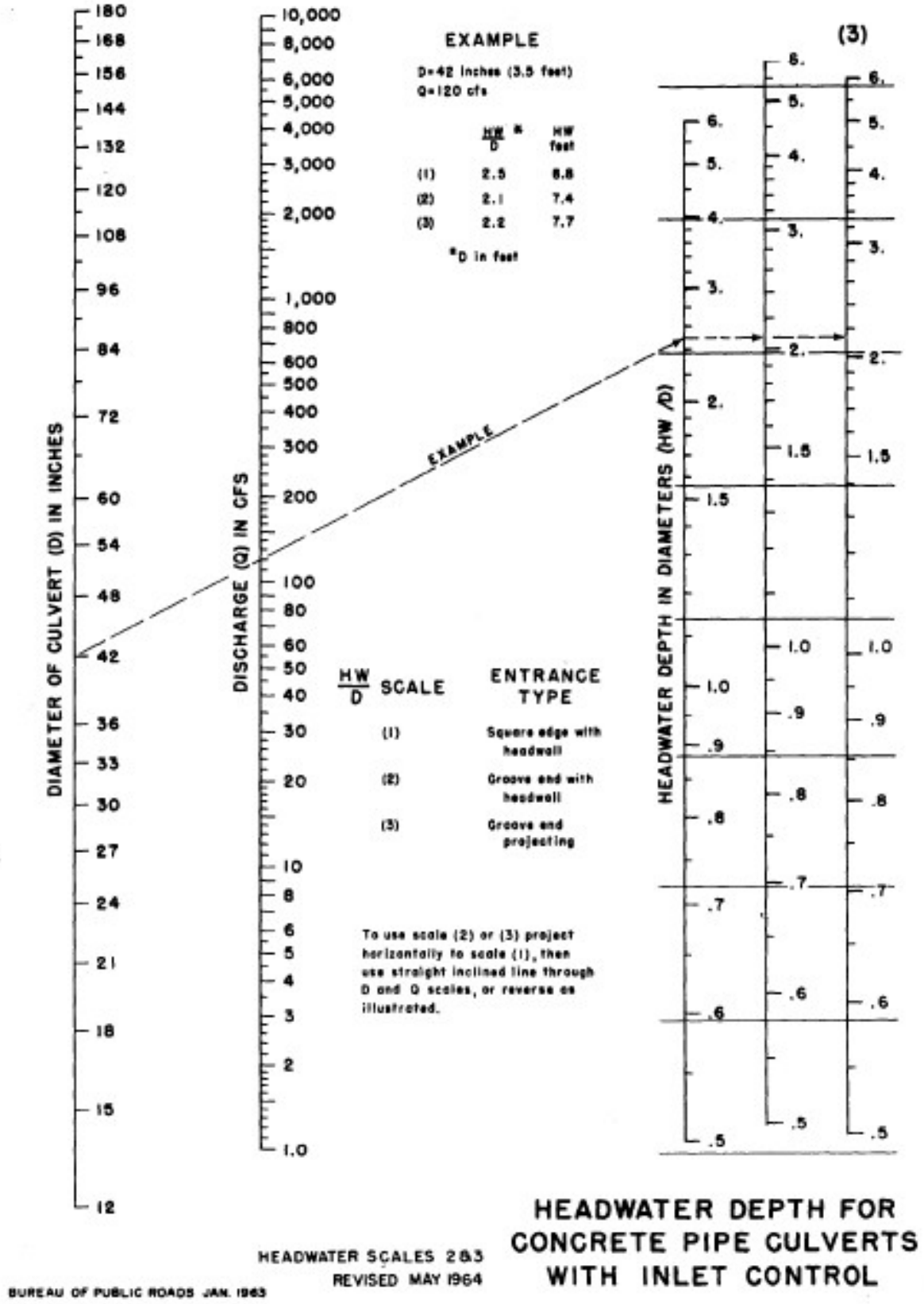
The purpose of the hydraulic analysis was to evaluate the adequacy of the existing storm drainage system, and to determine design options for inadequately sized conduits and channels. Creeks, channels, and storm drain trunks 12" in diameter and larger were simulated using the flow data generated in the hydrology model. Storm drains were simulated using Haestad Method's StormCAD or Inlet Control Nomographs (see Figure 4-2), and open channels were simulated using HEC-RAS or Manning's equation. Where Inlet Control Nomographs were used to calculate pipe capacity, the headwater depth, the actual depth of the water entering the pipe, is assumed to be 1.5 times the pipe diameter. Allowing head to build up in manholes and at inlets increases the capacity of the pipes. The Inlet Control Nomograph used in this study was obtained from the Federal Highway Administration's publication on the Hydraulic Design of Highway Culverts.

4.9.1 Hydraulic Analysis Methods

The hydraulic models utilize Manning's equation to relate depth of flow in the waterway to the flow rate (Q), cross sectional area of the drainage structure (A), slope of the structure (S), and roughness of the structure (Manning's roughness coefficient "n").

4.9.1.1 Flow Rates

In the hydrology model, runoff flow rates were computed at each node for the appropriate design storms. Runoff is assumed to enter the drainage ditches, channels, and closed conduits at node locations. Drop inlets serving closed conduits are assumed to have 100 percent capture



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Figure 4-2

efficiency. Within the hydraulic model, the flow that enters at each node location is assumed to be flowing through the entire upstream length of pipe, that is, the pipe between that node and the next upstream node. An example of this method is included in Appendix B of this report.

4.9.1.2 Closed Conduit Systems

The City of Fort Bragg provided maps and improvement plans showing the locations and dimensions of storm drain structures. These data sources show the locations of manholes and inlets, as well as most invert and rim elevation data.

During field investigations Winzler & Kelly verified invert elevations at key nodal locations, and obtained invert elevations where only rim elevations were known. Invert elevations were obtained by measuring from the rim of each structure to the flowline of storm drain pipelines. Pipe sizes and materials were verified as accurately as possible from the surface without confined space entry. This data was then incorporated into the hydraulic models. Where no data was available, the slope of storm drains was assumed to approximate the ground slope.

4.9.1.3 Open Channels

The cross-sectional areas and ground slopes for drainage ditches and open channels were measured from either the USGS 1:24,000 series Quadrangle map for Fort Bragg with 10-foot contour intervals. Measurements were also taken during field investigations.

For this study, the following Manning's roughness coefficients were used:

- Reinforced concrete pipe (RCP) 0.013
- Corrugated metal pipe (CMP) 0.024
- Asbestos-cement pipe (ACP) 0.013
- High density polyethylene pipe (HDPE) 0.012
- Polyvinylchloride pipe (PVC) 0.010
- Fiberglass pipe 0.012
- Earth channels 0.025
- Grassed channels 0.035
- Natural waterways 0.050

4.9.1.4 Boundary Conditions

For hydraulic analyses, a downstream and upstream water surface condition is required as input. For 10-year design storms, a uniform flow condition was assumed (i.e., discharge and cross-sectional area are constant throughout the length of the pipe or channel). For open channels the depth of flow is assumed to be constant, so the hydraulic grade line is parallel to the channel slope.

CHAPTER 5 – HYDRAULIC CAPACITY, RECOMMENDATIONS AND OPINION OF PROBABLE COSTS

5.1 General

The study area has been divided into ten separate drainage areas labeled A through J, as shown in Figure 5-1. The hydraulic capacity of the drainage facilities was calculated with the hydraulic models for the 10-year design storm. This chapter presents and discusses the capacities of existing drainage facilities, the hydraulically deficient drainage facilities, 10-year and 100-year design flows, and problem areas for each drainage basin. Hydraulically deficient facilities are those that are undersized for the 10-year design flow and/or backwatered pipes which are causing or have the potential to cause flooding problems. Estimated peak flows generated from a 10-year storm event at maximum build-out were used as a basis for sizing drainage facilities. Alternative flow routing for controlling flooding and a list of proposed improvements has been developed, along with our opinion of the probable cost for the various alternatives.

A major emphasis was placed on developing a plan that would minimize costs and solve all known existing drainage problems. Recommendations have also been made for the replacement or upgrade of existing facilities that the hydraulic models indicate are undersized for the design condition.

Because this plan is intended as a guide for the development of future drainage facilities and it is somewhat uncertain how future development will proceed, it does not attempt to present detailed drainage designs for individual areas. Rather, it determines peak flows for individual drainage systems and sizes lines to serve these areas. It should be noted that detailed designs and construction plans would be required before individual proposed projects are constructed.

5.2 Capacity of Existing Drainage Facilities

The existing stormwater drainage system contains several “problem areas” identified by City workers and hydraulic modeling efforts. Approximately half of the improvements recommended in the 1985 Storm Drainage Master Plan have been partially or fully completed. Improvements not recommended in the 1985 Storm Drain Master Plan have also been constructed to meet the drainage requirements for new developments, improve existing facilities and facility capacity, and reduce erosion caused by drainage outfalls. Much of the City still has undersized storm drains and culverts, and development in eastern areas is increasing runoff to the City’s drainage systems resulting in some areas of localized flooding. Improvement projects were recommended to correct the identified undersized storm drain conduits in the City limits.

In the discussion of each drainage basin is a list of the capacity of each facility. Winzler & Kelly established the following capacity criteria for identifying hydraulically deficient storm drainage systems:

- Channels and creeks shall accommodate the 10-year design storm flows with a 1-foot freeboard. 100-year design flows will be allowed above the defined banks provided that the water surface does not exceed finished grade elevations within lots or areas of improvements.

FILE: J:\CAD\JOBS\2003\03184302\dwg\843b-f5-01.dwg DATE: Oct 01 04 @ 9:30am

LEGEND

- DRAINAGE BASIN BOUNDARY
- CITY LIMITS
- SPHERE OF INFLUENCE

0 500' 1000' 2000'

JOB # 03184302
DESIGN MK
DRAWN MK/SD

PACIFIC OCEAN

GEORGIA-PACIFIC LOG POND

GLASS BEACH

CREEK

NOYO RIVER

PUDDING CREEK

PUDDING CREEK RD

AIRPORT RD

HWY ONE

MAIN ST

CHESTNUT ST

CYPRESS ST

FRANKLIN ST

HARRISON ST

HARGLD ST

LINCOLN ST

LAUREL ST

FIR ST

CEDAR ST

OAK ST

SANDERSON WAY

PETALUMA AVE

OCEAN VIEW DR

BASIN A — See Figures 5-2 & 3

BASIN B — See Figures 5-4 & 5

BASIN C — See Figures 5-6 & 7

BASIN D — See Figures 5-8 & 9

BASIN E — See Figures 5-10 & 11

BASIN F — See Figures 5-12 & 13

BASIN G — See Figures 5-14 & 15

BASIN H — See Figures 5-16 & 17

BASIN I — See Figures 5-18 & 19

BASIN J — See Figures 5-20 & 21

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

MAP INDEX

FIGURE 5-1

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

- The hydraulic capacity of closed conduit systems under 10-year design flows is a full-pipe condition.
- Where backwater conditions impede the conveyance of water under design flows, surcharging of manholes and drop inlets will be tolerated with depths up to 1.5 times the pipe diameter.

5.3 Recommended Improvement Projects

In addition to the hydraulic deficiencies, Winzler & Kelly also recommends improvement projects where stormwater facilities and outfalls that no longer have adequate hydraulic capacity causing backwater in pipes and/or flooding problems, or have physically degraded creating traffic and safety hazards or serious erosion. Hydraulic deficiencies are identified with an "H", and safety deficiencies are identified with an "S". A preliminary design was conducted for improvement projects to correct each identified deficiency. The projects include new or modified closed conduit systems and culvert replacements.

5.3.1 Improvement Projects

For closed conduits, the design consists of proposed pipe locations and dimensions, and numbers of manholes and drop inlets. The following criteria were used for the design of the majority of closed conduit systems. (Exceptions to these criteria are noted in the project descriptions.):

- Minimum capacity of a 10-year storm.
- Preferred minimum slope of 2%; minimum allowable slope of 0.5% per circumstances to meet a self-cleaning velocity of 2.5 ft/s.
- Manholes shall be placed at a maximum of 350 feet on center and at changes in pipe diameter.
- Standard manholes shall be 48 inches in diameter.
- Minimum pipe cover of 3 feet in roadways.
- Pipe material: high-density polyethylene pipe (HDPE).
- New storm drain systems shall be sized to convey the design storm without surcharging.
- Modifications to existing storm drain systems shall not increase downstream surcharging or backwater effects.
- Closed conduits shall be located within the public right-of-way or drainage easement.

The City of Fort Bragg prefers the use of high-density polyethylene (HDPE) pipe for all new storm drain conduits, as opposed to reinforced concrete pipe (RCP), but the design must fit the material. For the same diameter pipe, HDPE has greater than 50 percent higher hydraulic capacity than CMP and 5 percent higher capacity than RCP due to a lower Manning roughness factor. It is also generally less expensive in initial material cost than RCP. The real savings, however, are realized in installed costs. Due to the lightweight, longer lay lengths, and ease of handling, the installed cost savings of HDPE ranges from 10 to 30% when compared to RCP. Corrugated metal pipe (CMP) is not recommended for use in storm drainage improvements due to its short life span.

5.3.2 Project Design Methods

The proposed projects were hydraulically analyzed through computer simulations to confirm that the hydraulic criteria were met. Closed conduit systems and culverts were modeled using StormCAD. Open channels were modeled using HEC-RAS. These models were subjected to the flow rates generated during the hydrology analysis.

5.3.3 Development of Opinion of Probable Cost

Our opinion of the probable cost for the various proposed projects within individual drainage basins has been provided. Our opinion is based on the premise that all construction will be accomplished by competitively bid contracts. Our opinions of the probable cost were developed using *Means Construction Cost Data*, recent experience on bids received in Northern California for similar improvements, and costs obtained directly from suppliers. The following items are added to the subtotal amount:

- General Conditions (30%)
  - Mobilization/Demobilization (5%)
  - Contractor's Bond and Insurance (5%)
  - General Contractor's Overhead and Profit (15%)
  - Sales Tax (5%)
- Legal, Administration and Engineering (25%)
- Contingency (20%)
- Bonding (20%)

The general conditions are the sum of mobilization/demobilization, contractor's bond and insurance, contractor's overhead and profit, and sales tax, and are added to the construction subtotal. The legal, administration and engineering costs and contingencies are added to this total to obtain the total project cost. If the City of Fort Bragg funds the drainage improvements using bonds, and additional 20% is added to the total project cost to obtain the final opinion of probable cost. This 20% is to cover the bond costs, interest during construction, and provide reserve funds.

It should be noted that all costs are given in April 2004 dollars, with an Engineering News-Record (ENR) Construction Cost Index equal to 7017.

5.3.4 Project Priority Analysis

The proposed drainage improvements will require a number of years to complete. The proposed improvement projects were ranked according to priority for construction. Priority rankings of low, medium, or high were attributed to each project based upon the criteria established below.

High Priority was attributed to projects that met all of the following criteria:

- Existing drainage facilities are significantly undersized for current levels of development.
- Maximum development has occurred in the project area.
- Maximum anticipated runoff conditions currently exist.
- Flooding of structures or severe erosion is known to occur.

Medium Priority was attributed to projects that met all of the following criteria:

- Existing drainage facilities are significantly undersized for anticipated levels of development.
- Existing drainage facilities are undersized for current levels of development but do not currently flood during the design storm.
- Structures or improvements exist in the anticipated 100-year flood area.
- Further development is anticipated in the project area.
- Runoff rates are expected to increase due to anticipated future development.

Low Priority was attributed to projects that met all of the following criteria:

- Existing drainage facilities are undersized for current levels of development but do not currently flood during the design storm.
- Further development is not anticipated in the project area.
- Structures or improvements exist in the anticipated 100-year flood area.

5.3.5 Development-Driven Projects

The existing land use surrounding proposed improvements was compared to build-out conditions as designed in the current zoning plans. Development was expected in areas where current land use density was significantly less than that shown in the Land Use Element of Fort Bragg's 2002 General Plan. Development-driven projects were considered to be those located in areas where the existing land use was significantly less dense than build-out conditions. Storm drainage systems within new developments are typically paid for by the owner/builder in addition to fees for connecting the new system to the existing City-owned storm drainage system. Whenever permanent off site storm drainage facilities are required by the City to be constructed and installed as a part of a development, an amount of money based on the cost of construction of the storm drainage facilities is credited against storm drainage fees chargeable to the owner/builder provided the facilities are owned by the City at the time the owner pays the fees. Refer to the Fort Bragg City Municipal Code Chapter 12.14: *Drainage Facility Improvements and Drainage Fees* for more detail.

5.4 Comparison to 1985 Storm Drainage Master Plan

The hydrology analysis used in this updated 2004 Storm Drainage Master Plan resulted in less conservative (10 – 30 %) yet more realistic flows than predicted in the 1985 Storm Drainage Master Plan. This outcome is a result of the method used to calculate the times of concentration, precipitation intensities, and resulting flow estimates. The effect of a cumulative time of concentration is a lower precipitation intensity. Combining this intensity with the total upstream area gives the updated flow estimate. This method differs from that used in the 1985 Storm Drainage Master Plan, where inlet times, precipitation intensities and resulting flows were computed for each contributing area, and then summed downstream. The new hydrology model, when used to combine and route small watersheds downstream, tends to result in conservative estimates. Improvement projects were recommended to correct the identified undersized storm drain conduits in the City limits.

5.5 Existing and Recommended Storm Drainage Facilities by Drainage Basin

A description of the existing and undersized facilities for each drainage basin is provided in this section, followed by a list of proposed improvements with cost estimates. Drainage facilities having capacity in excess of the 10-year design flows are considered adequately sized, and are shown in normal type. Undersized facilities are shown in bold type. The capacities of the existing storm drain system, and the estimated 10-year and 100-year flows at specific nodal points are shown for each drainage basin on Figures 5-2, 5-4, 5-6, 5-8, 5-10, 5-12, 5-14, 5-16, 5-18 and 5-20. On each figure, capacities and flows for undersized facilities are in **bold**. The existing drainage facilities and recommended improvements for each drainage basin are shown on Figures 5-3, 5-5, 5-7, 5-9, 5-11, 5-13, 5-15, 5-17, 5-19 and 5-21. Tables 5-1 through 5-10 describe the existing and recommended facilities with reference to the figures. In Tables 5-1 through 5-10, undersized facilities are shown in **bold red**, hydraulic deficiencies are identified with an H, and safety deficiencies are identified with an S. Table 5-11 summarizes the proposed drainage projects.

5.5.1 Drainage Basin A

This area is mainly commercial and residential, is located in the southwest section of the City, and encompasses approximately 140 acres including the hospital. It is, essentially, bounded by Hazel Street to the north, Minnesota Avenue to the east, the Noyo River to the south and Whipple Street and Main Street to the west. This area is divided through its center by Georgia-Pacific's logging road. The general flow direction is toward the logging road, then east to a large natural channel, which carries it to the Noyo River.

The drainage in Basin A is generally acceptable and in good condition, with most of the improvement projects recommended in the 1985 Storm Drainage Master plan being completed. Table 5-1 summarizes the capacities and design flows for the existing drainage facilities in Basin A. Figure 5-2 shows the location of facilities, their existing capacities and the estimated 10-year and 100-year flows at specific nodal points for drainage facilities in Basin A. Undersized facilities are shown in bold. Results of the hydraulic modeling efforts indicate that a number of the drainage facilities are slightly undersized for the 10-year rainfall event. However, the layout of the existing drainage system is such that excess flows will be routed via street gutters to hydraulically suitable inlets or to drainage discharge points without causing any flooding problems. Discussions with City staff also suggested there are no flooding problems in this area. Table 5-1 and Figure 5-3 summarize the undersized existing facilities, and describe their deficiencies and the recommended improvements.

Hydraulic analyses indicate that the 12" RCP storm drain on Olsen Lane is slightly undersized for the 10-year event (see Node A-1.5 on Figure 5-2). There are two inlets for this storm drain. Any excess flow will either bypass the first inlet and enter the storm drain through the second inlet, or travel as gutter flow to the outfall. No project is proposed for this deficiency, however should excess gutter flow in this area become a problem in the future replacing the existing 12" RCP with an 18" HDPE will allow for complete containment of the flow. Significant erosion was also observed down slope of the discharge point. Improvements were underway in late 2003 to correct this problem by installing an 18" HDPE pipe from the discharge point down slope to the Georgia-Pacific haul road, and installing rip rap and erosion control.

The 18" CMP storm drain outfall discharging at the east end of Kemppe Way is slightly undersized for the expected 10-year flow (see Nodes A-3.0 on Figure 5-2). Increasing the size of the Kemppe Way outfall pipe to 24" will allow for complete containment of the 10-year event. However, because this section of undersized pipe is near the discharge point it is not expected to cause any flooding or drainage problems.

5.5.1.1 New Storm Drain System: Park Street Project

A new storm drain system is proposed to provide drainage to the area north of Chestnut Street between Harold Street and Lincoln Street (see Node A-1.4.2 on Figure 5-3). The Park Street Project consists of approximately 300-feet of 18" HDPE along the southern extension of Park Street. Two new drop inlets are also recommended, one at the upstream end of the conduit and one where the new storm drain ties in with the existing storm drain on Chestnut Street. This drain will collect runoff before it can flow further west across private property to Harold Street. This project was recommended in the 1985 Storm Drainage Master Plan, and has been assigned a medium priority ranking because further development is anticipated in the project area, and runoff rates are expected to increase due to anticipated future development. The new storm drain is considered a development driven project whose installation may promote development in the area. Our opinion of the probable cost of the project is $76,700.

5.5.1.2 Storm Drain Replacement: Chestnut Street Project

Hydraulic analyses of 12" RCP storm drains on Chestnut Street between Whipple Street and Lincoln Street and the 12" RCP relief line on Whipple Street between Chestnut Street and Walnut Street show these pipes are undersized for the 10-year storm event (see Nodes A-1.3.1, A-1.3.1.1, A-1.3.1.2, A-1.3.2.1 and A-1.4.1 on Figure 5-3). The relief lines running from Chestnut Street down Grove Street and Spring Street have sufficient capacity to carry the necessary flow. Replacing the existing 12" RCP pipes on Chestnut Street with 18" HDPE pipe and the existing 12" RCP on Whipple Street with 30" HDPE will allow for complete containment of the 10-year flow. This project is assigned a low priority ranking because the existing structure does not cause any known flooding problems during the design storm and further development is not anticipated in this area. Should flooding occur along this section of Chestnut Street, excess flows will travel as gutter flow to discharge points at east Walnut Street, Spring Street, South Harold Street, Olsen Lane and Lincoln Street. This project is not development-driven. Our opinion of the probable cost of this improvement is $508,600.

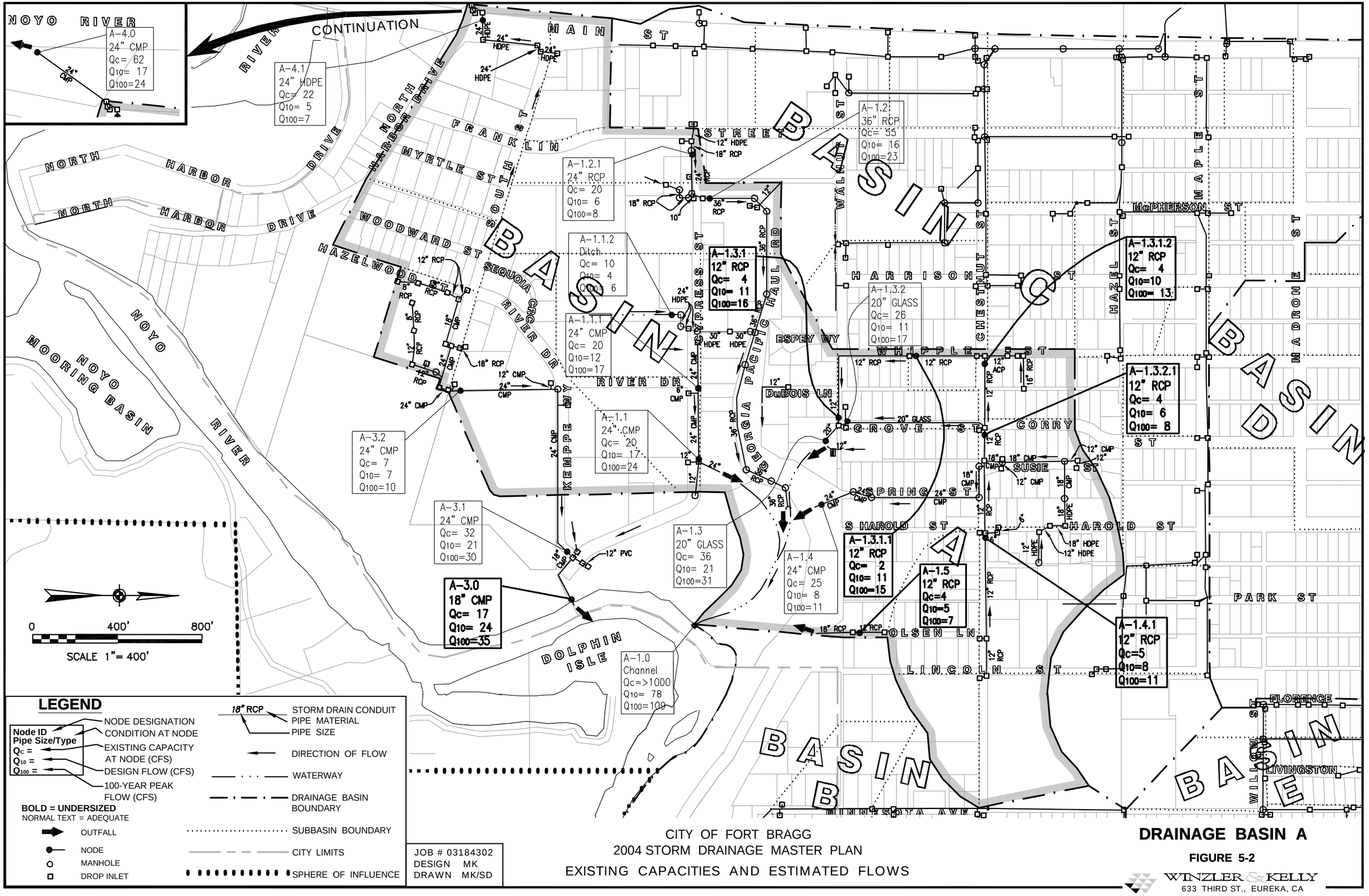
5.5.1.3 New Storm Drain System: South Street Project

A new storm drain system is proposed to provide drainage to the area between South Street and North Harbor Drive (see Node A-4.2 on Figure 5-3). The South Street Project consists of approximately 600-feet of 18" HDPE along South Street connecting with the existing storm drain system on Main Street. Two new drop inlets are also recommended, one at the corner of Franklin Street and South Street, and one at the corner of Myrtle Street and South Street. This project has been assigned a medium priority ranking because further development is anticipated in the project area, and runoff rates are expected to increase due to anticipated future development. The new storm drain is considered a development driven project whose installation may promote development in the area. Our opinion of the probable cost of the project is $119,500.

TABLE 5-1 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN A

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
A-1.0	Noyo River	Channel	>5,000	78	109	None	None
A-1.1	Cypress St.	24" CMP	20	17	24	None	None
A-1.1.1	Cypress St.	24" CMP	20	12	17	None	None
A-1.1.2	Cypress St.	Ditch	10	4	6	None	None
A-1.2	G-P Haul Rd.	36" RCP	55	16	23	None	None
A-1.2.1	Cypress St.	24" RCP	20	6	8	None	None
A-1.3	Grove St.	20" Glass	36	21	31	None	None
A-1.3.1	**Walnut St.**	**12" RCP SD**	**4**	**11**	**16**	**30" HDPE SD**	**H**
A-1.3.1.1	**South Whipple St.**	**12" RCP SD**	**2**	**11**	**15**	**30" HDPE SD**	**H**
A-1.3.1.2	**Chestnut St.**	**12" RCP SD**	**4**	**10**	**13**	**18" HDPE SD**	**H**
A-1.3.2	Grove St.	20" Glass	26	11	17	None	None
A-1.3.2.1	**Chestnut St.**	**12" RCP**	**4**	**6**	**8**	**18" HDPE SD**	**H**
A-1.4	Spring St.	24" CMP	25	8	11	None	None
A-1.4.1	**Chestnut St.**	**12" RCP**	**5**	**8**	**11**	**18" HDPE SD**	**H**
A-1.5	**Olsen Ln.**	**12" RCP**	**4**	**5**	**7**	**None[1]**	**H**
A-3.0	**Kemppe Way**	**18" CMP**	**17**	**24**	**35**	**None[1]**	**H**
A-3.1	Kemppe Way	24" CMP	32	21	30	None	None
A-3.2	South St.	24" CMP	7	7	10	None	None
A-4.0	Noyo River	24" CMP	62	17	24	None	None
A-4.1	Main St.	24" HDPE	22	5	7	None	None

[1]See text for discussion.
*Note: Undersized facilities shown in **bold red type**.



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DRAWN MK/SD

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN
EXISTING CAPACITIES AND ESTIMATED FLOWS

DRAINAGE BASIN A

FIGURE 5-2

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

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NOYO RIVER
CONTINUATION
NOYO RIVER
NORTH HARBOR DRIVE
NORTH HARBOR DRIVE
NORTH HARBOR DRIVE
NOYO MOORING BASIN
NOYO RIVER
DOLPHIN ISLE
MAIN ST
FRANKLIN ST
MYRTLE ST
WOODWARD ST
HAZELWOOD ST
SEQUOIA
RIVER DR
KEMPPE WY
CYPRESS ST
EUREKA WALNUT ST
CHESTNUT ST
HAZEL ST
MAPLE ST
MADRONE ST
McPHERSON ST
HARRISON ST
ESPEY WY
WHIPPLE ST
DuBOIS LN
GROVE ST
CORRY ST
SUSIE ST
SPRING ST
S HAROLD ST
HAROLD ST
OLSEN LN
LINCOLN ST
PARK ST
FLORENCE
LIVINGSTON
MINNESOTA AVE
WILLOW
BASIN A
BASIN B
BASIN C
BASIN D
A-4.2 (N) 18" SD
A-1.3.1 (N) 30" SD
A-3.0 (N) 24" SD
A-1.3.1.1 (N) 18" SD
A-1.3.1.2 (N) 18" SD
A-1.3.2.1 (N) 18" SD
A-1.4.1 (N) 18" SD
A-1.4.2 (N) 18" SD
0 400' 800'
SCALE 1"= 400'

LEGEND

- NODE DESIGNATION
- Node ID / (N) Improvement — PROPOSED IMPROVEMENT
- OUTFALL
- EXISTING / NEW: MANHOLE
- EXISTING / NEW: DROP INLET
- HEADWALL
- 18" RCP — EXISTING (E) SD CONDUIT; PIPE MATERIAL; PIPE SIZE
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

JOB # 03184302
DESIGN MK
DRAWN MK/SD

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN
PROPOSED IMPROVEMENTS

DRAINAGE BASIN A

FIGURE 5-3

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.5.2 Drainage Basin B

This drainage is located in the southeastern portion of the City and is bordered by the Noyo River. It contains approximately 104 acres and lies mainly within a residential area with two schools partially contained within the drainage. The area is bordered on the north by Hazel Street and on the south by a steep slope dropping off directly into the Noyo River. Because of the slope, flow can run down of its own accord into the river. The general flow direction is toward the River. The western edge of the drainage is Lincoln Street and the eastern boundary is the east end of Chestnut Street.

The storm drain system in Basin B is in good condition, although none of the improvement projects recommended in the 1985 Storm Drainage Master plan have been completed. Table 5-2 summarizes the capacities and design flows for the existing drainage facilities in Basin B. Figure 5-4 shows the location of facilities, their existing capacities and the estimated 10-year and 100-year flows at specific nodal points for drainage facilities in Basin B. Undersized facilities are shown in bold. Results of the hydraulic modeling efforts indicate that a number of the drainage facilities are slightly undersized for the 10-year rainfall event. However, the layout of the existing drainage system is such that excess flows will be routed via street gutters to hydraulically suitable inlets or to drainage discharge points without causing any flooding problems. Also, discussions with City staff indicate that there are currently no flooding problems in this area. Table 5-2 and Figure 5-5 summarize the undersized facilities, and describe their deficiency and the recommended improvement. No projects are recommended for Drainage B.

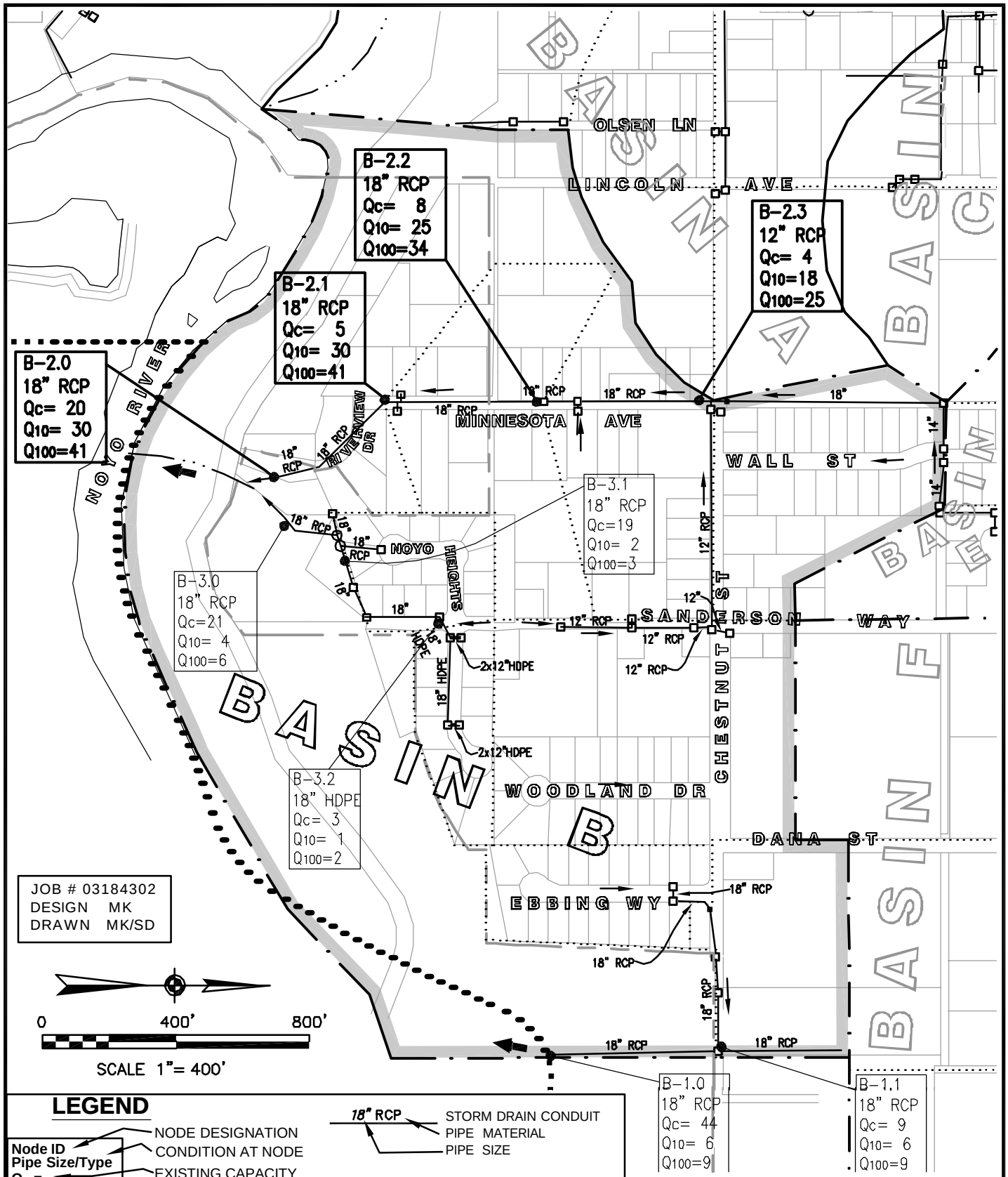
The results of the hydraulic analyses corroborate the undersized storm drains discussed in the 1985 Storm Drainage Master Plan. The storm drain on Chestnut Street from Sanderson Way west to Minnesota Avenue and then south on Minnesota Avenue to the outfall is undersized for the 10-year event (see Nodes B-2.3, B-2.2, B-2.1, and B-2.0 on Figure 5-4). To completely contain the 10-year flow the 12” RCP on Chestnut Street between Minnesota Ave. and Sanderson Way should be increased to 24” HDPE. The 18” RCP on Minnesota Ave. south of Chestnut should be increased to 30” HDPE and then increased again to 36” HDPE before discharging to the Noyo River. An additional drop inlet should be added to the existing 18” RCP on Minnesota Ave. between Hazel Street and Chestnut Street to alleviate any potential standing water in that area (see Figure 5-5). If the City does the work, our opinion of the probable cost of installing the new DI is $2,500. No projects are proposed for the above-mentioned deficiencies because the existing structures do not cause any known flooding problems and further development is not anticipated in this area. Also, discussions with City staff suggested that this section of storm drain conduits functions adequately and has never had any flooding or drainage problems.

TABLE 5-2 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN B

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
B-1.0	Noyo River	18" RCP	44	6	9	None	None
B-1.1	Chestnut St.	18" RCP	9	6	9	None	None
B-2.0	**Minnesota Ave**	**18" RCP**	**20**	**30**	**41**	**None[1]**	**H**
B-2.1	**Minnesota Ave.**	**18" RCP**	**5**	**30**	**41**	**None[1]**	**H**
B-2.2	**Minnesota Ave.**	**18" RCP**	**8**	**25**	**34**	**None[1]**	**H**
B-2.3	**Chestnut St.**	**12" RCP**	**4**	**18**	**25**	**None[1]**	**H**
B-3.0	Noyo River	18" RCP	21	4	6	None	None
B-3.1	Noyo Heights	18" RCP	19	2	3	None	None
B-3.2	Sanderson Way	18" HDPE	3	1	2	None	None

[1]See text for discussion.

*Note: Undersized facilities shown in **bold red type**.



CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

EXISTING CAPACITIES & ESTIMATED FLOWS

DRAINAGE BASIN B

FIGURE 5-4

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

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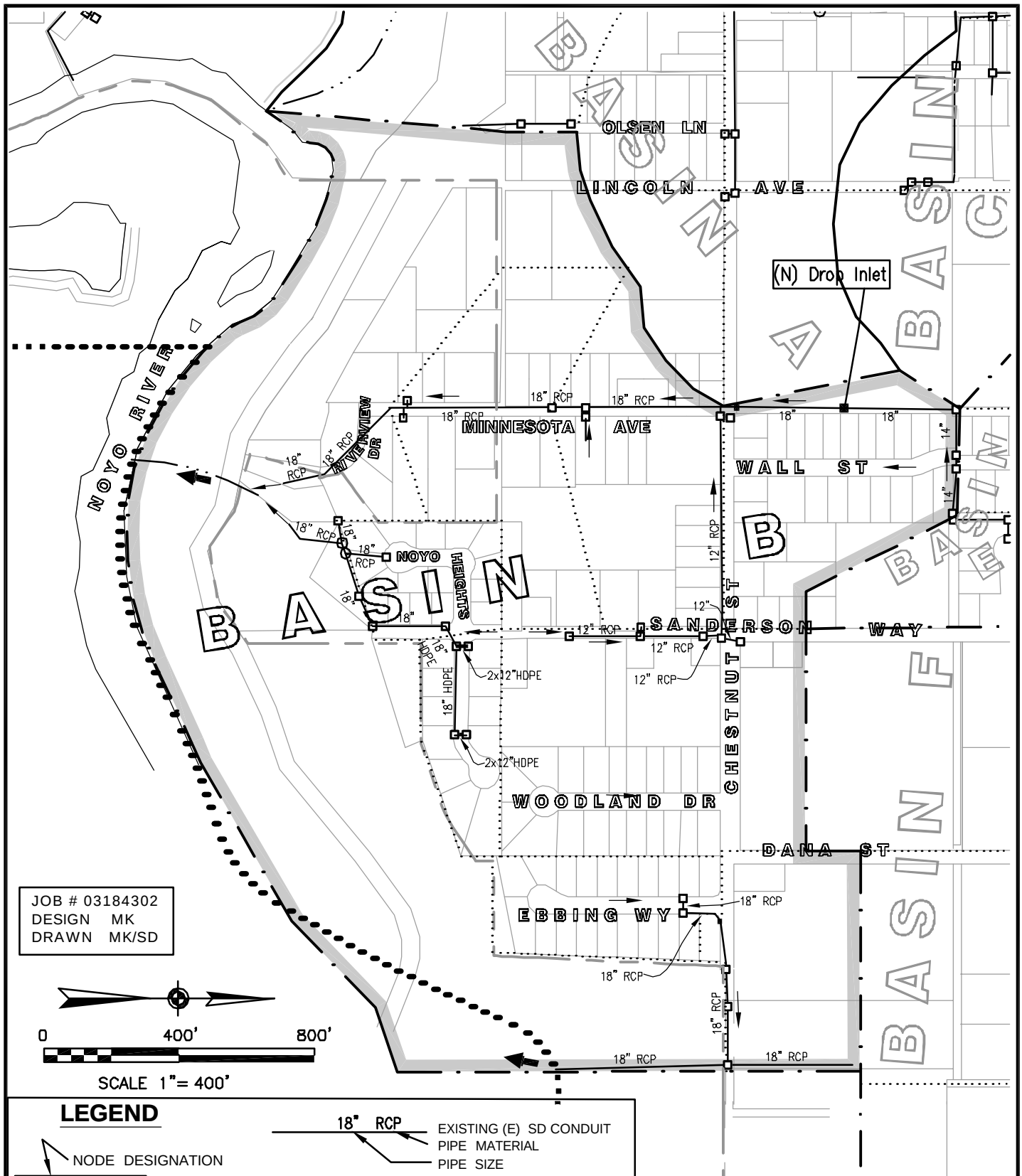

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LEGEND

- NODE DESIGNATION
- Node ID / (N) Improvement — PROPOSED IMPROVEMENT
- OUTFALL
- EXISTING / NEW: MANHOLE
- EXISTING / NEW: DROP INLET
- HEADWALL
- 18" RCP — EXISTING (E) SD CONDUIT (PIPE MATERIAL, PIPE SIZE)
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN B

FIGURE 5-5

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5.5.3 Drainage Basin C

This drainage area covers the majority of the center of Fort Bragg, encompassing approximately 130 acres. It is essentially bounded in the north by Oak Street, in the east by Whipple Street, in the south by Cypress Street, and in the west by Main Street, with an additional contributing area running between Maple Street and Hazel Street, and from Whipple Street to Minnesota Avenue (see Figure 5-6).

Drainage Basin C is mainly residential neighborhoods in the east and commercial in the west. The topography is generally sloping westward toward Main Street, with all contributing flows being carried across Main Street to the Georgia-Pacific log pond. Many of the drainage improvements recommended in the 1985 Storm Drainage Master Plan have been completed, but a number still remain. Table 5-3 and Figure 5-6 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin C. Undersized facilities are shown in bold. Table 5-3 and Figure 5-7 summarize the undersized facilities, and describe their deficiencies and the recommended improvements.

Hydraulic modeling efforts indicate that the small storm drain system on Main Street between Maple Street and Madrone Street is undersized for the 10-year flow (see Nodes C-1.1.1 and C-1.1 on Figure 5-6). Caltrans recently modified this section of storm drain during a Highway 1 improvement project (see Table 4-1). The existing system consists of approximately 435-feet of 24” RCP from Maple Street to just north of Madrone Street decreasing to 18” CMP and traveling 260-feet before discharging at the existing 36” RCP, which then discharges to the Georgia-Pacific log pond. Increasing the 24” RCP and 18” CMP to 30” HDPE will result in complete containment of the design flow. No project is proposed for this deficiency because the existing structures do not cause any known flooding problems, additional flows will be contained within the gutter system, and further development is not anticipated in this area.

The 325-foot section of storm drain conduit on Maple Street between Main Street and Franklin Street is slightly undersized for the 10-year event (see Node C-1.2.2 on Figure 5-6). Replacing the existing 12” RCP with 18” HDPE will provide complete containment of the design flow. No project is proposed for this deficiency because the existing structures do not cause any known flooding problems, additional flows will be contained within the gutter system, and further development is not anticipated in this area.

The 265-foot section of 12” RCP on McPherson Street between Chestnut Street and Hazel Street is undersized for the design flow (see Node C-1.5.1 on Figure 5-6). Increasing this conduit to 18” HDPE will allow for complete containment of the 10-year flow. No project is proposed for this deficiency because existing structures do not cause any known flooding problems, additional flows will be contained within the gutter system, and further development is not anticipated in this area.

5.5.3.1 Storm Drain Replacement: Hazel Street/Maple Street Project

A new storm drain system is recommended to replace the existing system running west on Maple Street, south on McPherson Street and west on Hazel Street. The existing system is well maintained but is undersized for the 10-year flow. The proposed project consists of the installation of approximately 3,310-feet of 24" to 30" storm drain conduits. The Hazel Street/Maple Street Project consists of replacing the existing 2,935-feet of 18" RCP on Maple Street from Lincoln Street to McPherson Street, south on McPherson Street to Hazel Street and west on Hazel Street to Franklin Street with 24" HDPE, and replacing the existing 24" RCP on Hazel Street from Franklin Street to Main Street with approximately 375-feet of 30" HDPE (see Nodes C-1.11, C-1.10, C-1.9, C-1.8, C-1.7, C-1.6, C-1.5 and C-1.4 on Figure 5-7). Although the conduits associated with nodes C-1.7 and C-1.8 are not undersized, their replacement is recommended to prevent surcharging of pipes due to a sudden decrease in pipe capacity. An alternative to this recommendation is to add 18" HDPE paralleling the existing 18" and 24" RCP on the same streets. The Hazel Street/Maple Street project is a modified version of a similar project recommended in the 1985 Storm Drainage Master Plan. This project has been given a medium ranking because the existing facilities are inadequate for present conditions, but do not currently flood during the design storm. This project is not considered development-driven because no significant growth is anticipated in the area. Our opinion of the probable cost of the project is $713,600. Our opinion of the probable cost of the alternative project is $578,700.

5.5.3.2 Storm Drain Replacement: Drainage Basin C Outfall Project

A new outfall pipe is recommended to replace the existing 36" RCP running from a natural channel approximately 400-feet northwest of the Drainage Basin C discharge point between Maple Street and Madrone Street to the Georgia-Pacific log pond (see Node C-1.0 on Figure 5-7). The existing outfall pipe is well maintained but undersized for the 10-year design flow. The approximate length of this pipe is unknown, but it is estimated to be between 700-feet and 900-feet. The proposed project replaces the existing 36" RCP with a 42" HDPE, which will provide complete containment of the 10-year flow. An alternative to this recommendation is to install a 24" HDPE paralleling the existing 36" RCP. This project has been given a medium ranking because the existing facility is inadequate for existing conditions but does not currently flood during the design storm because of the additional storage afforded by the natural channel. This project is not considered development-driven because no significant growth is anticipated in the area. Our opinion of the probable cost of the project is $228,300. Our opinion of the probable cost of the alternative project is $119,000.

TABLE 5-3 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN C

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
C-1.0	**G-P log pond**	**36" RCP**	**89**	**111**	**156**	**42" HDPE SD**	**H**
C-1.1	**West of Main St. and G-P log pond**	**18" CMP**	**6**	**19**	**26**	**None[1]**	**H**
C-1.1.1	**Main St.**	**24" RCP**	**12**	**19**	**26**	**None[1]**	**H**
C-1.2	Main St.	54" HDPE & 2 x 30" CMP	253	92	130	None	None
C-1.2.1	Main St.	24" HDPE	8	6	9	None	None
C-1.2.2	**Maple St.**	**12" RCP**	**5**	**6**	**9**	**None[1]**	**H**
C-1.3	Main St.	54" HDPE	274	85	119	None	None
C-1.3.1	Main St.	42" HDPE	77	46	64	None	None
C-1.3.1.1	Main St.	2 x 30" PP	147	26	36	None	None
C-1.3.1.1.1	Chestnut St.	12" RCP	5	5	8	None	None
C-1.3.1.1.2	Chestnut St.	12" RCP	8	5	8	None	None
C-1.3.1.2	Franklin St.	36" CMP	91	24	34	None	None
C-1.3.1.3	Between Walnut St. and Chestnut St.	30" CMP	25	9	13	None	None
C-1.3.1.4	Walnut St.	Ditch	23	9	13	None	None
C-1.3.2	Main St.	24" HDPE	35	21	29	None	None
C-1.3.3	Main St.	24" HDPE	37	18	25	None	None
C-1.3.4	Main St.	24" HDPE	20	10	13	None	None
C-1.4	**Hazel St.**	**24" RCP**	**26**	**47**	**66**	**30" HDPE SD**	**H**
C-1.5	**Hazel St.**	**18" RCP**	**20**	**41**	**58**	**24" HDPE SD**	**H**
C-1.5.1	**McPherson St.**	**12" ACP**	**4**	**10**	**15**	**None[1]**	**H**
C-1.5.2	Hazel St.	18" Glass	24	7	10	None	None
C-1.6	**McPherson St.**	**18" RCP**	**16**	**18**	**26**	**24" HDPE SD**	**H**
C-1.7	Maple St.	18" RCP	17	16	23	None	None

[1]See text for discussion.

*Note: Undersized facilities shown in **bold red type**.

TABLE 5-3 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN C
(Continued)

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
C-1.8	Maple St.	18" RCP	24	15	21	None	None
C-1.9	**Maple St.**	**18" RCP**	**13**	**14**	**19**	**24" HDPE SD**	**H**
C-1.10	**Maple St.**	**18" RCP**	**3**	**12**	**16**	**24" HDPE SD**	**H**
C-1.11	**Maple St.**	**18" RCP**	**7**	**8**	**12**	**24" HDPE SD**	**H**

*Note: Undersized facilities shown in **bold red type**.

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CONTINUATION

C-1.3.3
24" HDPE
Qc= 37
Q10= 18
Q100=25

C-1.3.2
24" HDPE
Qc= 35
Q10= 21
Q100=29

C-1.3.1
42" HDPE
Qc= 77
Q10= 46
Q100=64

C-1.3
54" HDPE
Qc= 274
Q10= 85
Q100=119

C-1.3.1.1
2x30"PP
Qc= 147
Q10= 26
Q100= 36

C-1.3.4
24" HDPE
Qc= 20
Q10= 10
Q100=13

C-1.3.1.2
36" CMP
Qc= 91
Q10= 24
Q100= 34

C-1.3.1.1.1
12" RCP
Qc= 5
Q10= 5
Q100= 8

C-1.3.1.4
DITCH
Qc= 23
Q10= 9
Q100= 13

C-1.3.3
30" CMP
Qc= 25
Q10= 9
Q100= 13

C-1.3.1.1.2
12" RCP
Qc= 8
Q10= 5
Q100= 8

C-1.5
18" RCP
Qc= 20
Q10= 41
Q100= 58

C-1.4
24" RCP
Qc= 26
Q10= 47
Q100= 66

C-1.2.1
24" HDPE
Qc= 8
Q10= 6
Q100= 9

C-1.2.2
12" RCP
Qc= 5
Q10= 6
Q100= 9

C-1.5.1
12" ACP
Qc= 4
Q10= 10
Q100=15

C-1.5.2
18" GLASS
Qc= 24
Q10= 7
Q100= 10

C-1.7
18" RCP
Qc= 17
Q10= 16
Q100= 23

C-1.6
18" RCP
Qc= 16
Q10= 18
Q100= 26

C-1.9
18" RCP
Qc= 13
Q10= 14
Q100= 19

C-1.8
18" RCP
Qc= 24
Q10= 15
Q100= 21

C-1.10
18" RCP
Qc= 3
Q10= 12
Q100=16

C-1.11
18" RCP
Qc= 7
Q10= 8
Q100= 12

C-1.0
36" RCP
Qc= 89
Q10= 111
Q100=156

C-1.1
18" CMP
Qc= 6
Q10= 19
Q100=26

C-1.1.1
24" RCP
Qc= 12
Q10= 19
Q100=26

C-1.2
54" HDPE &
2x30" CMP
Qc= 253
Q10= 92
Q100=130

BASIN A

BASIN B

BASIN C

BASIN D

BASIN E

8" HDPE
12" RCP
18" RCP
24" HDPE
24" HDPE (4 CONNECT'S TO MH)
42" HDPE
42" HDPE QVAL 34"x53" RCP
54" HDPE
2x30" CMP
18" CMP
24" RCP
HALF CIRCLE 12"x6" CMP
36" RCP
30" RCP
15" CMP
10" ACP
12" ACP
6" ACP
8" RCP
18" GLASS
36" RCP TO LOG POND

MAIN ST
FRANKLIN STREET
McPHERSON ST
HARRISON ST
WALNUT ST
HAZEL ST
MAPLE ST
OAK ST
MADRONE ST
CYPRESS ST
GEORGIA PACIFIC HAUL RD
ESPEY WY
WHIPPLE ST
DuBOIS LN
GROVE ST
CHESTNUT ST
CORRY ST
SUSIE ST
SPRING ST
S HAROLD ST
HAROLD ST
PARK ST
OLSEN LN
LINCOLN ST
WILLOW ST
FLORENCE
LIVINGSTON
MINNESOTA AVE
ALLEY
WALL ST
GEORGIA-PACIFIC LOG POND

0 400' 800'
SCALE 1"= 400'

JOB # 03184302
DESIGN MK
DRAWN MK/SD

LEGEND

- Node ID / Pipe Size/Type
- Q_C = EXISTING CAPACITY AT NODE (CFS)
- Q_{10} = DESIGN FLOW (CFS)
- Q_{100} = 100-YEAR PEAK FLOW (CFS)
- NODE DESIGNATION
- CONDITION AT NODE
- 18" RCP — STORM DRAIN CONDUIT PIPE MATERIAL / PIPE SIZE
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS
- SPHERE OF INFLUENCE
- OUTFALL
- NODE
- MANHOLE
- DROP INLET

BOLD = UNDERSIZED
NORMAL TEXT = ADEQUATE

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

EXISTING CAPACITIES AND
EXTIMATED FLOWS

DRAINAGE BASIN C

FIGURE 5-6

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

FILE: J:\CAD\JOBS\2003\03184302\dwg\843b-f5-07.dwg DATE: Oct 01 04 @ 10:09am

CONTINUATION

C-1.4 (N) 30" SD

C-1.5 (N) 24" SD

C-1.6 (N) 24" SD

C-1.7 (N) 24" SD

C-1.8 (N) 24" SD

C-1.9 (N) 24" SD

C-1.10 (N) 24" SD

C-1.11 (N) 24" SD

C-1.0 (N) 42" SD

42" SD TO LOG POND

GEORGIA-PACIFIC LOG POND

BASIN C

BASIN B

BASIN D

BASIN E

MAIN ST

FRANKLIN STREET

McPHERSON

HARRISON

WHIPPLE ST

CORRY ST

PARK ST

FLORENCE

LIVINGSTON

WALL ST

ALLEY

MINNESOTA AVE

LINCOLN ST

OLSEN LN

SPRING ST

S HAROLD ST

HAROLD ST

SUSIE ST

GROVE ST

DuBOIS LN

ESPEY WY

WALNUT ST

HAZEL ST

OAK ST

CYPRESS ST

GEORGIA PACIFIC HAUL RD

0 400' 800'

SCALE 1"= 400'

JOB # 03184302
DESIGN MK
DRAWN MK/SD

LEGEND

- NODE DESIGNATION
- Node ID / (N) Improvement — PROPOSED IMPROVEMENT
- OUTFALL
- EXISTING / NEW: MANHOLE
- DROP INLET
- HEADWALL
- 18" RCP — EXISTING (E) SD CONDUIT PIPE MATERIAL / PIPE SIZE
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN C

FIGURE 5-7

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.5.4 Drainage Basin D

This drainage area covers the north central portion of the City, north of Drainage C, and encompasses approximately 104 acres. The area is essentially bounded by Redwood Avenue in the north, Florence Street in the east, Maple Street in the south and Main Street in the west (see Figure 5-8).

The existing drainage system is essentially a single pipeline carrying runoff down the center of the drainage area, formerly known as Alder Creek, to the west end of Alder Street where it discharges to the Georgia-Pacific log pond. Table 5-4 and Figure 5-8 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin D. Undersized facilities are shown in bold. Table 5-4 and Figure 5-9 summarize the undersized facilities and their locations, and describe their deficiencies and the recommended improvements.

There is a system of cross drains at the corners of intersections on Redwood Street and Alder Street between Franklin Street and Whipple Street. The cross drains eliminates the potential for standing water at intersection corners by conveying gutter flow under intersections to downstream storm drains. Most of the cross drains are in serviceable condition, but will require seasonal maintenance to keep them free of debris.

5.5.4.1 Storm Drain Replacement: Oak Street Project

A new storm drain system is recommended to replace existing storm drains on Oak Street between Harold Street and McPherson Street. The existing system is well maintained but undersized for the 10-year flow. The proposed project consists of the installation of approximately 1,660-feet of 24” to 30” storm drain conduits. The Oak Street Project includes replacing the existing 18” RCP on Oak Street from Harold Street to Whipple Street with approximately 885-feet of 24” HDPE, and replacing the existing 24” RCP from Whipple Street to McPherson Street with approximately 775-feet of 30” HDPE (see Nodes D-1.9, D-1.8, D-1.7, D-1.6 and D-1.5 on Figure 5-9). An alternative to this recommendation is to add 18” HDPE paralleling the existing 18” RCP and 24” RCP on Oak Street from Harold Street to McPherson Street. The Oak Street project is a modified version of a similar project recommended in the 1985 Storm Drainage Master Plan. This project has been given a medium ranking because the existing facilities are inadequate for existing conditions but do not currently flood during the design storm. This project is not considered development-driven because no significant growth is anticipated in the area. Our opinion of the probable cost of the project is $406,300. Our opinion of the probable cost of the alternative project is $311,000.

5.5.4.2 Storm Drain Replacement: West Alder Street Project

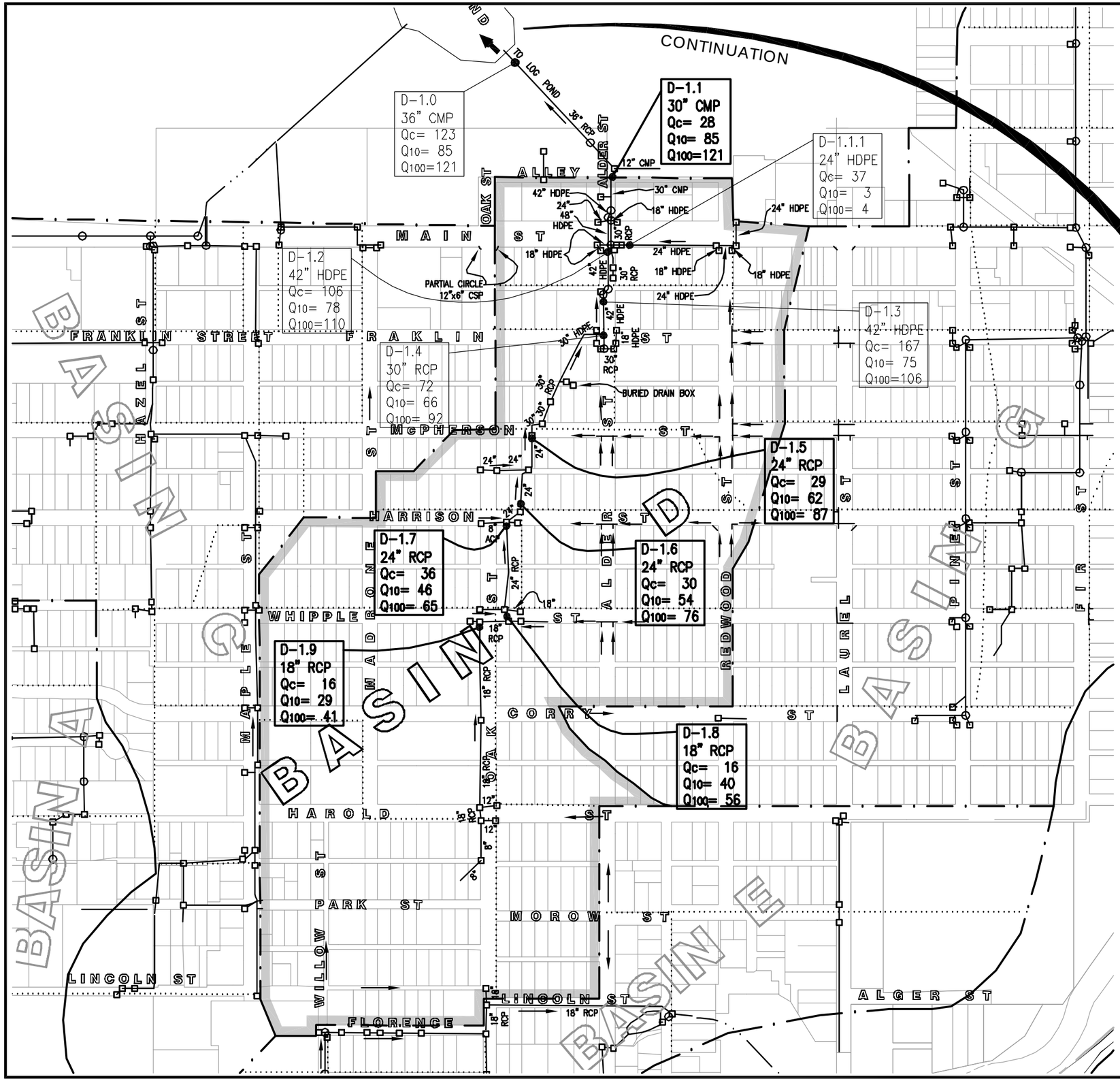
There is a 160-ft section of 30” CMP at the western most section of Alder Street between the alley and Main Street which is undersized for the design storm (see Node D-1.1 on Figure 5-9). The existing pipe has a capacity of approximately 28 cfs, while the design flow is 86 cfs, and acts as a bottleneck for flow entering the 36” RCP, which discharges to the Georgia-Pacific log pond. Replacing the existing 30” CMP with a 36” HDPE will allow the design flow to pass

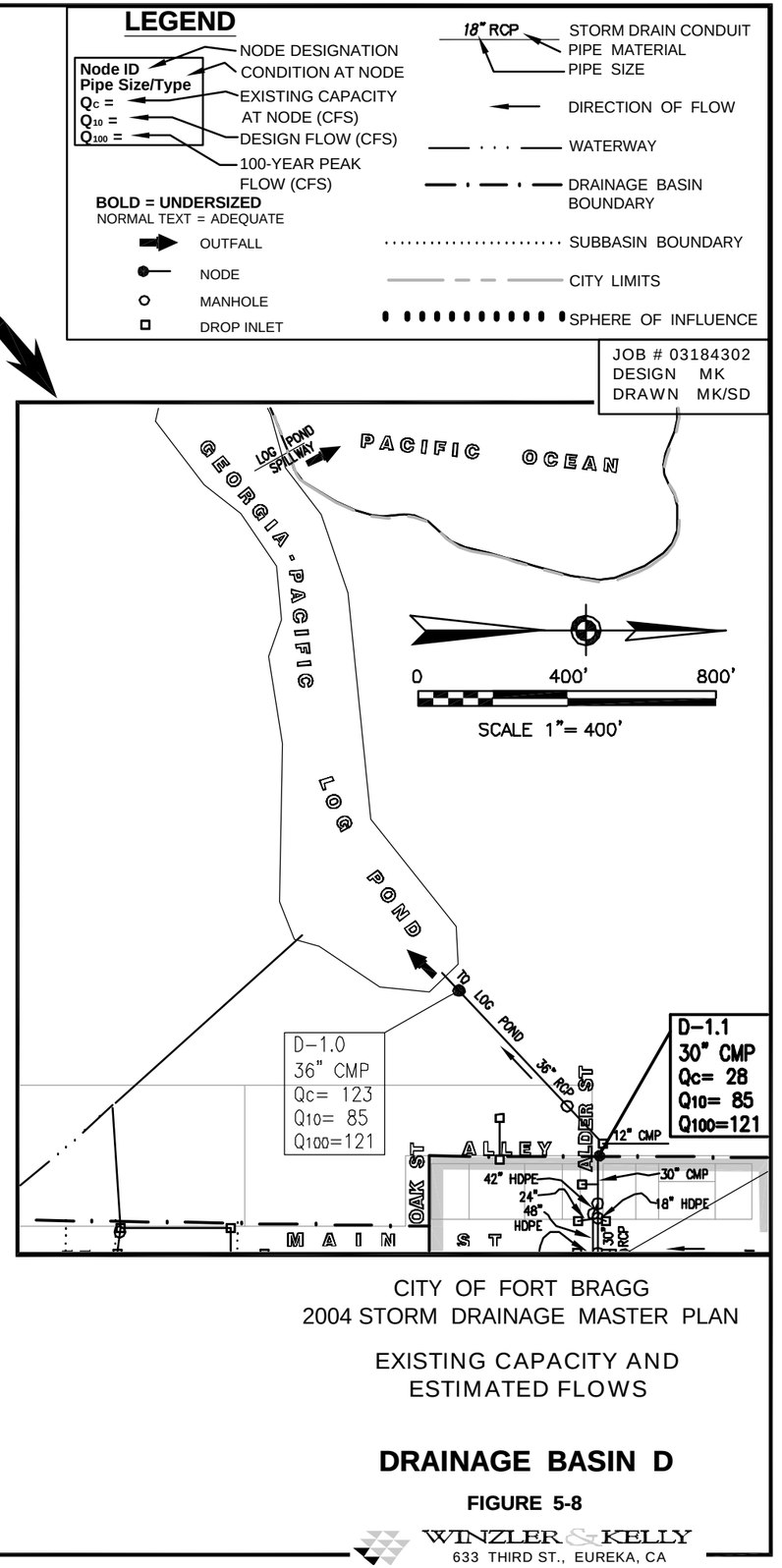
unimpeded. Also, just upstream of this section of pipe is a manhole restriction resulting from an abrupt change in elevation. As flow travels across Main Street through the 48" HDPE it enter a manhole where it must rise two feet in elevation in order to enter the 42" HDPE pipe and continue to the existing 30" CMP (see Figure 5-9). When this manhole was added to temporarily fix the elevation difference between these two pipes, the contractor who installed the manhole recommended that the City repair this section within the next five years. When the City replaces the undersized section of 30" CMP it is recommended that the elevations and grades of these pipes be adjusted to eliminate the restriction. Although discussions with City staff indicate that the existing facilities are not known to flood during the 10-year event, this project has been given a high priority ranking because the existing conduit is significantly undersized for the current level of development, flows are impeded by the manhole restriction, maximum development has occurred in this drainage area, and maximum runoff conditions currently exist. This project is not considered development-driven because no significant growth is anticipated in the area. Our opinion of the probable cost of the project is $78,100.

TABLE 5-4 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN D

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
D-1.0	G-P log pond	36" RCP	123	85	121	None	None
D-1.1	**West Alder St.**	**30" CMP**	**28**	**85**	**121**	**36" HDPE SD**	**H**
D-1.1.1	Cypress St.	24" HDPE	37	3	4	None	None
D-1.2	Cypress St.	42" HDPE	106	78	110	None	None
D-1.3	G-P Haul Rd.	42" HDPE	167	75	106	None	None
D-1.4	Cypress St.	30" RCP	72	66	92	None	None
D-1.5	**McPherson St.**	**24" RCP**	**29**	**62**	**87**	**30" HDPE SD**	**H**
D-1.6	**Harrison St.**	**24" RCP**	**30**	**54**	**76**	**30" HDPE SD**	**H**
D-1.7	**Harrison St./Oak St.**	**24" RCP**	**36**	**46**	**65**	**30" HDPE SD**	**H**
D-1.8	**Whipple St.**	**18" RCP**	**16**	**40**	**56**	**24" HDPE SD**	**H**
D-1.9	**Oak St.**	**18" RCP**	**16**	**29**	**41**	**24" HDPE SD**	**H**

*Note: Undersized facilities shown in **bold red type**.





CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

EXISTING CAPACITY AND ESTIMATED FLOWS

DRAINAGE BASIN D

FIGURE 5-8

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

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CONTINUATION

TO LOG POND

36" RCP

D-1.1
(N) 36" SD

Manhole Restriction
*SEE TEXT

12" CMP

30" CMP

36" SD

18" HDPE

42" HDPE

24"

48" HDPE

24" HDPE

30" RCP

PARTIAL CIRCLE
12"x6" CMP

BURIED DRAIN BOX

D-1.5
(N) 30" SD

D-1.6
(N) 30" SD

D-1.8
(N) 24" SD

D-1.7
(N) 30" SD

D-1.9
(N) 24" SD

8" ACP

12" RCP

18" RCP

24" SD

30" SD

ALDER ST

OAK ST

ALLEY

MAIN ST

FRANKLIN STREET

FRAKLIN ST

HAZEL ST

McPHERSON ST

HARRISON ST

DEWEY ST

STEVENS ST

MADRONE ST

WHIPPLE

CORRY ST

LAUREL

REDWOOD

PINE

FIR

HAROLD ST

PARK ST

MOROW ST

LINCOLN ST

WILLOW ST

MAPLE ST

FLORENCE

ALGER ST

BASIN A

BASIN B

BASIN C

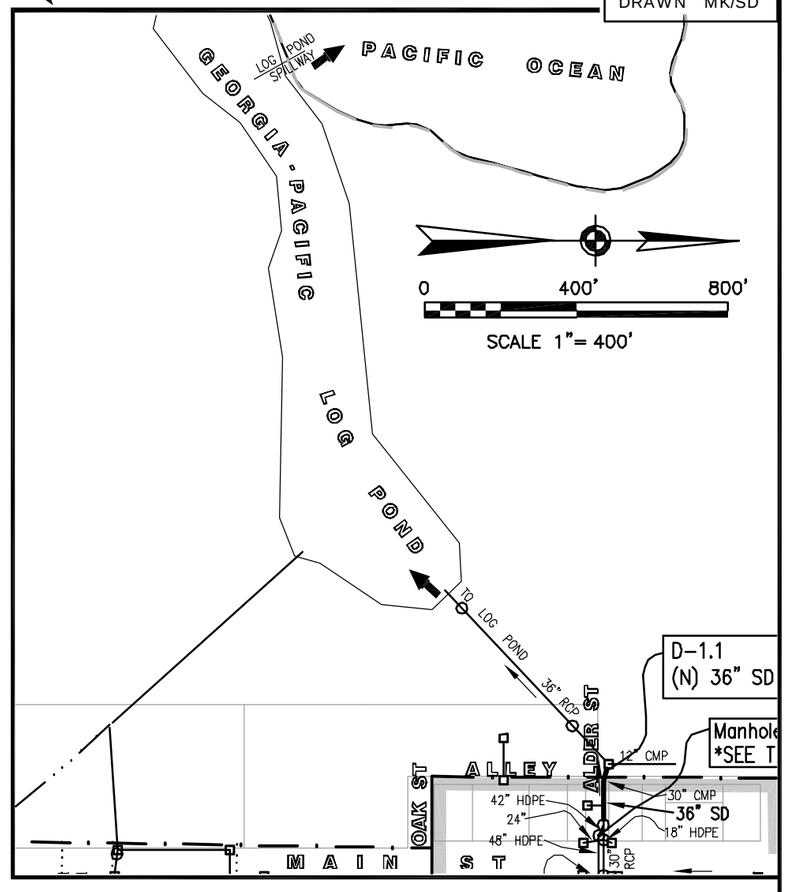
BASIN D

BASIN E

LEGEND

- NODE DESIGNATION
- Node ID / (N) Improvement
- PROPOSED IMPROVEMENT
- OUTFALL
- EXISTING / NEW: MANHOLE
- EXISTING / NEW: DROP INLET
- HEADWALL
- 18" RCP — EXISTING (E) SD CONDUIT, PIPE MATERIAL, PIPE SIZE
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

JOB # 03184302
DESIGN MK
DRAWN MK/SD



CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN D

FIGURE 5-9

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.5.5 Drainage Basin E

This area drains the central area of the City and contains approximately 76 acres. The area drains northwesterly to Pudding Creek from approximately Chestnut Street and Sanderson Way to Harold Street and the east end of Laurel Street (see Figure 5-10).

The existing drainage facilities consist almost entirely of 18" RCP. Storm flow generally travels northwest to Oak Street where the system branches. At this location an assumption is made that half of the flow travels up McKinley Street to Alder Street where it discharges into and through an old duck pond. The other half is assumed to travel west down Oak Street, then north on Lincoln Street to Cedar Street where it combines with flow from the duck pond before discharging to an open channel in Johnson Park and flowing to Pudding Creek. This assumption was also made in the 1985 Storm Drainage Master Plan. Table 5-5 and Figure 5-10 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin E. Undersized facilities are shown in bold.

Some of the improvements recommended in the 1985 Storm Drainage Master Plan have been completed, while the larger recommended improvement projects still remain. The planned construction of a new aquatic center in the area adjacent to and directly south of Willow Street will create additional impervious area resulting in increased runoff and will require increasing the capacity of the existing drainage system. Table 5-5 and Figure 5-11 summarize the undersized facilities, and describe their deficiencies and the recommended improvements.

5.5.5.1 Storm Drain Replacement: Willow Street to Cedar Street Project

Hydraulic analyses of the existing drainage system between Willow Street and Cedar Street show that it is undersized for the 10-year design flow. In addition, a new aquatic center is planned for development in the area adjacent to and directly south of Willow Street. The construction of this facility will create approximately 4 cfs of additional runoff to Willow Street. The existing storm drain system is well maintained but undersized for the current level of development, and is not adequately sized to handle the additional flows generated from the aquatic facility. The proposed project consists of the installation of approximately 3,310-feet of 24" to 36" storm drain conduits. The Willow Street to Cedar Street Project includes replacing the existing 18" RCP beginning at Willow Street and the alley east of Wall Street, running west to the alley between Livingston Street and Wall Street, then north up the alley to Oak Street, then west on Oak Street to Lincoln Street with approximately 1,195-feet of 24" HDPE. The 725-feet of 18" RCP running up McKinley Street and discharging in the duck pond, and the 775-feet of 18" RCP running from Oak Street up Lincoln Street to Cedar Street and tying in with the duck pond discharge is recommended to be upsized to 30" HDPE. It is also recommended that the outfall pipe be replaced with 75-feet of 36" HDPE (see Nodes E-1.8, E-1.7, E-1.6, E-1.5, E-1.4, E-1.3, E-1.2, E-1.1, and E-1.0 on Figure 5-11). An alternative to this recommendation is to add 18" HDPE paralleling the existing 18" RCP from Willow Street to Oak Street, 24" HDPE paralleling the existing 18" RCP on McKinley Street and Lincoln Street, and a 30" HDPE paralleling the existing 18" RCP outfall. The Willow Street to Cedar Street project is a modified version of a similar project recommended in the 1985 Storm Drainage Master Plan. This project has been given a high priority ranking because the existing drainage facilities are significantly

undersized for current levels of development. Additionally, the construction of the aquatic center will require adequate downstream drainage facilities. This project is not considered development-driven because no significant growth is anticipated in the area as a result of the new aquatic center. Our opinion of the probable cost of the project is $729,800. Our opinion of the probable cost of the alternative project is $613,600.

5.5.5.2 Storm Drain Replacement: East Laurel Street Project

The short section of storm drain on Laurel Street from Harold Street east to the outfall is undersized for the 10-year flow. Although the 16" RCP between Harold Street and Morrow Street is undersized, its replacement is not necessary due to sufficient gutter capacity and no known flooding problems. The 18" CMP between Morrow Street and the outfall is also undersized, and should be replaced with 400-feet of 24" HDPE (see Node E-2.0 on Figure 5-11). An alternative is to parallel the existing 18" CMP with 400-feet of 18" HDPE. This project is assigned a low priority ranking because the existing drainage facility is undersized for the existing level of development but does not currently flood during the design storm, and further development is not anticipated in the area. This project is not development-driven. Our opinion of the probable cost of the project is $89,800. Our opinion of the probable cost of the alternative project is $75,600.

TABLE 5-5 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN E

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
E-1.0	**Cedar St. (discharge to Pudding Creek)**	**18" RCP**	**19**	**37**	**52**	**36" HDPE SD**	**H**
E-1.1	**Lincoln St.**	**18" RCP**	**9**	**18**	**24**	**30" HDPE SD**	**H**
E-1.1.1	Florence St.	18" RCP	14	3	5	None	None
E-1.2	**Alder St.**	**18" RCP**	**15**	**18**	**26**	**30" HDPE SD**	**H**
E-1.3	**McKinley St.**	**18" RCP**	**5**	**16**	**22**	**30" HDPE SD**	**H**
E-1.3.1	Alley between Florence St. and Livingston St.	18" RCP	13	6	8	None	None
E-1.4	**Oak St.**	**18" RCP**	**15**	**22**	**31**	**24" HDPE SD**	**H**
E-1.5	**Oak St.**	**18" RCP**	**14**	**22**	**31**	**24" HDPE SD**	**H**
E-1.6	**Oak St.**	**18" RCP**	**11**	**21**	**29**	**24" HDPE SD**	**H**
E-1.6.1	Wall St.	18" RCP	12	3	4	None	None
E-1.7	**Alley between Livingston St. and Wall St.**	**18" RCP**	**6**	**18**	**25**	**24" HDPE SD**	**H**
E-1.8	**Willow St.**	**18" RCP**	**8**	**16**	**22**	**24" HDPE SD**	**H**
E-1.8.1	Alley between Wall St. and Sanderson Way	18" RCP	10	10	14	None	None
E-1.9	Willow St.	18" RCP	10	6	8	None	None
E-2.0	**Laurel St.**	**18" RCP**	**10**	**18**	**24**	**24" HDPE SD**	**H**
E-2.1	**Laurel St.**	**16" RCP**	**6**	**10**	**14**	**None[1]**	**H**

[1]See text for discussion.

*Note: Undersized facilities shown in **bold red type**.

LEGEND

- Node ID / Pipe Size/Type / Q_C = / Q_{10} = / Q_{100} = — NODE DESIGNATION; CONDITION AT NODE; EXISTING CAPACITY AT NODE (CFS); DESIGN FLOW (CFS); 100-YEAR PEAK FLOW (CFS)
- **BOLD = UNDERSIZED**
  NORMAL TEXT = ADEQUATE
- OUTFALL
- NODE
- MANHOLE
- DROP INLET
- 18" RCP — STORM DRAIN CONDUIT; PIPE MATERIAL; PIPE SIZE
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS
- SPHERE OF influence

JOB # 03184302
DESIGN MK
DRAWN MK/SD

0 400' 800'
SCALE 1"= 400'

BASIN B
BASIN C
BASIN D
BASIN E
BASIN F
BASIN G

E-1.1 18" RCP Qc= 9 Q10= 18 Q100= 24
E-1.1.1 18" RCP Qc= 14 Q10= 3 Q100= 5
E-1.3.1 18" RCP Qc= 13 Q10= 6 Q100= 8
E-1.0 18" RCP Qc= 19 Q10= 37 Q100= 52
E-2.1 16" RCP Qc= 6 Q10= 10 Q100= 14
E-2.0 18" RCP Qc= 10 Q10= 18 Q100= 24
E-1.2 18" RCP Qc= 15 Q10= 18 Q100= 26
E-1.3 18" RCP Qc= 5 Q10= 16 Q100= 22
E-1.4 18" RCP Qc= 15 Q10= 22 Q100= 31
E-1.5 18" RCP Qc= 14 Q10= 22 Q100= 31
E-1.6 18" RCP Qc= 11 Q10= 21 Q100= 29
E-1.7 18" RCP Qc= 6 Q10= 18 Q100= 25
E-1.8 18" RCP Qc= 8 Q10= 16 Q100= 22
E-1.6.1 18" RCP Qc= 12 Q10= 3 Q100= 4
E-1.8.1 18" RCP Qc= 10 Q10= 10 Q100=14
E-1.9 18" RCP Qc= 10 Q10= 6 Q100= 8

GROVE ST; SPRING ST; OLSEN LN; LINCOLN ST; WHIPPLE AVE; CORRY ST; HAROLD ST; PARK ST; MORROW ST; LINCOLN ST; FLORENCE; McKINLEY ST; LIVINGSTON; ALLEY; WALL ST; SANDERSON WAY; JEWETT ST; DANA ST; WOODLAND DR; EBBING WY; HOWLAND CT; MINNESOTA AVE; ALGER ST; PERKINS; BRANDON; MADRONE ST; REDWOOD ST; PINE ST; FIR ST; MAPLE ST; CHESTNUT ST; LAUREL ST; FERN AVE; ALDER ST; HAWLEY ST; EDDY ST; PENITENT WY; AZALEA CT; OAK TERRACE CT; POND; NANCY WY; RASMUSSEN; PUDDING CREEK; PETAL; C.W.P.& N.C.; C.W.R.& N.C.; 18" CMP; 18" HDPE

CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

EXISTING CAPACITIES AND ESTIMATED FLOWS

DRAINAGE BASIN E

FIGURE 5-10

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

FILE: J:\CAD\JOBS\2003\03184302\dwg\843b-f5-11.dwg DATE: Oct 01 04 @ 10:16am

BASIN A
BASIN B
BASIN C
BASIN D
BASIN E
BASIN F
BASIN G
BASIN I

SEE 1"=200' SCALE ENLARGEMENT BELOW FOR NODES 1.0 THROUGH 1.8

E-2.0
(N) 24" SD

0 400' 800'
SCALE 1"= 400'

0 200' 400'
SCALE 1"= 200'

E-1.1
(N) 30" SD

E-1.2
(N) 30" SD

E-1.3
(N) 30" SD

E-1.0
(N) 36" SD

E-1.4
(N) 24" SD

E-1.5
(N) 24" SD

E-1.6
(N) 24" SD

E-1.7
(N) 24" SD

E-1.8
(N) 24" SD

LEGEND

- NODE DESIGNATION
  - Node ID
  - (N) Improvement
- PROPOSED IMPROVEMENT
- OUTFALL
- EXISTING / NEW
  - MANHOLE
  - DROP INLET
  - HEADWALL
- 18" RCP — EXISTING (E) SD CONDUIT PIPE MATERIAL, PIPE SIZE
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

JOB # 03184302
DESIGN MK
DRAWN MK/SD

CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN E

FIGURE 5-11

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.5.6 Drainage Basin F

This drainage area is located on the eastern side of Fort Bragg and extends beyond the City limits and to the edge of the designated Sphere of Influence. The area encompasses approximately 144 acres and is primarily residential with two schools partly contained within the drainage. The area is bounded by Cedar Street in the north, Monson Way in the east, a divide 200-feet north of Chestnut Street in the south, and Sanderson Way in the west. Flow is entirely directed toward Pudding Creek (see Figure 5-12).

The existing drainage system on Oak Street is adequately sized in the eastern portions of the drainage area, but significantly undersized pipes in the western areas, particularly between Dana Street and Sanderson Way. This portion of the system acts as a bottleneck for flow traveling toward the outlet, which is located just northwest of the Oak Street and Sanderson Way intersection. Discussions with City staff indicate that this intersection frequently floods during typical winter storms creating traffic and safety hazards. Furthermore, continued development in this drainage basin, particularly in eastern areas, is resulting in increased runoff and discharge to a system already beyond capacity. A number of drainage improvement projects have been completed in this area in response to development, but small pipes in the downstream portion of the system continues to restrict flow. It should also be noted that there is a flow split at the intersection of Foot Path Way and Sanderson Way. At this intersection, 50 percent of the flow travels west on Willow Street, and 50 percent travels north on Sanderson Way. This flow split was verified during field investigations. Table 5-6 and Figure 5-12 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin F. Undersized facilities are shown in bold along with recommended improvements. Figure 5-13 shows the recommended improvements for undersized facilities.

The storm drain system serving the Howland Court subdivision is just slightly undersized for the 10-year design storm (see Node F-1.6.1 on Figure 5-12). Because the difference between the estimated capacity and 10-year flow is only 1 cfs, the existing structure does not currently flood, and the contributing subdivision has reached the full build-out condition for the current land use designation it would not be cost effective to upgrade the system. No replacement project is recommended.

5.5.6.1 Storm Drain Replacement: East Oak Street Project

A new storm drain system is proposed to replace the existing undersized conduits on Oak Street between California Way and Sanderson Way. The East Oak Street Project consists of the installation of 1,840-feet of 30” to 36” storm drain conduits (see Nodes F-1.9, F-1.7, F-1.6, F-1.5 and F-1.4 on Figure 5-13). It is recommended that the 12” to 30” RCP between Hocker Lane and Sanderson Way be replaced with 1,675-feet of 36” HDPE. It is also recommended that the 18” RCP between Hocker Lane and California Way be replaced with 165-feet of 30” HDPE. The proposed project has been assigned a high priority because existing drainage facilities are significantly undersized for current levels of development, and severe flooding of the Oak Street/Sanderson Way intersection is known to occur. The current storm conduits become successively smaller toward the outlet forcing flows out of storm drains and into gutters, which result in flooding problems and traffic hazards. This project will eliminate the frequent flooding

and provide the capacity necessary to support continued growth and development in this drainage basin. Because significant growth is possible in this drainage area and outlying areas to the east, this project is considered development-driven. Our opinion of the probable cost of the project is $593,900.

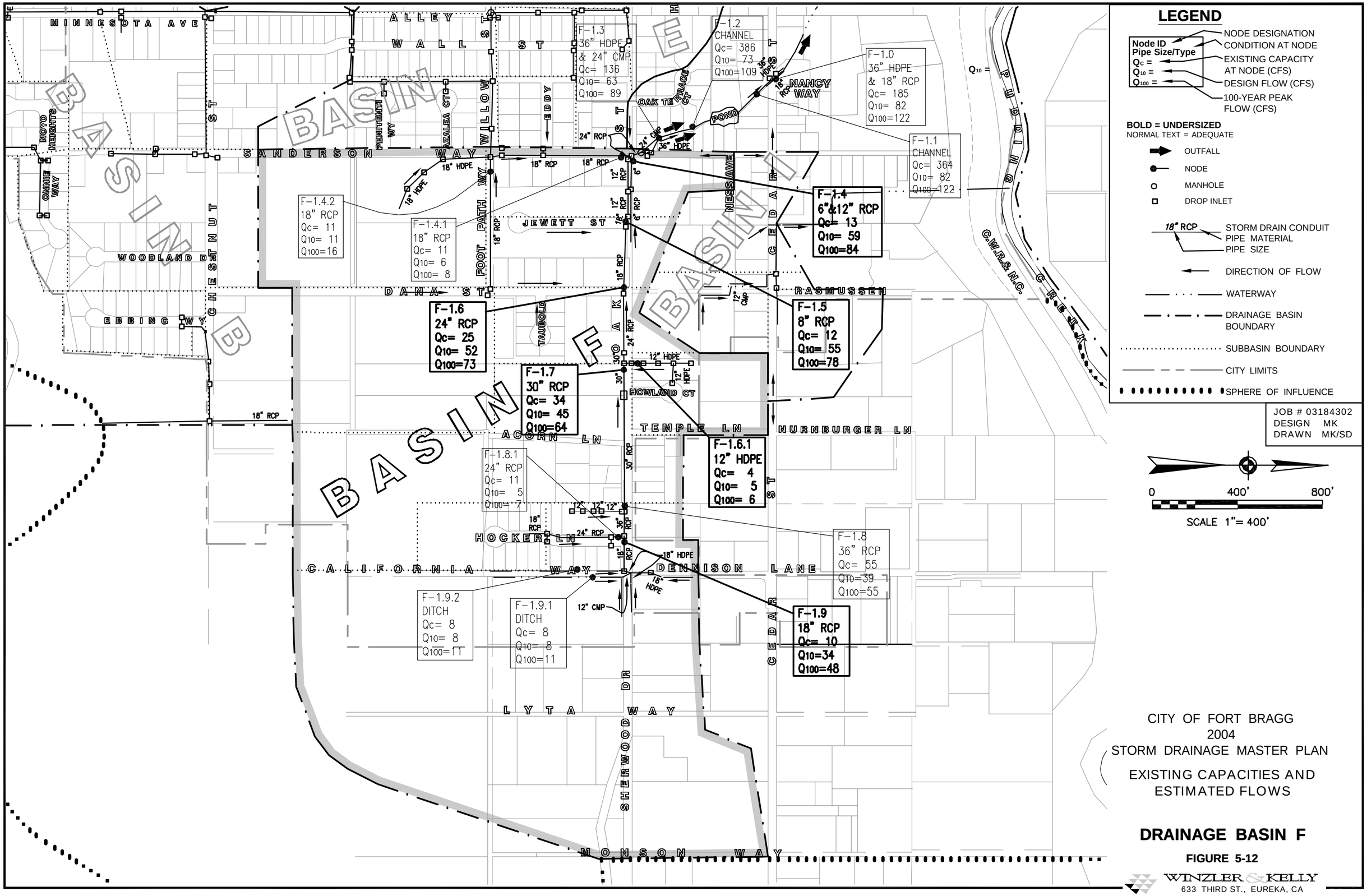
5.5.6.2 New Storm Drain System: East Oak Street/Sherwood Road Project

A new storm drain system is proposed to provide drainage to the area east of Hocker Lane between California Way and Lyta Lane (see Node F-1.10 on Figure 5-13). Approximately half of this proposed conduit is within the City limits, while the other half is outside City limits. Increasing runoff rates due to future development in the area east of the City limits is expected to continue impacting the City's storm drain system along Oak Street. The East Oak Street/ Sherwood Road Project consists of the installation of approximately 675-feet of 30" HDPE along East Oak Street and Sherwood Road. Two new drop inlets are also recommended, one at the upstream end of the conduit and one where the new conduit connects with the existing storm drain at the intersection of Oak Street and Sanderson Way. This project has been assigned a medium priority ranking because further development is anticipated in the project area. The new storm drain is considered a development-driven project whose installation may promote growth in the area. Our opinion of the probable cost of the project is $221,000.

TABLE 5-6 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN F

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
F-1.0	Unnamed Creek	36" HDPE & 18" RCP	185	82	122	None	None
F-1.1	Unnamed Creek	Channel	364	82	122	None	None
F-1.2	Florence St.	Channel	386	73	109	None	None
F-1.3	Sanderson Way	36" HDPE & 24" CMP	136	63	89	None	None
F-1.4	**Oak St.**	**6" & 12" RCP**	**13**	**59**	**84**	**36" HDPE SD**	**S, H**
F-1.4.1	Sanderson Way	18" RCP	11	6	8	None	None
F-1.4.2	Foot Path Way	18" RCP	11	11	16	None	None
F-1.5	**Oak St.**	**18" RCP**	**12**	**55**	**78**	**36" HDPE SD**	**S, H**
F-1.6	**Oak St.**	**24" RCP**	**25**	**52**	**73**	**36" HDPE SD**	**H**
F-1.6.1	**Howland Ct.**	**12" HDPE**	**4**	**5**	**6**	**None[1]**	**H**
F-1.7	**Oak St.**	**30" RCP**	**34**	**45**	**64**	**36" HDPE SD**	**H**
F-1.8	Oak St.	36" RCP	55	39	55	None	None
F-1.8.1	Hocker Ln.	24" RCP	11	5	7	None	None
F-1.9	**Oak St.**	**18" RCP**	**10**	**34**	**48**	**30" HDPE SD**	**H**
F-1.9.1	California Way	Ditch	8	8	11	None	None
F-1.9.2	California Way	Ditch	8	8	11	None	None

[1]See text for discussion.
*Note: Undersized facilities shown in **bold red type**.


BASIN F
BASIN F-1
MINNESOTA AVE
ALLEY
WALL ST
F-1.3
36" HDPE
& 24" CMP
Qc= 136
Q10= 63
Q100= 89
F-1.2
CHANNEL
Qc= 386
Q10= 73
Q100=109
F-1.0
36" HDPE
& 18" RCP
Qc= 185
Q10= 82
Q100=122
F-1.1
CHANNEL
Qc= 364
Q10= 82
Q100=122
NANCY WAY
OAK TERRACE CT
POND
MOYO HEIGHTS
ONNIE WAY
PENTENTH WY
AZALEA CT
EDDY
SANDERSON WAY
WILLOW ST
CHESTNUT ST
FOOT PATH WY
NESSA AVE
GEDAR ST
F-1.4
6"&12" RCP
Qc= 13
Q10= 59
Q100=84
F-1.4.2
18" RCP
Qc= 11
Q10= 11
Q100=16
F-1.4.1
18" RCP
Qc= 11
Q10= 6
Q100= 8
JEWETT ST
WOODLAND DR
DANA ST
EBBING WY
RASMUSSEN
F-1.5
8" RCP
Qc= 12
Q10= 55
Q100=78
F-1.6
24" RCP
Qc= 25
Q10= 52
Q100=73
TAUBOLD
OAK
F-1.7
30" RCP
Qc= 34
Q10= 45
Q100=64
HOWLAND CT
TEMPLE LN
NURNBURGER LN
ACORN LN
F-1.6.1
12" HDPE
Qc= 4
Q10= 5
Q100= 6
F-1.8.1
24" RCP
Qc= 11
Q10= 5
Q100= 7
HOCKER LN
CALIFORNIA WAY
DENNISON LANE
F-1.8
36" RCP
Qc= 55
Q10=39
Q100=55
F-1.9.2
DITCH
Qc= 8
Q10= 8
Q100=11
F-1.9.1
DITCH
Qc= 8
Q10= 8
Q100=11
F-1.9
18" RCP
Qc= 10
Q10=34
Q100=48
SHERWOOD DR
LYTA WAY
MONSON WAY
C.W.R.& N.C.
RAILROAD
PUDDING CREEK
Q10 =
LEGEND
Node ID
Pipe Size/Type
Qc =
Q10 =
Q100 =
NODE DESIGNATION
CONDITION AT NODE
EXISTING CAPACITY AT NODE (CFS)
DESIGN FLOW (CFS)
100-YEAR PEAK FLOW (CFS)
BOLD = UNDERSIZED
NORMAL TEXT = ADEQUATE
OUTFALL
NODE
MANHOLE
DROP INLET
18" RCP
STORM DRAIN CONDUIT
PIPE MATERIAL
PIPE SIZE
DIRECTION OF FLOW
WATERWAY
DRAINAGE BASIN BOUNDARY
SUBBASIN BOUNDARY
CITY LIMITS
SPHERE OF INFLUENCE
JOB # 03184302
DESIGN MK
DRAWN MK/SD
0
400'
800'
SCALE 1"= 400'
CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN
EXISTING CAPACITIES AND ESTIMATED FLOWS
DRAINAGE BASIN F
FIGURE 5-12
WINZLER & KELLY
633 THIRD ST., EUREKA, CA
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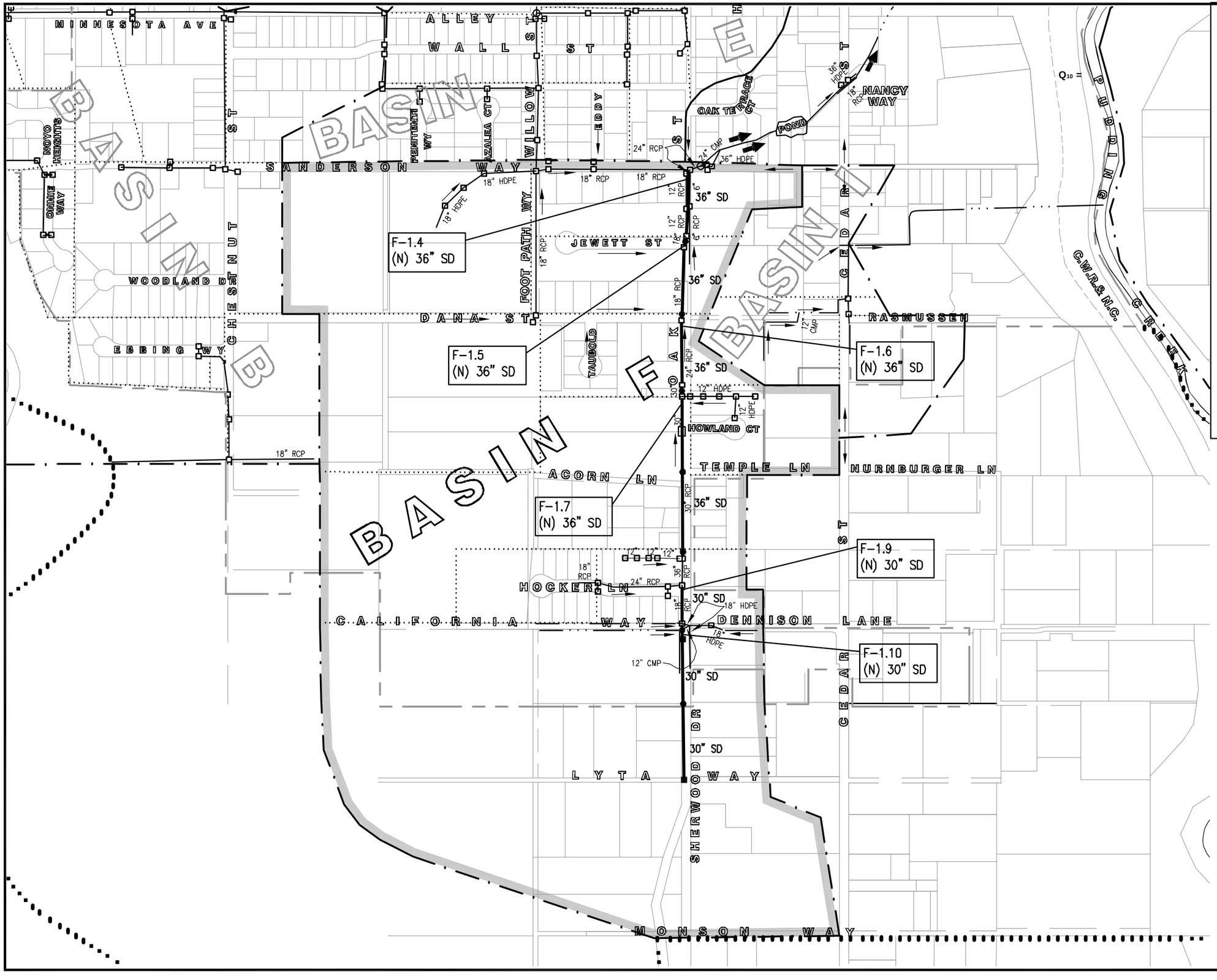

LEGEND

- NODE DESIGNATION
- Node ID / (N) Improvement — PROPOSED IMPROVEMENT
- OUTFALL
- EXISTING / NEW — MANHOLE
- DROP INLET
- HEADWALL
- 18" RCP — EXISTING (E) SD CONDUIT PIPE MATERIAL / PIPE SIZE
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

JOB # 03184302
DESIGN MK
DRAWN MK/SD

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CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN F

FIGURE 5-13

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.5.7 Drainage Basin G

This drainage area is located in the northwest section of the City and encompasses approximately 174 acres. It is essentially bounded by Elm Street and Pudding Creek in the north, Harold Street in the east, Redwood Avenue in the south and West Street and Glass Beach Drive in the west.

Drainage G is primarily residential with some commercial and industrial zoning in the areas surrounding Main Street. The existing drainage system has two main branches which flow in a northwesterly direction meeting at the intersection of Glass Beach Drive and Elm Street before discharging to the Pacific Ocean at Glass Beach. The drainage system is in good condition, with many of the improvements recommended in the 1985 Storm Drainage Master Plan have been completed. Discussions with City staff indicate that there are presently no major drainage or flooding problems in this drainage basin. Table 5-7 and Figure 5-14 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin G. Undersized facilities are shown in bold. There are some minor areas of flooding due to improper gutter flow routing.

Results of hydraulic simulations suggest that the majority of the drainage system is of adequate capacity to pass the 10-year design flow. However, there are three sections of the system that the model indicates are undersized, and several intersection cross drains that are not functioning properly. There are also several locations where improper drainage and gutter flow routing result in potential flooding of residences. Projects are assigned to the undersized drainage systems and known flooding problems, while the issues with the cross drains are discussed in more detail below. Table 5-7 describes the undersized facilities, and describes their deficiency and the recommended improvement. Figure 5-15 shows the location of recommended improvements for undersized facilities.

The cross drain at the intersection of Redwood Avenue and Corry Street does not properly drain the intersection, and a large puddle forms on the southeast corner near the drain inlet and floods the sidewalk ramp. Moving the cross drain inlet or removing the sag by sloping the gutter toward the existing inlet will eliminate this problem.

A large puddle forms in the east gutter in the middle of the block on Corry Street between Redwood Avenue and Laurel Street during heavy rains. Creating a sufficient gutter slope to allow proper drainage toward Laurel Street will solve this problem.

The cross drain at the intersection of Laurel Street and Whipple Street does not function properly, leaving standing water at the southern corners. City engineering staff was working on a design for this drainage problem during January and February 2004, therefore no recommendation is made here.

5.5.7.1 Cross Drain Replacement: Harrison Street and Laurel Street Project

The cross drain at the intersection of Laurel Street and Harrison Street does not function properly, leaving a large puddle on the southwestern corner (see Figure 5-15). In addition, the majority of the flow traveling to the Laurel Street/Harrison Street intersection is routed down

Harrison Street and toward the storm drain system on Pine Street. The high volume of gutter flow on this block of Harrison Street inundates sidewalks with substandard curbs causing residential flooding, even during typical winter storms. Specifically, flooding occurs at residences on the east side of Harrison Street approximately 100-feet and 225-feet north of the Laurel Street/Harrison Street intersection. Some residences had sand bags around driveways to reduce flooding. Redesigning the cross drain such that gutter flow continues down Laurel Street and is then routed north to Pine Street on either McPherson Street, Franklin Street or Main Street will eliminate the flooding problems. This project is assigned a high priority ranking because flooding of streets, sidewalks and residential property is known to occur. This project is not development-driven. Our opinion of the probable cost of this project is $49,700.

5.5.7.2 Storm Drain Replacement: Pine Street and Franklin Street Project

Portions of the storm drain system on Pine Street and Franklin Street are recommended for upgrade because they have very mild slopes, which reduces their capacity below that of the 10-year flow (see Nodes G-1.9 and G-1.8 on Figure 5-15). Adding a 360-foot section of 24" HDPE parallel to the conduit on Pine Street between McPherson Street and Franklin Street, and a 430-foot section of 30" HDPE parallel to the conduit on Franklin Street between Pine Street and Fir Street will provide complete containment of the 10-year flow. This project is assigned a low priority ranking because there are currently no known drainage or flooding issues in the project area and future growth is not anticipated. This project is not development-driven. Our opinion of the probable cost of the project is $197,700.

5.5.7.3 Storm Drain Replacement: Fir Street Project

There is a 715-foot section of 39" RCP storm drain on Fir Street between Main Street and West Street that is currently undersized for the design flow (see Nodes G-1.6 and G-1.5 on Figure 5-15). It is recommended that this pipe be replaced with 48" HDPE, which will allow for complete containment of the 10-year flow. An alternative to this design is to parallel the existing 39" conduit with a new 24" HDPE conduit. This project is assigned a low priority ranking because there are currently no known drainage or flooding issues in the project area and growth is not anticipated. This project is not development-driven. Our opinion of the probable cost of the project is $73,700. Our opinion of the probable cost of the alternative project is $39,100.

5.5.7.4 Storm Drain Replacement: Franklin Street to Elm Street Project

The section of storm drain running from Franklin Street and Bush Street to Elm Street and Glass Beach Drive is undersized for the 10-year flow (see Nodes G-1.1.7, G-1.1.6, G-1.1.5, G-1.1.4, G-1.1.3 and G-1.1.2 on Figure 5-15). The project consists of replacing approximately 2,590-feet of 12" to 24" storm drain conduits. In order to completely contain the design flow, the 250-feet of 12" RCP on Bush Street between Franklin Street and McPherson Street should be replaced with 18" HDPE, the 1,290-feet of 18" RCP on Franklin Street from Bush Street to Spruce Street and west on Spruce Street to Steward Street should be replaced with 24" HDPE, the 455-feet of 18" RCP on Steward Street between Spruce Street and Elm Street should be replaced with 30" HDPE, and the 595-feet of 24" HDPE on Elm Street between Stewart Street and Glass Beach Drive should be increased to 30" HDPE. An alternative to this design is to replace the 250-feet of

12” RCP on Bush Street between Franklin Street and McPherson Street with 18” HDPE, and parallel the existing 18” and 24” conduits on Franklin Street, Spruce Street, Stewart Street and Elm Street with 18” HDPE. This project is assigned a low priority ranking because there are currently no known drainage or flooding issues in the project area, gutters are of sufficient capacity to contain excess flows, and development is not anticipated. This project is not development-driven. Our opinion of the probable cost of the project is $599,800. Our opinion of the probable cost of the alternative project is $467,500.

TABLE 5-7 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN G

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
G-1.0	Ocean outfall	42" HDPE & 24" RCP	170	142	202	None	None
G-1.1	Glass Beach Dr.	30" HDPE	87	50	71	None	None
G-1.1.1	Glass Beach Dr.	24" HDPE	17	8	12	None	None
G-1.1.1.1	Glass Beach Dr.	18" HDPE	7	4	6	None	None
G-1.1.1.2	Holmes Ln.	15" HDPE	4	4	6	None	None
G-1.1.2	**West Elm St.**	**24" HDPE**	**19**	**45**	**64**	**30" HDPE SD**	**H**
G-1.1.3	**Stewart St.**	**18" RCP**	**11**	**40**	**57**	**30" HDPE SD**	**H**
G-1.1.4	**Spruce St.**	**18" RCP**	**12**	**30**	**43**	**24" HDPE SD**	**H**
G-1.1.4.1	Main St.	24" HDPE	24	6	9	None	None
G-1.1.5	**Spruce St.**	**18" RCP**	**9**	**20**	**28**	**24" HDPE SD**	**H**
G-1.1.6	**Franklin St.**	**18" RCP**	**11**	**16**	**23**	**24" HDPE SD**	**H**
G-1.1.7	**Bush St.**	**36" CMP**	**4**	**11**	**15**	**18" HDPE SD**	**H**
G-1.2	Glass Beach Dr.	30" CMP	155	92	132	None	None
G-1.3	Spruce St.	Ditch	106	86	122	None	None
G-1.4	Fir St.	24" HDPE	106	80	113	None	None
G-1.5	**Fir St.**	**24" HDPE**	**49**	**79**	**112**	**48" HDPE SD**	**H**
G-1.6	**Fir St.**	**24" HDPE**	**52**	**77**	**109**	**48" HDPE SD**	**H**
G-1.6.1	Main St.	24" PP	20	12	17	None	None
G-1.6.2	Main St.	24" RCP	20	11	15	None	None
G-1.7	Main St.	39" RCP	74	65	92	None	None
G-1.7.1	Fir St.	24" RCP	21	16	23	None	None
G-1.7.2	Harrison St.	24" RCP	36	8	11	None	None
G-1.8	**Franklin St.**	**30" HDPE**	**21**	**51**	**71**	**Parallel 30" HDPE SD**	**H**
G-1.9	**Pine St.**	**30" HDPE**	**38**	**50**	**70**	**Parallel 24" HDPE SD**	**H**
G-1.10	Pine St.	30" HDPE	58	43	60	None	None
G-1.11	Pine St.	18" HDPE	36	36	51	None	None

*Note: Undersized facilities shown in **bold red type**.

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CONTINUATION

GEORGIA-PACIFIC LOG POND

G-1.0
42"HDPE & 24" RCP
Qc= 170
Q10= 142
Q100= 202

G-1.4
42" RCP
Qc= 106
Q10= 80
Q100= 113

G-1.3
42" RCP
Qc= 106
Q10= 86
Q100= 122

G-1.2
42" RCP
Qc= 155
Q10= 92
Q100= 132

G-1.0
42"HDPE & 24" RCP
Qc= 170
Q10= 142
Q100= 202

G-1.1
30" HDPE
Qc= 87
Q10= 50
Q100= 71

G-1.1.1.1
18" HDPE
Qc= 7
Q10= 4
Q100= 6

G-1.5
39" RCP
Qc= 49
Q10= 79
Q100= 112

G-1.1.4
18" RCP
Qc= 12
Q10= 30
Q100= 43

G-1.1.2
24" HDPE
Qc= 19
Q10= 45
Q100= 64

G-1.6
39" RCP
Qc= 52
Q10= 77
Q100= 109

G-1.6.1
24" PP
Qc= 20
Q10= 12
Q100= 17

G-1.4.1
24" HDPE
Qc= 24
Q10= 6
Q100= 9

G-1.1.1
24" HDPE
Qc= 17
Q10= 8
Q100= 12

G-1.1.2
15" HDPE
Qc= 4
Q10= 4
Q100= 6

G-1.6.2
24" RCP
Qc= 20
Q10= 11
Q100= 15

G-1.7
39" RCP
Qc= 74
Q10= 65
Q100= 92

G-1.1.5
18" RCP
Qc= 9
Q10= 20
Q100= 28

G-1.1.3
18" RCP
Qc= 11
Q10= 40
Q100= 57

G-1.9
30" HDPE
Qc= 38
Q10= 50
Q100= 70

G-1.8
30" HDPE
Qc= 21
Q10= 51
Q100= 71

G-1.7.1
24" RCP
Qc= 21
Q10= 16
Q100= 23

G-1.1.7
12" RCP
Qc= 4
Q10= 11
Q100= 15

G-1.1.6
18" RCP
Qc= 11
Q10= 16
Q100= 23

G-1.10
30" HDPE
Qc= 58
Q10= 43
Q100= 60

G-1.11
18" HDPE
Qc= 36
Q10= 36
Q100= 51

G-1.7.2
24" RCP
Qc= 36
Q10= 8
Q100= 11

WEST STREET
STEWART STREET
MAIN ST.
FRANKLIN ST.
McPHERSON ST.
HARRISON ST.
WHIPPLE STREET
CORRY STREET
PERKINS
BRANDON
HAROLD ST
BUSH ST.
SPRUCE ST.
FIR STREET
LAUREL ST
PINE ST.
ALDER ST
REDWOOD AVE
OAK ST
HOLMES LANE
STEWART STREET
WEST STREET
GLASS BEACH DR.
WINFRED
C.W.R.&N.C.

BASIN A
BASIN B
BASIN E

PUDDING CREEK
PUDDING CREEK RD

JOB # 03184302
DESIGN MK
DRAWN MK/SD

0 400' 800'
SCALE 1"= 400'

LEGEND

Node ID
Pipe Size/Type
Q_c =
Q_{10} =
Q_{100} =

- NODE DESIGNATION
- CONDITION AT NODE
- EXISTING CAPACITY AT NODE (CFS)
- DESIGN FLOW (CFS)
- 100-YEAR PEAK FLOW (CFS)

BOLD = UNDERSIZED
NORMAL TEXT = ADEQUATE

- OUTFALL
- NODE
- MANHOLE
- DROP INLET
- 18" RCP — STORM DRAIN CONDUIT PIPE MATERIAL / PIPE SIZE
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS
- SPHERE OF INFLUENCE

CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

EXISTING CAPACITIES AND ESTIMATED FLOWS

DRAINAGE BASIN G

FIGURE 5-14

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

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CONTINUATION

GEORGIA-PACIFIC LOG POND

BASIN G

BASIN D

BASIN E

BASIN B

G-1.5 (N) 30" SD

G-1.6 (N) 48" SD

G-1.8 (N) 30" Parallel SD

G-1.9 (N) 24" Parallel SD

G-1.1.2 (N) 30" SD

G-1.1.3 (N) 30" SD

G-1.1.4 (N) 24" SD

G-1.1.5 (N) 24" SD

G-1.1.6 (N) 24" SD

G-1.1.7 (N) 18" SD

(N) INTERSECTION CROSS DRAIN * SEE TEXT

WEST STREET

STEWART STREET

MAIN ST.

FRANKLIN ST.

McPHERSON ST.

WHIPPLE STREET

CORRY STREET

HARRISON ST.

PERKINS

BRANDON

HAROLD ST

HOLMES LANE

GLASS BEACH DR.

SPRUCE ST.

BUSH ST.

FIR ST

OAK ST

ALDER ST

REDWOOD ST

LAUREL ST

PINE ST

WINFRED ST

C.W.R.&N.C.

PUDDING CREEK

PUDDING CREEK RD

JOB # 03184302
DESIGN MK
DRAWN MK/SD

0 400' 800'

SCALE 1"= 400'

LEGEND

- NODE DESIGNATION
- Node ID / (N) Improvement
- PROPOSED IMPROVEMENT
- OUTFALL
- EXISTING / NEW: MANHOLE
- DROP INLET
- HEADWALL
- 18" RCP — EXISTING (E) SD CONDUIT PIPE MATERIAL PIPE SIZE
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN G

FIGURE 5-15

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.5.8 Drainage Basin H

This drainage area is located south of the Noyo River and west of Highway 1 in the area generally known as Todd Point. It encompasses approximately 142 acres, and is bounded in the north by Noyo Bay, in the east by Highway 1 and Boatyard Drive, in the south by Hare Creek and in west by the Pacific Ocean (see Figure 5-16). It should be noted that much of Drainage Basin H is outside of Fort Bragg City limits, and within the jurisdiction of the County of Mendocino (see Figure 5-1).

Drainage H is zoned primarily as residential, with some commercial and park areas. The College of the Redwoods Mendocino Coast Campus is located approximately in the center of this area. Also included as part of Drainage H are Highway 1, and a small commercial area just east of Highway 1. Projected runoff flows were calculated assuming full development. The existing drainage system, which consists of closed conduits on Highway 1, Highway 20 and Boatyard Drive, and a series of drainage ditches and culverts along Ocean View Drive, is generally in serviceable condition. However, the drainage ditches and culverts on Ocean View Drive require maintenance. Several of these culverts have been partially crushed or filled with sediments. During field investigations severe bluff erosion was also observed in the vicinity of the Ocean View Drive outfall pipe, which is creating a safety hazard. Table 5-8 and Figure 5-16 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin H. Undersized facilities are shown in bold type. Table 5-8 also shows undersized facilities and the recommended improvements. These facilities and improvements are shown on Figure 5-17.

5.5.8.1 Culvert Replacement: Ocean View Drive Project

A project is proposed to replace existing culverts and regrade drainage ditches on Ocean View Drive. Three undersized culverts were identified for replacement. It is recommended that the 12" HDPE culvert crossing Monterey Avenue be replaced with a 24" HDPE culvert (see Node H-1.6 on Figure 5-17). It is also recommended that the 18" CMP culvert at Pacific Drive and the 12" CMP culvert at Neptune Avenue be replaced with 30" HDPE culverts (see Nodes H-1.4 and H-1.2 on Figure 5-17). However, it should be noted that these two culverts are outside of the Fort Bragg City limits, and therefore fall within the jurisdiction of the County of Mendocino. It is also recommended that the drainage ditches on both sides of Ocean View Drive be cleaned and regraded to 2' x 2' x 3'. This project is designated as a medium priority because the existing culverts are undersized for the current levels of development and drainage ditches are in need of maintenance. Because of the growth potential in the Todd Point area this project is considered development-driven. Our opinion of the probable cost for the project is $118,300.

5.5.8.2 Storm Drain Outfall Replacement: Ocean View Drive Outfall Project

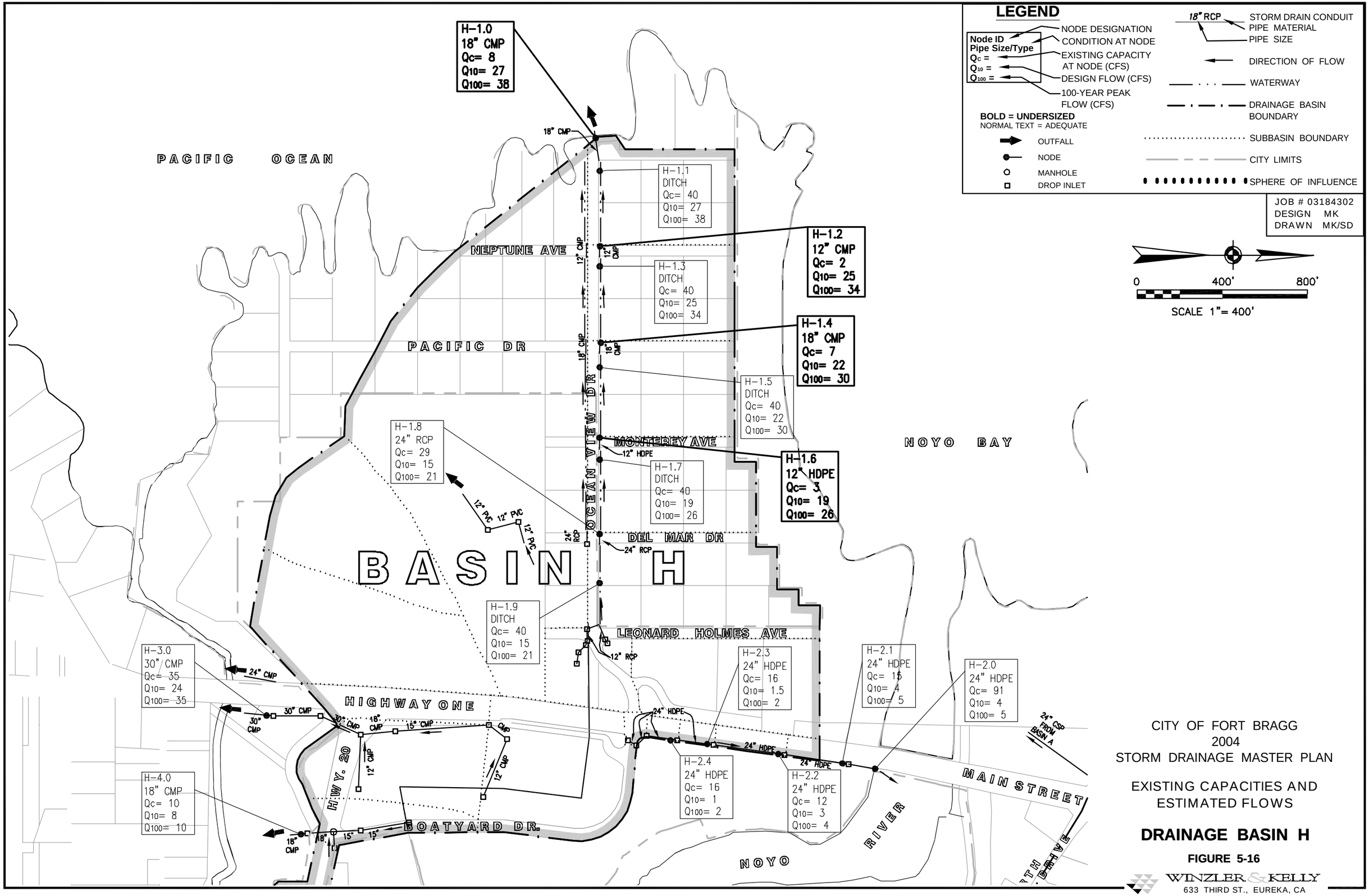
A project is proposed to replace the existing outfall pipe and stabilize the bluff at the west end of Ocean View Drive. The existing 18" CMP outfall pipe is undersized for the design storm, and severe erosion is occurring on the bluff surrounding the culvert (see Node H-1.0 on Figure 5-17). A visual inspection of the outfall pipe showed an eroded area approximately 15-feet high and 30-feet wide. The culvert is perched over the eroded area extending approximately 6-feet out

from the end of the bluff. There is also a guardrail at the outfall location that is failing as a result of the erosion. This outfall pipe is located outside the Fort Bragg City limits, and its maintenance is the responsibility of the County of Mendocino. It is recommended that the existing outfall pipe be replaced with a 30" HDPE, and that bank stabilization and erosion control methods be used to stabilize the material surrounding the pipe. Because visitors frequent the project site, the eroding bank creates a serious safety hazard. For this reason The Ocean View Drive Outfall Project has been assigned a high priority ranking. Because the outfall pipe is located in an area with significant growth potential, this project is considered development-driven. Our opinion of the probable cost of the project is $67,300.

TABLE 5-8 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN H

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
H-1.0	**Ocean View Dr.**	**18" CMP**	**8**	**27**	**38**	**30" HDPE Culvert**	**S,H**
H-1.1	Ocean View Dr.	Ditch	40	27	38	None	None
H-1.2	**Ocean View Dr.**	**12" CMP**	**2**	**25**	**34**	**30" HDPE Culvert**	**H**
H-1.3	Ocean View Dr.	Ditch	40	25	34	None	None
H-1.4	**Ocean View Dr.**	**18" CMP**	**7**	**22**	**30**	**30" HDPE Culvert**	**H**
H-1.5	Ocean View Dr.	Ditch	40	22	30	None	None
H-1.6	**Ocean View Dr.**	**12" HDPE**	**3**	**19**	**26**	**24" HDPE Culvert**	**H**
H-1.7	Ocean View Dr.	Ditch	40	19	26	None	None
H-1.8	Ocean View Dr.	24" RCP	29	15	21	None	None
H-1.9	Ocean View Dr.	Ditch	40	15	21	None	None
H-2.0	Noyo River	24" HDPE	91	4	5	None	None
H-2.1	Highway 1	24" HDPE	15	4	5	None	None
H-2.2	Highway 1	24" HDPE	12	3	4	None	None
H-2.3	Highway 1	24" HDPE	16	1.5	2	None	None
H-2.4	Highway 1	24" HDPE	16	1	2	None	None
H-3.0	Highway 1	30" CMP	35	24	35	None	None
H-4.0	Highway 20	18" CMP	10	8	10	None	None

*Note: Undersized facilities shown in **bold red type**.



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2004
STORM DRAINAGE MASTER PLAN

EXISTING CAPACITIES AND ESTIMATED FLOWS

DRAINAGE BASIN H

FIGURE 5-16

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

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LEGEND

- NODE DESIGNATION
- Node ID / (N) Improvement — PROPOSED IMPROVEMENT
- 18" RCP — EXISTING (E) SD CONDUIT, PIPE MATERIAL, PIPE SIZE
- 42" SD — PROPOSED SD CONDUIT
- DIRECTION OF FLOW
- OUTFALL
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS

EXISTING	NEW
○	● MANHOLE
□	■ DROP INLET
	⏚ HEADWALL

JOB # 03184302
DESIGN MK
DRAWN MK/SD

0 400' 800'

SCALE 1"= 400'

PACIFIC OCEAN

NOYO BAY

NOYO RIVER

BASIN H

H-1.0 (N) 30" CULVERT

H-1.2 (N) 30" CULVERT

H-1.4 (N) 30" CULVERT

H-1.6 (N) 24" CULVERT

18" CMP

NEPTUNE AVE

12" CMP

12" CMP

PACIFIC DR

18" CMP

18" CMP

OCEAN VIEW DR

MONTEREY AVE

12" HDPE

12" PVC 12" PVC 12" PVC

24" RCP

DEL MAR DR

24" RCP

LEONARD HOLMES AVE

12" RCP

24" CMP

HIGHWAY ONE

30" CMP

30" CMP

30" CMP

18" CMP

15" CMP

CMP

12" CMP

12" CMP

HWY. 20

18" CMP

18"

15"

15"

BOATYARD DR.

24" HDPE

24" HDPE

24" HDPE

24" CSP FROM BASIN A

MAIN STREET

CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN H

FIGURE 5-17

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.5.9 Drainage Basin I

This is the smallest drainage area in Fort Bragg. This drainage area was not included in the 1985 Storm Drainage Master Plan, and was added in this Master Plan Update to address drainage concerns in that area. Drainage Basin I is located between Drainage Basin F and Pudding Creek. It is a residential area of approximately 17 acres. It is bounded by Pudding Creek in the north, Nurnburger Lane in the east, Oak Street in the south, and Sanderson Way in the west, and is divided through the middle by Cedar Street (see Figure 5-18).

Due to continued development in areas to the east the amount of runoff to this drainage area is increasing. Localized flooding during moderate winter storms is becoming more common, and the existing drainage facilities, which consist of a small section of storm drain, some culverts and drainage ditches, are inadequately sized to handle the increasing volume of runoff. Table 5-9 and Figure 5-18 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin I. Undersized facilities are shown in bold type. Table 5-9 also shows undersized facilities and the recommended improvement. These facilities and the improvement are shown on Figure 5-19.

Hydraulic analysis indicates that the 15" RCP and 12" RCP on Cedar Street west of Rasmussen Drive is undersized for the design storm (see Nodes I-1.1 and I-1.2 on Figure 5-19). Replacing this storm drain conduit with 18" HDPE will provide complete containment of the 10-year flow. Because this section of storm drain is not critical to the drainage of this area, no replacement project is recommended.

5.5.9.1 New Storm Drain System: Cedar Street Project

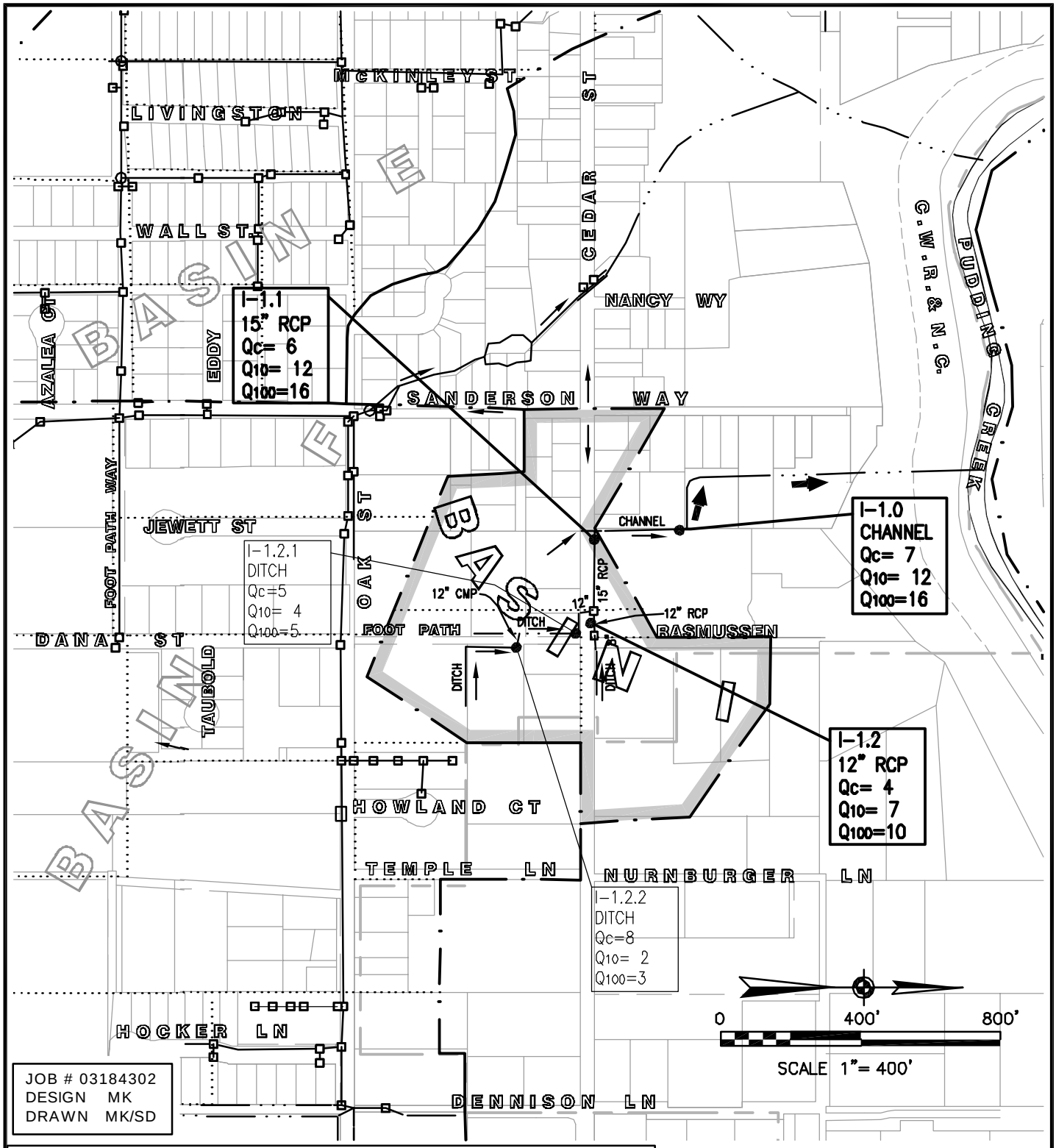
A new storm drain system is proposed to replace a drainage ditch on Cedar Street between Rasmussen Drive and Sanderson Way. The Cedar Street Project consists of abandoning the existing drainage ditch that currently carries all flow out of this drainage area to Pudding Creek and install approximately 700-feet of 24" HDPE on Cedar Street connecting with the existing 15" RCP and discharging to the channel west of Nancy Way (see Node I-1.0 on Figure 5-19). A grade break at Sanderson Way will require excavations to depths of approximately 11-feet to obtain the correct pipe slope when installing the new conduit. A new drop inlet should also be installed at the low point where the existing 15" RCP meets the new 24" HDPE. Because flooding in the project area is known to occur, the existing drainage facilities are significantly undersized for current levels of development, and maximum development has not yet occurred, a high priority ranking was assigned to this project. This project is considered development-driven. Our opinion of the probable cost of the project is $180,800.

TABLE 5-9 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN I

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
I-1.0	**Cedar St. (Pudding Creek)**	**Ditch**	**7**	**12**	**16**	**24" HDPE SD**	**S,H**
I-1.1	**Cedar St.**	**15" RCP**	**6**	**12**	**16**	**None**	**H**
I-1.2	**Cedar St.**	**12" RCP**	**4**	**7**	**10**	**None**	**H**
I-1.2.1	Cedar St.	Ditch	5	4	5	None	None
I-1.2.2	Foot Path	Ditch	8	2	3	None	None

[1]See text for discussion.

*Note: Undersized facilities shown in **bold red type**.



LEGEND

- Node ID / Pipe Size/Type — NODE DESIGNATION
- CONDITION AT NODE
- Q_c = EXISTING CAPACITY AT NODE (CFS)
- Q_{10} = DESIGN FLOW (CFS)
- Q_{100} = 100-YEAR PEAK FLOW (CFS)

BOLD = UNDERSIZED
NORMAL TEXT = ADEQUATE

- OUTFALL
- NODE
- MANHOLE
- DROP INLET
- 18" RCP — STORM DRAIN CONDUIT, PIPE MATERIAL, PIPE SIZE
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS
- SPHERE OF INFLUENCE

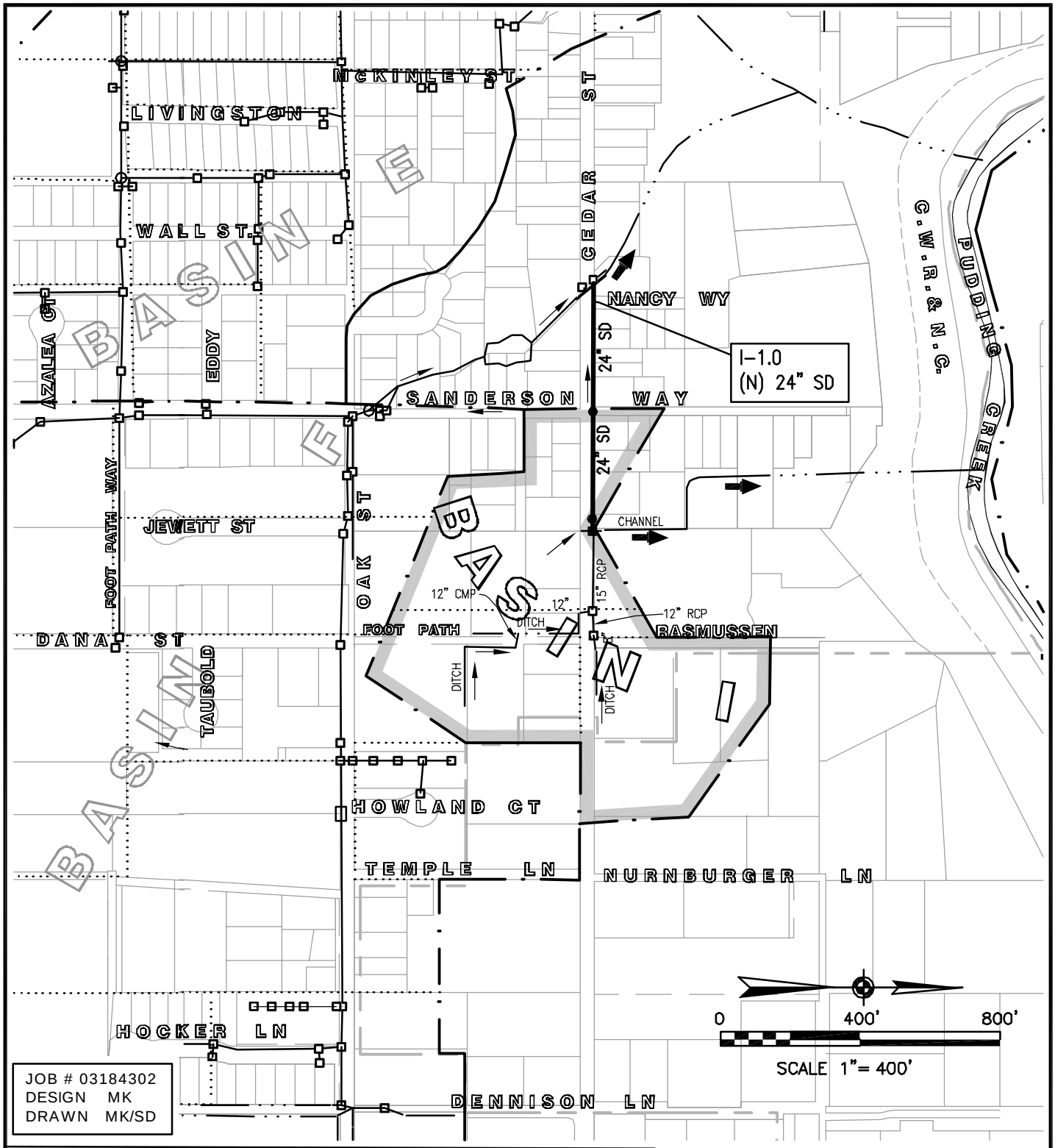
CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

EXISTING CAPACITIES AND ESTIMATED FLOWS

DRAINAGE BASIN I

FIGURE 5-18

WINZLER & KELLY
633 THIRD ST., EUREKA, CA



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JOB # 03184302
DESIGN MK
DRAWN MK/SD

LEGEND

NODE DESIGNATION

Node ID
(N) Improvement

PROPOSED IMPROVEMENT

OUTFALL

EXISTING	NEW	
O	●	MANHOLE
□	■	DROP INLET
		HEADWALL

18" RCP — EXISTING (E) SD CONDUIT, PIPE MATERIAL, PIPE SIZE

42" SD — PROPOSED SD CONDUIT

DIRECTION OF FLOW

WATERWAY

DRAINAGE BASIN BOUNDARY

SUBBASIN BOUNDARY

CITY LIMITS

CITY OF FORT BRAGG
2004
STORM DRAINAGE MASTER PLAN

PROPOSED IMPROVEMENTS

DRAINAGE BASIN I

FIGURE 5-19

WINZLER & KELLY
633 THIRD ST EUREKA CA

5.5.10 Drainage Basin J

This drainage area is the largest in this study, encompassing approximately 983 acres on the north side of Pudding Creek. It is bounded by the City limits in the north, Virgin Creek in the east, Pudding Creek in the south and the Pacific Ocean in the west (see Figure 5-20).

Drainage J is a mixture of rural residential, commercial and industrial land zoning, with some parks and open space. The area primarily drains northwesterly toward the Pacific Ocean, with steep slopes on the south side draining directly to Pudding Creek. Although only a small percentage of the area is within the City limits, the majority of the drainage lies to the east and is a contributing area for runoff to the west. The existing drainage system consists of ditches and culverts which route flow across Highway 1 to discharge points along the Pacific Ocean. Table 5-10 and Figure 5-20 summarize the capacities and design flows for the existing drainage facilities at specific nodal points in Basin J. Undersized facilities are shown in bold.

The California Department of Transportation (Caltrans) is responsible for the drainage facilities along State Highway 1, and replaced the culverts at post mile 62.81 and post mile 63.05 during construction year 1988/1989 (see Nodes J-2.0 and J-3.0 on Figure 5-21). Table 5-10 and Figure 5-21 summarize the undersized facilities, and describe their deficiency and the recommended improvement.

The 30" RCP culvert located at the northern City limit at P.M. 63.37 is just slightly undersized for the design flow (see Node J-1.0 on Figure 5-21). However, because the difference between the estimated capacity and 10-year flow is only 1 cfs, replacement of this culvert is not recommended.

5.5.10.1 Culvert Replacement: Highway 1 Projects

Two existing culverts running under Highway 1 north of Pudding Creek and within the City limits were identified for replacement. The 23"x14" Oval RCP culverts at P.M. 63.05 and P.M. 62.81 were installed by Caltrans in 1988/1989, but hydraulic analyses indicate that they are undersized for the 10-year event (see Nodes J-2.0 and J-3.0 on Figure 5-21). It is recommended that the culvert at P.M. 63.05 be replaced with a 36" HDPE culvert, and the culvert at P.M. 62.81 be replaced with a 48" HDPE culvert. These culvert replacement projects were given a medium priority ranking because they do not currently pose a flooding hazard because of deep roadside ditches. Future development is expected in this drainage area that may result in increased runoff rates and flooding potential. Therefore the culvert replacements are considered development-driven. Our opinion of the probable cost of the project is $59,700.

TABLE 5-10 EXISTING CONDITIONS AND PROPOSED DRAINAGE FACILITIES IN BASIN J

Node ID	Location	Existing Condition	Existing Capacity (cfs)	Estimated Flows (cfs)		Recommended Improvement	Deficiency H=Hydraulic S=Safety
				10-Year	100-Year		
J-1.0	**Highway 1 at P.M. 63.37**	**30" RCP**	**43**	**44**	**62**	**None[1]**	**H**
J-2.0	**Highway 1 at P.M. 63.05**	**23"x14" Oval RCP**	**7**	**65**	**93**	**36" HDPE Culvert**	**H**
J-3.0	**Highway 1 at P.M. 62.81**	**23"x14" Oval RCP**	**9**	**210**	**300**	**48" HDPE Culvert**	**H**
J-4.0	Highway 1 at P.M. 62.52	84" and 18" CMP	449	170	242	None	None

[1]See text for discussion.
*Note: Undersized facilities shown in **bold red type**.

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LEGEND

Node ID
Pipe Size/Type
Q_C =
Q_{10} =
Q_{100} =

- NODE DESIGNATION
- CONDITION AT NODE
- EXISTING CAPACITY AT NODE (CFS)
- DESIGN FLOW (CFS)
- 100-YEAR PEAK FLOW (CFS)

BOLD = UNDERSIZED
NORMAL TEXT = ADEQUATE

- OUTFALL
- NODE
- MANHOLE
- DROP INLET
- 18" RCP — STORM DRAIN CONDUIT PIPE MATERIAL / PIPE SIZE
- DIRECTION OF FLOW
- WATERWAY
- DRAINAGE BASIN BOUNDARY
- SUBBASIN BOUNDARY
- CITY LIMITS
- SPHERE OF INFLUENCE

JOB # 03184302
DESIGN MK
DRAWN MK/SD

BASIN G

GLASS BEACH DR
STEWART ST
STORM WATER INTERCEPTOR
15" HDPE
15" HDPE
18" RCP
18" HDPE
PUDDING CREEK

J-4.0
84" & 18" CMP
Q_C= 449 cfs
Q_{10}= 170 cfs
Q_{100}= 242 cfs

84" CMP
18" CMP
OLD HAUL ROAD
NORTH HIGHWAY ONE
23"x14" RCP

J-2.0
24"x13" RCP
Q_C= 7 cfs
Q_{10}= 65 cfs
Q_{100}= 93 cfs

J-3.0
24"x13" RCP
Q_C= 9 cfs
Q_{10}= 210 cfs
Q_{100}= 300 cfs

23"x14" RCP

0 400' 800'
SCALE 1"= 400'

BASIN J

PUDDING CREEK RD.
PUDDING CREEK
AIRPORT RD
BURROWS RANCH RD.

J-1.0
30" RCP
Q_C= 43 cfs
Q_{10}= 44 cfs
Q_{100}= 62 cfs

30" RCP

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN

EXISTING CAPACITIES AND ESTIMATED FLOWS

DRAINAGE BASIN J

FIGURE 5-20

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

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LEGEND

NODE DESIGNATION
Node ID
(N) Improvement
PROPOSED IMPROVEMENT

EXISTING	NEW	
		OUTFALL
		MANHOLE
		DROP INLET
		HEADWALL

18" RCP — EXISTING (E) SD CONDUIT, PIPE MATERIAL, PIPE SIZE
42" SD — PROPOSED SD CONDUIT
DIRECTION OF FLOW
WATERWAY
DRAINAGE BASIN BOUNDARY
SUBBASIN BOUNDARY
CITY LIMITS

JOB # 03184302
DESIGN MK
DRAWN MK/SD

0 400' 800'
SCALE 1"= 400'

BASIN G
BASIN J
GLASS BEACH DR
STEWART ST
STORM WATER INTERCEPTOR
15" HDPE
15" HDPE
18" RCP
18" HDPE
PUDDING CREEK
OLD HAUL ROAD
NORTH HIGHWAY ONE
64" CMP
18" CMP
J-2.0
(N) 36" CULVERT
23"x14" RCP
J-3.0
(N) 48" CULVERT
23"x14" RCP
AIRPORT RD
BURROWS RANCH RD.
30" RCP
PUDDING CREEK RD.

CITY OF FORT BRAGG
2004 STORM DRAINAGE MASTER PLAN
PROPOSED IMPROVEMENTS

DRAINAGE BASIN J
FIGURE 5-21

WINZLER & KELLY
633 THIRD ST., EUREKA, CA

5.6 Georgia-Pacific Mill Site

The Georgia-Pacific (G-P) mill site in located in western Fort Bragg between Main Street and the Pacific Ocean, encompassing an area of approximately 430 acres, or about 25% of the City. Its location effectively isolates Fort Bragg from most coastal access points. The mill, which had been one of the cornerstones of the area's economy for the last 120 years, permanently closed operations in November 2002. After a year of preliminary studies and reuse planning for the property by G-P's consultants, the lumber company announced its intention to sell the property in November 2003. Since this time, G-P has been working closely with the City of Fort Bragg, as well as planners, economic development consultants, and the public to plan the future reuse of the site. Of particular interest in the scope of this Storm Drainage Master Plan is the log pond, which is located approximately in the center of the site, encompassing an area of about 10 acres.

The log pond was once the main stem of Alder Creek, which is now underground and part of the City's closed conduit storm drain system (see Drainage Basin D). When the mill site was developed in the late 19th and early 20th centuries the creek was dammed creating the pond. Approximately 30 percent of the City's stormwater from a 233-acre area (Drainage Basins C and D), as well as stormwater from the G-P site, are discharged into the log pond on its way to the Pacific Ocean. The log pond, which was once an integral part of the lumber mill's daily operations, has essentially become a wetland as a result of fill operations and sedimentation. It contains several types of aquatic emergent plants, and provides treatment to stormwater before it spills into the Pacific Ocean. Although no wetland studies have been done on the G-P log pond, stormwater treatment wetlands in general help remove pollutants by temporarily storing stormwater in shallow pools that create ideal growing conditions for wetland plants. The plants and associated microorganisms act to filter sediments, uptake nutrients, and biodegrade carbonaceous material.

Although still in the planning phase, any development plans need to address the importance of this drainage as a part of the City's stormwater system. In its present configuration the log pond likely provides for the removal of some pollutants (sediments, oils and grease) from the stormwater, even though that was not its primary function. The pond could be modified to improve its stormwater treatment capabilities. For example, creating a central park surrounding the log pond site, and redesigning the log pond into a series of ponds connected by small channels. Utilizing the log pond as part of the stormwater system while incorporating it into a park-like setting would have the benefit of improving the water quality of stormwater discharges and providing public recreational benefits such as picnic areas, trails, coastal access and wildlife viewing.

5.7 Capital Improvement Program

The purpose of the Capital Improvement Program (CIP) is to be a hands-on tool that is used by the City to plan subsequent work. The CIP prioritizes the 19 recommended and proposed drainage projects based on the following set of critical factors:

- Current flooding potential
- Long-term impacts on public safety
- Potential to reduce flooding or erosion
- Correction of structural deficiencies
- Cost-effectiveness
- Inclusion of BMPs
- Short-term construction impacts
- Impacts on operation and maintenance
- Potential to influence development, business growth, or create jobs

This method of assessing the relative value of the improvement projects is in adherence with the guidelines of the Government Accounting Standards Board Statement 34 (GASB-34). Adherence with these guidelines is an important step in protecting the City's bond rating.

The California Department of Transportation (Caltrans) is responsible for the drainage facilities along State Highway 1, which becomes Main Street within the Fort Bragg City limits. If Caltrans proposes a project in Fort Bragg that includes drainage facility improvements similar to those proposed in this Storm Drainage Master Plan, it may be possible to negotiate with them to either contribute funds to or construct part of the proposed improvement.

The drainage projects described in this chapter are summarized in Table 5-11. Figures 5-3, 5-5, 5-7, 5-9, 5-11, 5-13, 5-15, 5-17, 5-19 and 5-21show the location of the proposed improvements. Using the above set of critical factors, the proposed projects for each drainage area were assigned a high, medium or low priority ranking. In addition to these rankings, the table shows a recommended grouping of projects, and the order in which they should be completed. It is important to note that this priority ranking may change as conditions within each drainage basin change and as future development occurs. Also, developers typically fund development-driven projects in part or in full.

5.8 Recommended Channel Maintenance Program

A channel maintenance program is important for maintaining the design capacity of flood control channels and ditches. Channels should be designed with 1-foot of freeboard at the estimated 10-year flow. Once a channel is created, the hydraulic capacity of a channel is a function of the roughness of the channel. Debris and vegetation increase the roughness of the section and decrease the channel's hydraulic capacity.

Winzler & Kelly recommends the following channel maintenance program to ensure that drainage channels and ditches function as designed:

Biannual Maintenance

- Flood control channels and ditches: Trees and thick vegetation such as grasses, cattails and blackberry bushes should be removed within the banks. Channel floor and banks should be mown. Debris should be removed.

- Natural creeks and channels: Trees should be pruned such that the leaves are above the bank level. Thick vegetation such as grasses, cattails and blackberry bushes should be removed within the banks. Debris should be removed.

Five-Year Maintenance

- Flood control channels and ditches: Remove excess sediment to restore original channel dimensions.

Table 5-12 summarizes the primary channels and drainage ditches with recommended maintenance under the Channel Maintenance Program.

5.9 Noyo River Stormwater Discharges

According to the current Clean Water Act Section 303(d) List of Water Quality Limited Segments (2002), 144 miles of the Noyo River (Calwater Watershed No. 11320010) are listed as impacted by sedimentation/siltation from silviculture-related nonpoint sources, effecting water quality and aquatic life (sustainable populations of salmonids, coho salmon in particular). As such, the Noyo River was listed as a Total Maximum Daily Load (TMDL) High Priority water body. The sedimentation/siltation TMDL established for the Noyo River is 470 tons/mile^2/year, which includes background loading and load allocations for mass wasting from the railroad, mass wasting from timber harvest areas, and surface erosion from skid trails. The proposed TMDL completion is 2003 (year target TMDL is achieved). For more information on the Noyo River TMDL, refer to USEPA Region IX document titled *Noyo River Total Maximum Daily Load for Sediment*, dated December 16, 1999.

As of 2002, The State Water Resources Control Board (SWRCB) staff concluded that the water body should not be placed on the TMDLs Completed List because a plan to implement the TMDL has not been adopted or approved even though the TMDL has been approved by USEPA. The SWRCB is currently in the process of updating and revising the current List of Water Quality Limited Segments to assess the State's water bodies for possible inclusion on or removal from the existing list.

Although the established TMDL for the Noyo River does not include load allocations for specific point sources from urban areas, it is recommended that the City of Fort Bragg monitor known point source discharges to this water body for inputs of sediment and silt, and if necessary, implement Best Management Practices (BMP's) pertaining to each applicable Control Measure. Sources of sediment loading to storm drain systems within City Limits that discharge to the Noyo River should be identified and eliminated using suitable BMP's. Point source control methods, such as stormwater interceptors and filtering systems, may also be used where appropriate, however, their routine maintenance is important to ensure consistent functionality. For more information refer to Section 5.10 of this report and the City of Fort Bragg Storm Water Management Program.

TABLE 5-11 PROPOSED IMPROVEMENT PROJECTS FOR THE FORT BRAGG STORM DRAIN MASTER PLAN

Ranking H = High M = Medium L = Low Numbers indicate project order	**Node ID**	**Location**	**Existing Storm Drain Description**	**Improvement**	**Development Driven?**	**Cost**
H-1	F-1.4	Oak St.	6” & 12” RCP SD	Replace w/36” HDPE	YES	$593,900
H-1	F-1.5	Oak St.	18” RCP SD	Replace w/36” HDPE	YES	Included in F-1.4
H-1	F-1.6	Oak St.	24” RCP SD	Replace w/36” HDPE	YES	Included in F-1.4
H-1	F-1.7	Oak St.	30” RCP SD	Replace w/36” HDPE	YES	Included in F-1.4
H-1	F-1.9	Oak St.	18” RCP SD	Replace w/30” HDPE	YES	Included in F-1.4
H-2	H-1.0	Ocean View Dr.	18” CMP Culvert	Replace w/30” HDPE	YES	$67,300
H-3	I-1.0	Cedar St.	Ditch	Replace w/24” HDPE	YES	$180,800
H-4	G-1.11	Laurel St.	12” Cross Drain	Replace w/12” HDPE	NO	$49,700
H-5	E-1.0	Cedar St.	18” RCP SD	Replace w/36” HDPE	NO	$729,800
H-5	E-1.1	Lincoln St.	18” RCP SD	Replace w/30” HDPE	NO	Included in E-1.0
H-5	E-1.2	Alder St.	18” RCP SD	Replace w/30” HDPE	NO	Included in E-1.0
H-5	E-1.3	McKinley St.	18” RCP SD	Replace w/30” HDPE	NO	Included in E-1.0
H-5	E-1.4	Oak St.	18” RCP SD	Replace w/24” HDPE	NO	Included in E-1.0
H-5	E-1.5	Oak St.	18” RCP SD	Replace w/24” HDPE	NO	Included in E-1.0
H-5	E-1.6	Alley	18” RCP SD	Replace w/24” HDPE	NO	Included in E-1.0
H-5	E-1.7	Alley	18” RCP SD	Replace w/24” HDPE	NO	Included in E-1.0
H-5	E-1.8	Willow St.	18” RCP SD	Replace w/24” HDPE	NO	Included in E-1.0
H-6	D-1.1	Alder St.	30” CMP SD	Replace w/36” HDPE	NO	$78,100
M-7	H-1.2	Ocean View Dr.	12” CMP Culvert	Replace w/30” HDPE	YES	$118,300
M-7	H-1.4	Ocean View Dr.	18” CMP Culvert	Replace w/30” HDPE	YES	Included in H-1.2
M-7	H-1.6	Ocean View Dr.	12” HDPE Culvert	Replace w/24” HDPE	YES	Included in H-1.2
M-8	C-1.0	G-P log pond	36” RCP SD	Replace w/42” HDPE	NO	$228,300
M-9	C-1.4	Hazel St.	24” RCP SD	Replace w/30” HDPE	NO	$713,600
M-9	C-1.5	Hazel St.	18” RCP SD	Replace w/24” HDPE	NO	Included in C-1.4

Note: The developer typically funds development-driven project in part or in full.

TABLE 5-11 PROPOSED IMPROVEMENT PROJECTS FOR THE FORT BRAGG STORM DRAIN MASTER PLAN
(continued)

Ranking H = High M = Medium L = Low Numbers indicate project order	**Node ID**	**Location**	**Existing Storm Drain Description**	**Improvement**	**Development Driven?**	**Cost**
M-9	C-1.6	McPherson St.	18” RCP SD	Replace w/24” HDPE	NO	Included in C-1.4
M-9	C-1.7	Maple St.	18” RCP SD	Replace w/24” HDPE	NO	Included in C-1.4
M-9	C-1.8	Maple St.	18” RCP SD	Replace w/24” HDPE	NO	Included in C-1.4
M-9	C-1.9	Maple St.	18” RCP SD	Replace w/24” HDPE	NO	Included in C-1.4
M-9	C-1.10	Maple St.	18” RCP SD	Replace w/24” HDPE	NO	Included in C-1.4
M-9	C-1.11	Maple St.	18” RCP SD	Replace w/24” HDPE	NO	Included in C-1.4
M-10	D-1.5	McPherson St.	24” RCP SD	Replace w/30” HDPE	NO	$406,300
M-10	D-1.6	Harrison St.	24” RCP SD	Replace w/30” HDPE	NO	Included in D-1.5
M-10	D-1.7	Oak St.	24” RCP SD	Replace w/30” HDPE	NO	Included in D-1.5
M-10	D-1.8	Whipple St.	18” RCP SD	Replace w/24” HDPE	NO	Included in D-1.5
M-10	D-1.9	Oak St.	18” RCP SD	Replace w/24” HDPE	NO	Included in D-1.5
M-11	F-1.10	Oak St. and Sherwood Rd.	None	Install 30” HDPE	YES	$221,000
M-12	A-1.4.2	Park St. at Chestnut St.	None	Install 18” HDPE	YES	$65,400
M-13	A-4.2	South Street	None	Install 18” HDPE	YES	$119,500
M-14	J-2.0	Highway 1	23”x14” Oval RCP Culvert	Replace w/36” HDPE	YES	$59,700
M-14	J-3.0	Highway 1	23”x14” Oval RCP Culvert	Replace w/48” HDPE	YES	Included in J-2.0
L-15	A-1.3.1	South Whipple St.	12” RCP SD	Replace w/30” HDPE	NO	$508,600
L-15	A-1.3.1.1	South Whipple St.	12” RCP SD	Replace w/30” HDPE	NO	Included in A-1.3
L-15	A-1.3.1.2	Chestnut St.	12” RCP SD	Replace w/18” HDPE	NO	Included in A-1.3

Note: The developer typically funds development-driven project in part or in full.

TABLE 5-11 PROPOSED IMPROVEMENT PROJECTS FOR THE FORT BRAGG STORM DRAIN MASTER PLAN
(continued)

Ranking H = High M = Medium L = Low Numbers indicate project order	**Node ID**	**Location**	**Existing Storm Drain Description**	**Improvement**	**Development Driven?**	**Cost**
L-15	A-1.3.2.1	Chestnut St.	12” RCP SD	Replace w/18” HDPE	NO	Included in A-1.3
L-16	E-2.0	Laurel St.	18” RCP SD	Replace w/24” HDPE	NO	$89,800
L-17	G-1.5	Fir St.	39” RCP SD	Replace w/48” HDPE	NO	$73,700
L-17	G-1.6	Fir St.	39” RCP SD	Replace w/48” HDPE	NO	Included in G-1.5
L-18	G-1.1.2	Elm St.	24” HDPE SD	Replace w/30” HDPE	NO	$599,800
L-18	G-1.1.3	Stewart St.	18” RCP SD	Replace w/30” HDPE	NO	Included in G-1.1.2
L-18	G-1.1.4	Spruce St.	18” RCP SD	Replace w/24” HDPE	NO	Included in G-1.1.2
L-18	G-1.1.5	Spruce St.	18” RCP SD	Replace w/24” HDPE	NO	Included in G-1.1.2
L-18	G-1.1.6	Franklin St.	18” RCP SD	Replace w/24” HDPE	NO	Included in G-1.1.2
L-18	G-1.1.7	Bush St.	12” RCP SD	Replace w/18” HDPE	NO	Included in G-1.1.2
L-19	G-1.8	Franklin St.	30” HDPE SD	Parallel 30” HDPE	NO	$197,700
L-19	G-1.9	Pine St.	30” HDPE SD	Parallel 24” HDPE	NO	Included in G-1.8

Note: The developer typically funds development-driven project in part or in full.

Abbreviations: CMP = Corrugated Metal Pipe
HDPE = High-Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe

TABLE 5-12 CHANNELS MAINTAINED UNDER MAINTENANCE PROGRAM

Node ID	Figure Reference	Description	Design Capacity[1] (cfs)	Estimated Flow (cfs)	
				10-year	100-year
A-1.0	Figure 5-2	Natural channel	>1000	79	111
C-1.3.1.4	Figure 5-6	Ditch along PG&E Yard	23	9	13
C-1.11	Figure 5-6	Ditch between Lincoln St. and Park St.	N/A	3	5
F-1.2	Figure 5-12	Natural channel (Old duck pond)	386	73	109
F-1.1	Figure 5-12	Natural channel (Johnson Park)	364	82	122
H-1.9	Figure 5-16	Ditch on Ocean View Drive	40	15	21
H-1.7	Figure 5-16	Ditch on Ocean View Drive	40	19	26
I-1.2.2	Figure 5-18	Drainage ditch on foot path	8	2	3
I-1.2.1	Figure 5-18	Drainage ditch on foot path	5	4	5
I-1.0*	**Figure 5-18**	**Constructed channel**	**7**	**12**	**16**

Undersized facilities shown in **bold red type**.
[1]Design capacity or capacity in maintained state
*There is no known easement for this drainage channel.

5.10 Implementation of a City-Wide NPDES Permit

The Stormwater Phase II Final Rule requires operators of small municipal separate storm sewer systems (MS4s) to obtain a National Pollutant Discharge Elimination System (NPDES) permit by October 2003. An NPDES permit is required because stormwater discharges from these MS4s are considered "point sources" of pollution. The Phase II Rule is the follow-up to the Environmental Protection Agency's (EPA's) Phase I NPDES Program. The Phase II Program expands the Phase I program by requiring additional operators of MS4s in urbanized areas and operators of small construction sites, through the use of NPDES permits, to implement programs and practices to manage stormwater runoff.

Specifically, the Phase II Program applies to any operators of small MS4s located in "urbanized areas" as delineated by the Bureau of the Census. A "small" MS4 is any MS4 not already covered by Phase I of the NPDES stormwater program. Small construction sites covered by this Rule include those that are between 1 and 5 acres in size. The State of California Regional Water Quality Control Board (SRWQCB) is the regulatory agency with NPDES permit oversight authority.

In October 2003 the City of Fort Bragg submitted the Stormwater Management Program and Permit package and Notice of Intent to Comply to the SRWQCB Region I – North Coast Region office, as required by SWRCB Water Quality Order No. 2003-005-DWQ. The document contains the NPDES General Permit and outlines the Stormwater Management Program and the following Six Required Minimum Control Measures:

1. Public education and outreach;
2. Public involvement/participation;
3. Illicit discharge detection and elimination;
4. Construction site stormwater runoff control;
5. Post construction stormwater management in new development and redevelopment; and
6. Pollution prevention/good housekeeping for municipal operations.

BMPs are designated to each of the above Control Measures in order to meet the specific goals of the Measure. Refer to the City of Fort Bragg Stormwater Management Program FY 2003/04 to FY 2007/08 for the BMPs pertaining to each Control Measure. Appropriate measures from this Management Program should be incorporated whenever construction activities take place.

The fiscal impacts of implementing the Stormwater Management Program are expected to be greater than $500,000 over the next five years. One potential source of funding for the City's Stormwater Management Program is through an urban runoff management fee. The City of San Clemente was successful in implementing an urban runoff management/water quality program along with an urban runoff management fee. The fee was passed in accordance with Proposition 218 in November 2002, receiving 57% of the vote. Proposition 218, The Right to Vote on Taxes Act, was passed by California voters in 1996, and went into effect the following year. The intent of Proposition 218 is to ensure that all taxes and most charges on property owners are subject to voter approval. The program and associated fee were created as part of San Clemente's NPDES permit requirements. The revenue from this fee is used to fund structural urban runoff treatment projects to reduce pollution discharges along the San Clemente's beaches, street sweeping, capital projects to maintain and repair the storm drain system, water quality inspections and enforcement, and a public education and outreach program. Successful implementation of any program that falls under the requirements of Proposition 218 will require a well-organized public education and outreach campaign. In addition, the level at which any proposed fee is set will have a significant impact on the public's perception of the fee and the associated program. More information on the City of San Clemente's program may be found online at:

http://ci.san-clemente.ca.us/sc/Org/Dept/Engineering/WaterQ/

CHAPTER 6 – FUNDING AND FINANCING

6.1 General

The purpose of this Chapter is to explore the various methods of financing and administering the recommended projects set fourth in the Storm Drainage Master Plan and Capital Improvement Program. There are several factors to examine when considering potential funding for the proposed storm drainage facilities. These factors include the type of project, who the project will serve, the economic status of the service area, if there are any health or safety concerns, and the project's potential to create jobs.

There are several potential sources of funds for the City of Fort Bragg that would provide loans and/or grants to reduce the cost incurred by the City and/or its customers for implementation of a capital improvement project for stormwater management. Some of the more common grant and loan funding sources that have been used for storm drainage projects include the Economic Development Administration Public Works Program, Community Development Block Grants, and State Bond initiatives. These and other programs are discussed in more detail below.

6.2 Grants and Loans

Grants and loans are available through programs offered by various federal and state agencies. A description of the programs offered by each of these entities is provided here. It is important to note when considering the possibility of funding storm drainage projects through state and federal assistance programs that grant money is often severely limited, and competition for funds is intense. In addition, the future funding of these and other programs is dependent on the strength and condition of current state and federal budgets.

Economic Development Administration: The U.S. Department of Commerce Economic Development Administration (EDA) Public Works Program is designed to empower distressed communities in economic decline to revitalize, expand and upgrade their physical infrastructure to attract new industry, encourage business expansion, diversify local economics, and generate or retain long-term private sector jobs and investment. Those communities that demonstrate a "special need" for funding due to the closure or restructuring of industrial firms essential to area economics resulting in sudden job losses, or extraordinary depletion of natural resources, such as fisheries or timber, may increase their eligibility for funding under this program. For example, the uncertain future of the Georgia-Pacific mill site in Fort Bragg, and declines in timber and fisheries resources may significantly increase the City's ability to obtain funds through this program. EDA usually funds 50 percent of project cost, however certain conditions of high economic distress or an applicant's inability to provide the matching share may permit a higher grant rate. Interested applicants are encouraged to contact the appropriate EDA Regional Office or Economic Development Representative to discuss the proposal and obtain additional EDA program information, application instructions and forms. The EDA Program's Regional Office may be contacted at:

Economic Development Administration
Oregon and Northern California Office
One World Trade Center
121 S.W. Salmon Street, Suite 244
Portland, OR 97204
(503) 326–3078 (phone)

or

Economic Development Administration
Seattle Regional Office
Jackson Federal Building, Room 1890
915 Second Avenue
Seattle, WA 98174
(206) 220-7660 (phone)
(206) 220-7669 (fax)

Additional information may be obtained online at: http://www.eda.gov

Neighborhood Initiatives Grants: The U.S. Department of Housing and Urban Development (HUD) Community Planning and Development department provides Neighborhood Initiatives Grants for neighborhood revitalization and grant money for a variety of community and housing activities, specifically including improvement of distressed areas. Grant funds must be used to improve the conditions of distressed and blighted areas and neighborhoods, stimulate investment, economic diversification, and community revitalization in areas with population out-migration or a stagnating or declining economic base, or determine whether housing benefits can be integrated more effectively with welfare reform initiatives. The Neighborhood Initiatives Staff may be contacted at (202) 708-3773 (phone) or (202) 708-7543 (fax).

Rural Housing and Economic Development Program: The U.S. Department of Housing and Urban Development (HUD) Rural Housing and Economic Development (RHED) Program was created to build capacity at the State and local level for rural housing and economic development and to support innovative housing and economic development activities in rural areas. The RHED program allows for grant money to be spent on capacity building or support for innovative housing and economic development activities. Specifically, grants may be used for the development of infrastructure to support the housing or economic development activities, preparation of plans, architectural or engineering drawings, and the purchase of construction materials. Eligible applicants are local rural non-profit groups, community development corporations, state housing finance agencies, state community and/or economic development agencies, and federally recognized Indian tribes. After HUD publishes a Notice of Funding Availability for the Rural Housing and Economic Development program, applicants must submit specific information about a proposed project or activities in their application. After HUD makes conditional selections, applicants must then submit additional information. Funds made available under this program are awarded competitively on an annual basis, through a selection process conducted by HUD in consultation with the USDA. Grants of up to $400,000 are available. The RHED program office may be contacted at:

Office of Rural Housing and Economic Development
Office of Community Planning and Development (CPD)
U. S. Department of Housing and Urban Development
451 7th Street, SW, Room 7137
Washington, DC 20410
(202) 708-2290 (phone)

Additional information is available online at:

http://www.hud.gov/offices/cpd/economicdevelopment/programs/rhed/

Community Development Block Grants: State administered Community Development Block Grants (CDBG) are federal funds from the U.S. Department of Housing and Urban Development which are administered by the state through the local county to the local community. They are available to non-entitlement areas to fund public improvement projects. Non-entitlement areas are cities with populations of less than 50,000, and counties with populations of less than 200,000. There are two CDBG programs.

The first program is for Planning and Technical Assistance grants. These grants may be used for planning and evaluation studies related to any CDBG-eligible activity, including housing studies, public works, community facilities and economic development activities that meet CDBG national objectives and provide principal benefit to low-income persons. There are two sources of Planning and Technical Assistance funds: a General Allocation and an Economic Development Allocation. The General Allocation fund focuses on housing, public works, and community facilities. The Economic Development Allocation focuses on job creation and retention through business expansion and retention projects. The Planning and Technical Assistance grants provide up to $70,000 per year per jurisdiction, with no more than $35,000 allowed under the General Allocation and a maximum of $35,000 under the Economic Development Allocation. The projects funded must principally benefit a targeted income group, which is based on the most recent U.S. Census data.

The second program is for General Allocation grants. The primary goal of this program is to develop viable communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for persons of low- and moderate-income. The purpose of the program is to fund housing activities, public works, community facilities, and public service projects. Eligible activities include the costs of acquisition, construction, or installation of the public works project and site or other improvements. Grant applications are evaluated based on seven categories as follows:

- Poverty Index (100 points) – Percentage of population with incomes below the poverty level;
- Target Income Group (300 points) – Project beneficiaries who earn 80 percent or less of the county's median income;
- Need for Activity (200 points) – Documented need for the proposed project;
- Prior Performance Operating CDBG Grants (150 points) – Performance administering past CDBG Grants; criteria include timeliness of expenditures, reporting, closeout submittals, resolving outstanding audit issues, and the amount of income in hand;
- Capacity (150 points) – Ability to administer the proposed activities, based on experience on past grants and readiness to proceed;
- Leverage (50 points) – Documented commitments of additional (non-federal or state) funding;
- State Objectives (50 points) – Additional credit for grants addressing one or more state objectives.

Grants of up to $500,000 are available for eligible projects. State CDBG money is frequently combined with funding from other federal programs to finance the construction of public facilities and other improvement projects. Funds obtained through this program are usually distributed and paid back on the basis of an assessment. The Program's California State office may be contacted at:

State of California
Division of Community Affairs
2710 Gateway Oaks Drive
North Building - Suite 190
Sacramento, CA 95833
(916) 263-0485 (phone)
(916) 263-0489 (fax)

Additional information may be obtained online at: http://www.hcd.ca.gov/ca/

Clean Water State Revolving Fund Loans: Since 1987, the State Water Resources Control Board (SWRCB) has administered a revolving loan fund authorized by the Clean Water Act of 1987. Low interest loans are available to municipalities, nonprofit organizations and private parties through the Clean Water State Revolving Fund (SRF) Loan Program. Loans may be used to help pay for projects that address water quality problems associated with public and private non-point source discharges, stormwater treatment and water reclamation, and estuary enhancement. Some examples include construction of demonstration projects, retention/detention basins, wet ponds, infiltration strips, grassy swales or any other structures intended to remove pollutants originating from non-point sources. The SRF Loan Program is administered by the SWRCB, Division of Clean Water Programs. To be eligible for a loan or grant, the applicant must be a public agency and must be recommended for placement on the statewide priority list by the Department of Health Services or the local Regional Water Quality Control Board. The SRF will fund up to 97 ½ percent of eligible costs with a maximum loan amount of $50 million per agency per year, a 20-year payback period, and an interest rate of one-half the interest rate paid on the sale of the State's latest general obligation bonds. An agency can get a zero percent interest rate loan if the agency will supply funds equal to 16.7 percent of the eligible costs. The program is capitalized by grants from the U.S. Environmental Protection Agency (USEPA), and requires a 20 percent state match. The SRF Loan Program state and regional offices may be contacted at:

State Water Resources Control Board
Division of Financial Assistance
1001 I Street, 15th Floor
Sacramento, CA 95814
(916) 323-4201

or

State Water Resources Control Board
North Coast Region (1)
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403
(707) 576-2220 (phone)
(707) 523-0135 (fax)

Additional information may be obtained online at: http://www.swrcb.ca.gov/funding/index.html

Clean Beaches Initiative Grant Program: The SWRCB Clean Beaches Initiative (CBI) Grant Program provides grants to help local agencies and non-profit organizations implement projects

to meet current bacterial standards and improve the water quality of California's coastal waters with the goal of reducing or eliminating postings and closures at California's public beaches. Qualifying may be difficult depending on circumstances. The City must provide public use records and proof that the beach was closed during the year. Eligibility is determined as (Public user days per year) x (# of days beach was closed by health dept.). If the number is >50,000, the project will probably get funded. Projects are submitted to the Clean Beaches Task Force (CBTF) for review. The CBTF reviews all project proposals and make recommendations to the SWRCB for funding under the Clean Beaches Program. Eligible projects are placed on a Priority List and ranked according to the potential public health risk, whether the project addresses a specific pollution problem at a coastal beach, and the project location relative to the Coastal Zone. The CBI Grant Program office may be contacted at:

State Water Resources Control Board
Division of Clean Water Programs
1001 I Street, 16th Floor
Sacramento, CA 95814

Additional information may be obtained online at: http://www.swrcb.ca.gov/cwphome/beaches/

The Non-Point Source Implementation Grant Program: The 319 Program, also known as the Clean Water Act Section 319(h) Non-Point Source Implementation Grant Program, is an annually federally funded program administered by the SWRCB with the goals of reducing, eliminating, or preventing water pollution resulting from polluted runoff (i.e., non-point sources [NPS]) and to enhance water quality in impaired waters. The Noyo River is listed as an impaired water body in the State of California, as required by Section 303(d) of the Clean Water Act. This list describes water bodies that do not fully support all beneficial uses or are not meeting water quality objectives, and describes the pollutants for each water body that limit its use or prevent attainment of its water quality objectives. The Noyo River watershed was listed due to water quality problems related to sedimentation. Sedimentation was determined to be impacting the cold water fishery, a beneficial use of the Noyo River watershed, including the migration, spawning, reproduction, and early development of cold water fish such as Coho salmon and steelhead trout. Cold freshwater and estuarine habitats are also designated uses of the Noyo River watershed. Projects that show the potential to reduce non-point sediment loading to the Noyo River may be funded under this program. Approximately $5 to $6 million may be available for NPS implementation projects in California for each state fiscal year, and the amount is dependent on the funds available from USEPA. Nonprofit organizations, local government agencies including special districts (e.g., resource conservation districts or water districts), Indian Tribes, and educational institutions are eligible to receive 319 implementation funds. The California State 319 Grant Program office may be contacted at:

Lauma Jurkevics, Chief
Regional Programs Unit
State Water Resources Control Board (SWRCB)
Division of Financial Assistance, SWRCB
1001 I Street, 15th Floor, Sacramento, CA 95814
(916) 341-5498

Additional information may be obtained online at: http://www.swrcb.ca.gov/funding/index.html

Urban Streams Restoration Program: The California Department of Water Resources (DWR) Urban Streams Restoration Program assists communities in reducing damages from stream bank and watershed instability and floods while restoring the environmental and aesthetic values of streams, and to encourage stewardship and maintenance of streams by the community. Assistance is in the form of grants The Program will be making available $4.5 million in Proposition 40 funding for stream restoration projects for the Fall 2003 funding cycle. The Urban Streams Restoration Program office may be contacted at:

Margie Graham
North District
2440 Main Street
Red Bluff, CA 96080
(530) 529-7330 (phone)

or

Sara Denzler
Program Coordinator
P.O. Box 942836
Sacramento, CA 94236-0001
(916) 651-9625 (phone)

Additional information may be obtained online at:

http://www.watershedrestoration.water.ca.gov/urbanstreams/

California Coastal Conservancy Programs: The California Coastal Conservancy, established in 1976, is a state agency that uses entrepreneurial techniques to purchase, protect, restore, and enhance coastal resources, and to provide access to the shore. The Coastal Conservancy's Urban Waterfronts Program may be potential sources of grant funding for storm drainage projects in the immediate coastal areas of Fort Bragg. The urban waterfront program provides capital funds and technical assistance to protect, restore and expand coastal-dependent recreational, commercial and industrial facilities and to expand opportunities for public access and use of urban waterfronts in conjunction with new development, including the provision of technical assistance to landowners and local governments and through land acquisition and the construction and restoration of facilities. This is a promising source of funding, which has been used by the City in the recent past. In 2001 the Conservancy provided $1,256,000 to the City of Fort Bragg to acquire the Noyo Bluffs property, and to develop a management plan for this and the adjacent property. In 2003 the Conservancy provided a $125,000 grant to the City of Fort Bragg to conduct planning and feasibility studies for restoration and reuse of the Georgia-Pacific former mill site on the Fort Bragg waterfront, and a grant of $78,000 to conduct engineering and design of public access improvements at Pomo Bluffs Park on Todd Point. The Coastal Conservancy may be contacted at:

California Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, CA 94612
(510) 286-1015 (Phone)
(510) 286-0470 (Fax)

Additional information may be obtained online at: http://www.coastalconservancy.ca.gov/

Future State Loan and Grant Funding: Funding for existing and future State loan and grant programs may become available through the voter passed Proposition 40, the Clean Water, Clean Air, Safe Neighborhood Parks and Coastal Protection Act of 2002, and/or Proposition 50, the

Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002. Proposition 40 allows the State to borrow two billion six hundred million dollars ($2,600,000,000) through the sale of general obligation bonds for development, restoration, and acquisition of state and local parks, recreation areas and historical resources, and for land, air, and water conservation programs. Proposition 50 allows the State to borrow three billion four hundred forty million dollars ($3,440,000,000) through the sale of general obligation bonds for a variety of water projects including coastal protection, the CALFED Bay-Delta Program, integrated regional water management, safe drinking water, and water quality. The grant programs to disburse these funds have not yet been finalized. Proposals are expected out in the summer/fall of 2004 or later.

6.3 Other Financing Options

The following section describes other funding options available to the City which may be used to finance storm drainage projects. Some of these options include the formation of assessment districts, sales taxes, a general obligation bond, and drainage fees.

Formation of a Flood Control Benefit Assessment District: An assessment district is an area within a public agency's corporate boundaries containing parcels that will receive a special benefit from the construction of stormwater facilities. It does not have to incorporate the entire study area. Any property owner can petition for an assessment district. Assessment districts may be created by either a 50 percent majority voter approval among the owners of the property that would be benefited, weighted based on assessment, or by a unilateral action of the governing body. The sale of bonds secured by special assessment liens would be required unless all property owners elect to pay their assessments in cash. In recent years some storm assessments have been successfully passed by voter approval, however the yes vote was influence by a decrease in flood insurance fees paid by homeowners.

Proposition 218 Stormwater Property Fee, Special Tax, or Assessment: In November 1996 California voters passed Proposition 218 "The Right To Vote on Taxes Act". The intent of Proposition 218 is to ensure that all taxes and most charges on property owners are subject to voter approval. Proposition 218 restricts local governments' ability to impose assessments and property-related fees, and requires elections to approve many local government revenue raising methods. Under Proposition 218 the adoption of a property related fee requires a public hearing and voter approval, and is required to reflect the cost of service. This significantly impacted the ability of public agencies to levy charges for storm or floodwater management purposes. In order to impose a stormwater property fee under Proposition 218 an agency would hold a hearing 45 days after the mailing of notification of the establishment of the fee. If a majority of affected property owners submitted written protests to the proposed fee, it would be rejected. If a majority did not protest, then the agency would hold an election on the imposition of the fee to be decided by a majority of property owners or two-thirds of the electorate. A stormwater special tax or fee would require a two-thirds vote of the electorate and a stormwater assessment would require a two-thirds vote of electorate or majority of property owners by weight of assessment.

Sales Tax Funding: Funding by a sales tax is another voted option. In 1998 Napa County passed a one-half of one percent transaction and use tax titled the "Flood Protection Sales Tax." The County established a Flood Protection and Watershed Improvement Expenditure Plan describing the types of projects that qualify for funding with the proceeds of the Flood Protection Sales Tax. Authorization of a sales tax surcharge requires a two-thirds voter approval.

Creation of a Flood Control Funding Charge that Builds in Beneficiaries: This option would be a voted charge or assessment which creates consensus for a positive vote by building a block of beneficiaries over whom costs can be levied and/or support can be gained including: environmental concerns, habitat restoration, recreation facilities, streets, storm drains, and bike paths. The agency of a flood control district must first prepare a report containing a description and the amount of assessment of each effected parcel. Next, a public hearing is set to receive public comment, and any changes or modifications to the assessments are made and confirmed by resolution. A 50 percent majority voter approval is required before the district is authorized to levy these assessments. This approval may be secured by a district-wide election or by a special ballot mailed to each property owner or registered voter of the district or zone. This effort would require a complex, coordinated effort to build consensus between different advocacy groups on the elements of such a plan. This is not so much a solution in itself, but rather an option for helping to implement the options discussed above.

General Obligation (GO) Bond: A 20 or 30 year GO bond could be voted to pay for some or all of the capital improvements recommended in this Storm Drainage Master Plan. This would require a two-thirds vote of the public. A GO bond could only be used to fund capital costs. Only projects whose lives are greater than the tem of the financing can be funded using bonds. Any voted option would require substantial lead-time in order to mount a successful public education campaign in order to secure support.

Developer Financed Projects: Another method of financing new storm drainage projects is to hold the developer of a new subdivision responsible for storm drainage facility costs both on and off site. This option may include the requirement to connect to the nearest existing stormwater facility that is adequately sized to handle the increased flow. It may also require that off-site stormwater facilities be upsized for a distance downstream, depending on downstream development potential.

If additional upsizing is required above the sizing for the new development due to potential downstream development it may be appropriate to consider constructing a larger system. The added cost may be borne by the developer who can establish an agreement to be reimbursed as other developments connect to the system. Another option is for a public agency to advance the additional costs of upsizing drainage systems for potential future growth, and then collecting reimbursements as development occurs.

Drainage Development Fees: Under Chapter 12.14 of the Fort Bragg Municipal Code, the City requires that a one-time drainage fee associated with any construction or development project resulting in 120 square feet or more increase in impermeable area be paid prior to the City issuing a building permit for the project. These drainage fees were set fourth in an ordinance governing drainage facility improvements and drainage fees approved by the City Council of

Fort Bragg, and authorized by the Subdivision Map Act of the State of California. The ordinance describes the minimum storm drainage design requirements and the drainage fees associated with each land use zoning. Revenue from the drainage development fees is intended for use in the planning, design, construction, upgrade, and maintenance of new or existing drainage facilities which serve the new development. The revenue generated by the Drainage Development Fee varies from year to year, but averages about $30,000 per year. Since 1998 the City has collected approximately $200,000 in drainage fees.

Table 6-1 summarizes the current Drainage Fee Schedule and runoff coefficients "C" for each land use zone (adjusted 1/1/2004). The Drainage Fee Schedule is updated on January 1 of each year, based on the change in the Engineering News-Record (ENR) 20-City Construction Cost Index over the prior year.

TABLE 6-1 CITY OF FORT BRAGG DRAINAGE FEE SCHEDULE

Land Use Zoning		Runoff Coefficient "C"	Drainage Fee	
			Per Acre	Per Sq Ft
RESIDENTIAL				
RR5	-Large Lot Rural Residential	0.35	$726	$0.0167
RR2	-Medium Lot Rural Residential	0.35	$726	$0.0167
RR1	-Rural Residential	0.40	$829	$0.0790
SR	-Suburban Residential	0.40	$829	$0.0190
R1	-Low Density Residential	0.55	$1,803	$0.0414
R2	-Medium Density Residential	0.70	$2,660	$0.0611
R3	-High Density Residential	0.75	$2,131	$0.0489
R4	-Very High Density Residential	0.85	$2,846	$0.0653
COMMERCIAL				
CBD	-Central Business District	0.85	$3,816	$0.0876
C1	-Neighborhood Commercial	0.85	$3,816	$0.0876
C2	-General Commercial	0.85	$3,816	$0.0876
C3	- Highway and Visitor Commercial	0.85	$3,816	$0.0876
C4	-Office Commercial	0.85	$3,816	$0.0876
INDUSTRIAL				
LI	-Light Industrial	0.85	$3,816	$0.0876
HI	-Heavy Industrial	0.90	$4,039	$0.0927
TRI	-Timber Resources Industrial	0.90	$4,039	$0.0927
SPECIAL ZONES				
HD	-Harbor District	0.85	$3,816	$0.0876
PR	-Parks and Recreation	0.25	$469	$0.0108
PF	-Public Facilities	0.35	$469	$0.0108
OS	-Open Space	0.20	$389	$0.0089
A	-Agricultural	0.30	$469	$0.0108

Fees became effective April 25, 1990
Adjusted by ENR Construction Cost Index January 1st of each year beginning in 1994.

When a new subdivision is to be developed, the subdivider is required to pay 100 percent of the drainage fees due at the time of issuance of the building permit. Subdivision drainage fees are determined by multiplying the Base Fee per acre by the gross area of the subdivision, excluding areas within the public right of way, and multiplying this product by the runoff coefficient "C" designated to the subdivision.

Drainage Maintenance Fees: Some cities have passed ordinances that allow a maintenance fee be charged for storm drainage facilities, similar to a water or sewer charge. A stormwater drainage maintenance fee could be paid along with sewer and water charges, or it could be paid with taxes. The charge for residential users is typically based on lot size and the average amount of impervious surface area, with separate rate structures for urban and rural residential, commercial and industrial sites. The fee for industrial and commercial users may be developed case by case based on known impervious area. However, local governments must make sure that no property owner's fee is greater than the proportionate cost to provide the property-related service to the customer's parcel.

Should the City decide to try to implement a storm drainage maintenance fee, it may also be necessary to create a stormwater drainage enterprise and utility to administer the City's stormwater drainage facilities, and a stormwater drainage fund to provide funding for stormwater drainage maintenance. The purpose of the enterprise and utility is to collect and manage stormwater maintenance fees from property owners. The stormwater drainage fund is a separate account where the fees are deposited for use in future storm drainage projects and maintenance. Municipalities typically provide a provision that allows property owners to reduce their fees based on the type of impervious surface area on the parcel, or whether the customer has implemented approved runoff control measures. The City's existing Drainage Development Fee should also be grouped with the proposed stormwater drainage enterprise and utility so that funds from this source are deposited with those from with the proposed storm drainage maintenance fee.

The creation of a stormwater drainage enterprise and utility, and any associated fees will be subject to the requirements of Proposition 218. Exemptions to the Proposition 218 rules include water, sewer and garbage services, but not storm drainage related services. If the City chooses to adopt a storm drainage fee and comply with Proposition 218, both property owner and voter approval are required. Property owners must be given the opportunity to register their approval or protest at a public hearing. If there is not a majority protest of those property owners, the fee must be submitted to the voters for approval. The following requirements apply to such a fee:

- Revenues from the fee may not exceed the funds required to provide the property-related services;
- Revenues may not be used for any purpose other than that for which the fee was imposed; and
- The amount of the fee may not exceed the proportional cost of the service attributable to the parcel.

Within the past 15 years, several cities throughout the State of California have created stormwater drainage enterprises and utilities, and regularly collect storm drainage maintenance fees from property owners. However, of those City's who successfully implemented such fees, all were created prior to the passage of Proposition 218. These include the City of Arcata, the City of Santa Clarita, the City of San Diego, and the City of Palo Alto. The City of Salinas and the City of Oakland tried unsuccessfully to establish storm drainage fees post-Proposition 218. Residences of both cities fiercely opposed the proposed fee. In light of this history, it may be difficult for the City of Fort Bragg to implement such a utility and property-based fee, particularly with regard to the area's depressed economy and the fact that the City's median household income is below the poverty level. Successful implementation of any program that falls under the requirements of Proposition 218 will require a well-organized public education and outreach campaign. In addition, the level at which the proposed fee is set will have a significant impact on the public's perception of the fee.

A sample stormwater drainage ordinance for the City of Fort Bragg is included in Appendix A.

Appendix A
Drainage Maintenance Fee Ordinance

DIVISION 1 - STORM DRAIN MAINTENANCE FEES

ARTICLE 1 - GENERAL PROVISIONS

SECTION I. Purposes and Findings

1. The Council finds that due to its climate, terrain, and geographical location, the City is subject to damage from storm waters, which, from time to time, overflow existing watercourses and drainage facilities. Accordingly, a system of storm water drainage collection control and management must be maintained and operated by the City. The purpose of this ordinance is therefore to create a stormwater drainage enterprise and utility and to establish a fund with which to improve, operate, and maintain stormwater drainage facilities appurtenant to such an enterprise and utility.

2. The Council finds that storm and surface water runoff is increased due to impervious surface development. Consequently, each owner of a lot or parcel of real property within the City makes use of and is served by the City's stormwater drainage facilities by contributing stormwater runoff in excess to that which would occur if the real property were undeveloped. The City's existing drainage facilities must be improved, operated, and maintained in order to service stormwater drainage from existing development. In addition, new development will contribute additional stormwater drainage for which the capacity of the City's drainage facilities will need to be increased.

3. The Council, therefore, finds that there is a reasonable relationship between the costs of operating and maintaining storm water drainage facilities and existing development. Accordingly, existing development should contribute to the cost of operating and maintaining storm water drainage facilities in an amount related to the amount of impervious surface area found on any particular parcel.

SECTION II. Definitions

Unless the context requires otherwise, the definitions in this section govern the construction of this chapter. The definition of a word applies to any of that word's variants.

1. "Developed parcel," means any lot or parcel of land altered from its natural state by the construction, creation, or addition of impervious surface area.

2. "Impervious surface area" means any part or any developed parcel of land that has been modified by the action of persons to reduce the land's natural ability to absorb and hold rainfall. This includes any hard surface, which either prevents or retards the entry of water into the soil as it entered under natural conditions preexistent to development, and/or a hard surface area, which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions preexistent to development. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, or any cleared, graded, paved, graveled,

or compacted surface or packed earthen materials, or areas covered with structures or other surfaces which similarly impede the natural infiltration of surface water into the soil.

4. "Storm water drainage facilities" means the storm and surface water drainage systems comprised of storm water control facilities and any other natural features, which store, control, treat, and/or convey storm and surface water. Storm water drainage facilities shall include all natural and constructed elements used to convey storm water from the first point of impact with the surface of the earth to a suitable receiving body of water or location, internal or external, to the boundaries of the City. They shall include all pipes, appurtenant features, culverts, streets, curbs, gutters, pumping stations, channels, streams, ditches, wetlands, detention/retention basins, ponds, and other storm water conveyance and treatment facilities whether public or private. Regardless of whether or not the City shall have recorded rights-of-way or easements, it is presumed that the City has a prescriptive right of access to all storm drainage facilities for operation, maintenance, rehabilitation, or replacement.

SECTION III. Creation of an Enterprise and Utility

There is hereby created and established a Stormwater Drainage Enterprise and Utility of the City which shall administer the City's stormwater drainage facilities.

SECTION IV. Administration

The Storm Water Drainage Fee shall be administered by the Director of Public Works, except where specifically designated otherwise in this chapter.

SECTION V. Application

Fees for the use in improving the City's storm water drainage facilities shall apply to all developed parcels within the City, including those classified as nonprofit or tax-exempt for ad valorem tax purposes. Such fees shall apply to all government properties, to the full extent permitted by the Constitutions of the United States and the State of California, including developed parcels of the City, such as City-owned buildings, parks, and streets. Fees imposed by this chapter shall not be levied against undeveloped parcels that have not been altered from their natural state as defined herein under (c) "impervious surface area."

SECTION VI. Storm Drainage Master Plan

1. The Director of Public Works shall, as soon as practicable, adopt the Storm Drainage Master Plan for the City. The Storm Drainage Master Plan shall describe all major natural and constructed drainage ways within the City, including the boundaries of natural drainage courses presently existing within the City, and shall identify all storm water drainage facilities required to provide for the drainage and control of surface and storm water runoff within the City to carry such waters to the designated points of discharge. The Master Drainage Plan shall evaluate operational and maintenance requirements and improvements needed to the City's storm drainage facilities to insure adequate operation at existing levels of development. In addition, the Storm Drainage Master Plan shall identify capacity limits of the storm water

drainage facilities and establish standards for determining additional capacity needs to service new development.

2. The Storm Drainage Master Plan shall be revised and updated on a regular basis as needed by new development and/or changing conditions.

3. The Storm Drainage Master Plan and all revisions thereto shall be adopted by the City Council after public hearing.

ARTICLE 2 - STORMWATER DRAINAGE DEVELOPMENT FEE

SECTION I. Stormwater Drainage Development Fee

The drainage development fee shall be deposited in a stormwater drainage fund and shall be accounted for in accordance with the provisions set forth in this chapter.

Refer to Chapter 12.14 of the Fort Bragg Municipal Code for more information on the Stormwater Drainage Development Fee.

ARTICLE 3 - STORMWATER DRAINAGE MAINTENANCE FEE

SECTION I. Stormwater Drainage Maintenance Fee

There is hereby imposed on each and every developed parcel of land within the City, and the owners thereof, a storm water drainage maintenance fee which shall be payment for use of the City's storm water drainage facilities by the real property on, and with respect to which the charge is imposed, and the owners thereof. Said storm water drainage maintenance fee is deemed reasonable and necessary to pay for the operation, maintenance, improvement and replacement of the existing City storm water drainage facilities.

SECTION II. Determination of Annual Cost

The total cost of operating, maintaining, repairing, and replacing the existing storm water drainage facilities of the City shall be determined on an annual basis by the Director of Public Works. This annual cost shall be presented to the Council for adoption as part of the annual budget process.

SECTION III. Determination of Fee

1. The storm water drainage maintenance fee shall be determined based on the total impervious surface area in or on the parcel of real property. The Director of Public Works shall determine the total impervious surface area in or on the real property of each parcel by any one of the following methods:

(1). On-site measurements of the impervious surface area in or on such real property;

(2). Computation of the impervious surface area using the dimensions of the impervious surface areas in or on the real property which are set forth and contained in the records of the City;

(3). Estimation, calculation and computation of the impervious surface areas using aerial photography or photogrammetry, or using the information and data from on-site measurements of like or similar property or features or as contained in the records of the City which set forth certain characteristics of the improvements on such real property.

2. The storm water drainage maintenance fee shall be established by ordinance based on the total annual cost of maintaining and operating the storm water drainage facilities, as adopted by the Council, and on the amount of impervious surface area for any particular parcel.

SECTION IV. Proportional Reduction of Storm Water Drainage Fee

1. The storm water drainage maintenance fee may be reduced by the Director of Public Works based on: (1) The type of impervious surface area on a particular developed parcel; or, (2) whether approved runoff control measures have been taken.

2. Rate reduction shall occur on a case-by-case basis and shall reflect the extent to which the type of impervious surface area or alternate control measures reduce or eliminate use of the City's storm water drainage facilities. The burden of establishing the reduced extent of contribution to the City's Storm water Drainage Enterprise and Utility shall be on the property owner. The Director of Public Works may require the property owner to present an engineered drainage plan or any other technical information, which may be needed to support the request for fee reduction.

SECTION V. Collection of Storm Water Drainage Fee

The storm water drainage maintenance fee shall be billed every six (6) months by the City to the property owner. Said fee shall be due and payable upon presentation of bill.

SECTION VI. Penalties, Lien

1. All storm water drainage maintenance fees not paid thirty (30) days after the billing date shall be assessed a basic penalty of ten percent (10%) and an additional interest charge of one and one-half percent (1.5%) per month.

2. If the fee and penalties remain delinquent for a period of sixty (60) days after the billing date, the amount due including penalty and interest charges shall become a lien on the property provided that the City has given notice to the property owner as shown on the latest equalized assessment roll of the delinquent charges and lien herein. The lien shall have no force or effect until a certificate specifying the amount of the unpaid charges is recorded with the County Recorder and when so recorded shall have the force, effect, and priority of a judgment

lien and continue for three (3) years from the time of recording unless sooner released or otherwise discharged.

SECTION VII. Administrative Review

1. A property owner who disputes the amount of a storm water drainage fee imposed against his or her parcel pursuant to this chapter may file a written request with the Director of Public Works to review the fee imposed. At the discretion of the Director of Public Works, the requesting party may be required to present an engineered report and/or survey showing information relevant to the request such as the total property area, the impervious surface area, and any other features or conditions which influence the drainage or storm and surface water runoff from the property.

2. The Director of Public Works shall conduct a technical review to determine if an adjustment of the fee is in conformance with the provisions of this ordinance. At the conclusion of the review, the Director of Public Works shall issue a written determination stating whether a fee reduction is appropriate and, if so, the amount of such reduction. All decisions of the Director of Public Works shall be served on the property owner personally or by certified mail.

3. A property owner may appeal the decision of the Director of Public Works to the City Council within thirty (30) days after service of the Director of Public Works' written decision. Notice of appeal shall include a description of the general grounds for the appeal. The Council shall conduct a public hearing to consider the testimony of the appealing party. After public hearing, the Council may affirm or modify the decision of the Director of Public Works, provided that any modification of the fee is in conformance with the provisions of this ordinance.

ARTICLE 4 - STORMWATER DRAINAGE FUND

SECTION I. Establishment of Stormwater Drainage Fund

1. A stormwater drainage fund is hereby established to provide funding for stormwater drainage maintenance. The fund may be expended for the following:

(1) All activities and resultant expenses associated with the maintenance and operation of the Stormwater Drainage Enterprise and Utility;

(2) Capital expenses associated with the repair, replacement, and capital improvement of the Stormwater Drainage Enterprise and Utility;

(3) All expenses associated with maintenance, operation, and capital requirements of any stormwater drainage facility which may be required by state or federal law; and

(4) All expenses for activities directly related to any of the foregoing.

SECTION II. Stormwater Drainage Fund Management

1. Each development project for which drainage development fees are collected in accordance with this chapter shall be managed within the stormwater drainage fund in such a manner as to allow tracking for each fiscal year of the beginning and ending balance, fees collected, other sources of income, interest accumulated, expenditures made, and refunds paid out.

2. Within sixty (60) days of the close of each fiscal year, the City shall make available to the public the information listed in subsection A.

3. The Council shall review the information made available to the public pursuant to this section at the next regularly scheduled council meeting not less than fifteen (15) days after the information is made available to the public. Notice of the time and place of the Council meeting, including the address where this information may be reviewed, shall be mailed at least 15 days prior to the meeting to any interested party who files a written request with the local agency for a mailed notice of a meeting.

SECTION III. Annual Findings, Refunds

1. The Council shall make findings each fiscal year with respect to any portion of drainage development fees remaining unexpended or uncommitted in the stormwater drainage maintenance fund five (5) or more years after deposit to identify the purpose to which the fee is to be put and to demonstrate a reasonable relationship between the fee and the purpose for which it was charged.

2. The Council shall authorize refunds to the then current record owner of the lots or units of a development project on a prorated basis of the unexpended or uncommitted portion of the fee, and the interest accrued thereon, for which need cannot be demonstrated pursuant to subsection 1. The Council may authorize refund by direct payment, by providing a temporary suspension of fees, or by any other means consistent with this chapter.

3. If the administrative costs of refunding unexpended or uncommitted revenues pursuant to this section exceed the amount to be refunded, the City, after a noticed public hearing where notice is published and posted in three prominent places within the area of the development project, may determine that the revenues shall be allocated for some other purpose for which the fees are collected, but which serves the project on which the fee was originally imposed.

ARTICLE 5 - MISCELANEOUS PROVISIONS

SECTION I. Limitations of Responsibility

1. The City shall be responsible only for the portions of the Stormwater Drainage Enterprise and Utility, which are in City-maintained street rights-of-way, and permanent stormwater drainage easements conveyed to and accepted by the City. Repairs and improvements to the stormwater drainage facilities shall be in accordance with established standards, policies, and schedules.

2. The City's acquisition of stormwater drainage easements and/or the construction or repair by the City of stormwater drainage facilities does not constitute a warranty against Stormwater hazards, including, but not limited to, flooding, erosion, or standing water.

SECTION II. Unlawful to Obstruct Flow of Stormwater Runoff

It shall be unlawful for any person to place, cause to be placed, or permit to be placed, any obstruction on or within any portion of the Stormwater Drainage Enterprise and Utility. For purposes of this section, "obstruction" shall mean anything, which, by itself or in conjunction with any other thing or things, impedes or tends to impede the flow of stormwater.

SECTION III. Severability

If any section or sections of this ordinance is or are held to be invalid or unenforceable, all other sections shall nevertheless continue in full force and remain in effect.

ARTICLE 5 - STORM WATER DRAINAGE MAINTENANCE FEE SCHEDULE

SECTION I. Determination of Storm Water Drainage Maintenance Fee

1. The storm water drainage maintenance fee shall be computed for a six-month period as a product of the Equivalent Impervious Surface Area, as defined in this Article, and the Unit Rate, as specified in this Article.

SECTION II. Equivalent Impervious Surface Area. (Ordinance No. _____)

1. The Equivalent Impervious Surface Area is the multiplication factor to be applied to the Unit Rate specified in this article.

2. For single-family residential parcels, including duplex parcels, the Equivalent Impervious Surface Area is based on existing data for the City and shall be 2500 square feet.

3. For non-single-family residential parcels, the Equivalent Impervious Surface Area shall be the actual total impervious area for the parcel.

SECTION III. Unit Rate

The storm water drainage maintenance fee Unit Rate is $0.005 per square foot for each six-month period. (Ordinance No. _____)

Appendix B
Example Rational Method Calculations

Rational Method for Calculating Stormwater Runoff

The following pages summarize the Rational Method for calculating stormwater runoff used in the hydrology analysis of this report. The summary includes step-by-step instructions for computing runoff using area, flow type (overland or pipe flow), time of concentration, precipitation intensity, and the runoff coefficient "C". An example calculation for Drainage Area D is provided on the last page.

Step 1: Within the drainage basin, determine the area, A (in acres), associated with each land use for each sub-basin (i.e. point of concentration). Calculate the composite runoff coefficient, $C_{composite}$, for the entire basin. Enter the total sub-basin area in Column 12, and enter the composite runoff coefficient in Column 2. Use the equation below to calculate the composite runoff coefficient:

$$C_{composite} = \frac{\sum_{i=1}^{n} C_i A_i}{\sum_{i=1}^{n} A_i}$$

where:
- i = Sub-basin
- C_i = Runoff Coefficient "C" for Sub-basin i
- A_i = Area of Sub-basin i
- n = Total Number of Sub-basins.

Step 2: Calculate the cumulative upstream area for each sub-basin (point of concentration), and enter the value in Column 13. The cumulative area is equal to the area of the sub-basin plus the total upstream area contributing to runoff seen at that point of concentration.

Step 3: Determine the runoff travel distance (longest travel distance for runoff) and elevation change (change in elevation over the travel distance) for each sub-basin. Enter the elevation change for each sub-basin in Column 3, and enter the travel distance for each sub-basin in Column 4.

Step 4: Calculate travel slope. If flow is overland flow (only at the upper most sub-basin(s)), then the slope is equal to the elevation change divided by the travel distance. If flow is in a pipe, enter the slope of the pipe. Enter the value of the slope in Column 5.

Step 5: Calculate the estimated flow rate. Assume 1.0 cubic foot per second (cfs) of flow for every acre of contributing area. The estimated flow rate should equal the cumulative upstream area for each sub-basin (Column 13). This value is used to determine a "ball park" estimate of the flow. This estimate should be somewhere between the 10-year and 100-year flow, plus or minus 5 cfs. Enter the estimated flow rate in Column 6. The estimated flow rate is used to calculate the overland flow velocity (Step 6).

Step 6: Enter the Manning's "n" roughness coefficient corresponding to the pipe material upstream of and including each point of concentration in Column 7 (if applicable). Refer to "notes" column for pipe material.

Step 7: Calculate the hydraulic radius of the pipe, R, if applicable using the following equation, and enter the value in Column 8:

R = D/4 = Hydraulic Radius of Pipe (ft)
D = Pipe Diameter (ft)

Refer to the "notes" column for pipe sizes.

Step 8: Calculate the flow velocity, and enter the value in Column 9. If flow is overland, use the following equation:

$$V = 5.46 \cdot S^{0.486} \cdot Q^{0.3287}$$

where: V = Velocity (ft/sec)

S = Slope (ft/ft)

Q = Estimated Flow Rate (cfs)

If flow is within a pipe, use Manning's equation with appropriate roughness coefficient:

$$V = \frac{1.49}{n} \cdot R^{2/3} \cdot S^{1/2}$$

where: n = Manning's Roughness Coefficient (unitless)

Step 9: Calculate the travel time in minutes (time of concentration for each sub-basin), and enter the value in Column 10. The travel time is equal to the runoff travel distance (Column 4) divided by the flow velocity (Column 9), with the appropriate unit change. Add 10 minutes to the travel time for the upstream most area for conservativeness and to ensure that the time of concentration is *at least* 10 minutes.

Step 10: Calculate the total travel time, and enter the value in Column 11. The total travel time is a cumulative time of concentration. It is determined by adding the time required for water to travel from the upstream point of concentration to the downstream point of concentration to the previous inlet time, similar to the cumulative upstream area (Step 2). The highest inlet time is always carried through to the next downstream area. This cumulative inlet time is the time of concentration for the entire upstream area contributing to the flow at that point of concentration.

Step 9: Enter values for the coefficient K in Column 14. The coefficient, K, is a factor used to maintain unit consistency, and is equal to 1.0 ft^3/s per acre·in/hr for U.S. Standard Units. For S.I. units, K equals 0.00278 m^3/s per hectare·mm/hr.

Step 10: Calculate the values of KAC, and enter them in Column 15. That is, the coefficient K (Column 14) multiplied by the area A (Column 12) multiplied by the composite runoff coefficient (Column 2).

Step 11: Calculate the cumulative values of ΣKAC, and enter them in Column 16. For each sub-basin, the value of ΣKAC is equal to the value of ΣKAC for the upstream sub-basin plus the value of KAC for the current sub-basin. At the most upstream sub-basin, the value of ΣKAC equals KAC.

Step 12: From the Intensity-Duration-Frequency curves, determine the precipitation intensities (in/hr) for the 10-year and 100-year events corresponding to the total travel times in Column 11 (times of concentration). Enter the 10-year intensities in Column 17 and the 100-year intensities in Column 19.

Step 13: Calculate the estimates for 10-year and 100-year runoff by multiplying the value of ΣKAC in Column 16 by the precipitation intensities in Column 17 and Column 19, respectively. Enter the 10-year runoff in Column 18 and the 100-year runoff in Column 20.

Sample Rational Method Calculations

Drainage Basin D

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11
					Estimated				Time of Concentration (min)	
Point of Concentration (Node ID No.)	Composite Runoff Coeff., C	ΔElev (ft)	ΔDist (ft)	Slope (ft/ft)	Q (cfs)	Manning "n"	Hydraulic Radius, R (ft)	Velocity (ft/s)	Travel Time (min)	Total Time (min)
1.11	0.49	13	1160	0.011	20.1	N/A	N/A	1.7	21.7	Initial
1.10	0.57	9	800	0.011	27.7	N/A	N/A	1.8	7.3	29.0
1.9	0.66	16	772	0.023	41.8	0.013	0.375	9.1	1.4	30.4
1.8	0.72	16	162	0.021	54.4	0.013	0.375	8.6	0.3	30.7
1.7	0.65	9	341	0.025	62.5	0.013	0.500	11.5	0.5	31.2
1.6	0.85	8	66	0.018	69.8	0.013	0.500	9.6	0.1	31.3
1.5	0.79	15	317	0.017	78.4	0.013	0.500	9.3	0.6	31.9
1.4	0.85	10	512	0.026	82.6	0.013	0.625	13.6	0.6	32.5
1.3	0.85	26	184	0.024	92.6	0.015	0.875	14.0	0.2	32.7
1.2	0.85	9	430	0.010	95.9	0.015	0.875	8.9	0.8	33.5
1.1.2	0.85	10	360	0.028	2.4	N/A	N/A	0.3	27.7	Initial
1.1.1	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
1.1	0.85	20	292	0.009	100.5	0.024	0.500	5.4	0.9	33.6
1.0	N/A	N/A	N/A	N/A	100.5	N/A	N/A	N/A	N/A	N/A

Column 1	Column 12	Column 13	Column 14	Column 15	Column 16	Column 17	Column 18	Column 19	Column 20	Notes
		Total				10-Year		100-Year		
Point of Concentration	Area (acre)	Area (acre)	K	KAC	Σ(KAC)	Intensity (in/hr)	Discharge (cfs)	Intensity (in/hr)	Discharge (cfs)	
1.11	20.14	20.14	1.00	9.79	9.79	1.49	14.6	2.10	20.6	Overland Flow
1.10	7.58	27.72	1.00	4.31	14.10	1.28	18.0	1.78	25.1	Overland Flow
1.9	14.03	41.75	1.00	9.28	23.38	1.24	29.0	1.74	40.7	18" RCP
1.8	12.60	54.35	1.00	9.03	32.41	1.24	40.2	1.74	56.4	18" RCP
1.7	8.12	62.47	1.00	5.24	37.65	1.23	46.3	1.72	64.8	24" RCP
1.6	7.36	69.83	1.00	6.26	43.91	1.23	54.0	1.72	75.5	24" RCP
1.5	8.52	78.35	1.00	6.71	50.62	1.22	61.8	1.71	86.6	24" RCP
1.4	4.24	82.59	1.00	3.60	54.22	1.21	65.6	1.70	92.2	30" RCP
1.3	10.00	92.59	1.00	8.50	62.72	1.20	75.3	1.69	106.0	42" HDPE
1.2	3.27	95.86	1.00	2.78	65.50	1.19	77.9	1.68	110.0	42" HDPE; Adds to POC 1.1
1.1.2	2.36	2.36	1.00	2.01	2.01	1.31	2.6	1.82	3.7	Overland Flow
1.1.1	0.00	2.36	1.00	N/A	N/A	N/A	2.6	N/A	3.7	24" HDPE; Flows to POC 1.1
1.1	5.55	103.77	1.00	4.72	72.23	1.18	85.2	1.67	120.6	30" CMP
1.0	0.00	103.77	1.00	N/A	N/A	N/A	85.2	N/A	120.6	36" RCP; Outlet

Note: Assumed POC-1.1.2 is the only inflow contributing to POC-1.1.1
Note: No additional inflow to POC-1.0
Note: Red text indicates flow in pipe conduit

Appendix C
StormCAD Hydraulic Model Results

Appendix D
HEC-RAS Hydraulic Model Results

Appendix E
Project Cost Estimate Details

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin A: Park Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,696	1,696
		Insurance	1	LS	0.025	848	848
		Bonding	1	LS	0.025	848	848
		Contractor O&P	1	LS	0.150	5,089	5,089
		Sales Tax	1	LS	0.050	1,696	1,696
Subtotal						10,177	10,177
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	233	CY	6.00	1,400	1,400
	02315 100 1900	Backfill	214	CY	7.00	1,496	1,496
	02315 100 2200	Compacting (Vibrating Roller)	126	CY	5.00	632	632
	02315 130 0050	Bedding (River Run)	130	TON	18.00	2,334	2,334
	02320 200 0200	Hauling/Disposal (Excess Excavation)	78	CY	10.00	782	782
02500	02530 730 2030	HDPE Piping (18" Laid in Trench)	300	LF	25.00	7,500	7,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	58	TON	22.00	1,271	1,271
	02740 300 0200	AC Pavement (4")	33	TON	80.00	2,610	2,610
	02766 550 0200	Pavement Markings (6")	600	LF	1.50	900	900
		New Drop Inlets	2	EA	2,500.00	5,000	5,000
		Traffic Control	1	LS	10,000.00	10,000	10,000
Subtotal						33,924	33,924
Subtotal							$33,924
Division 010							$10,177
Construction Subtotal							$44,101
Cost per LF HDPE Installed							$147
20% Contingency							$8,820
25% Legal, Admin., Engineering							$11,025
Total Cost of Project							$63,946
20% Bonding							$12,789
Total Estimated Cost							**$76,735**
Total Cost per LF HDPE							**$256**
						CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin A: Chestnut Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	11,242	11,242
		Insurance	1	LS	0.025	5,621	5,621
		Bonding	1	LS	0.025	5,621	5,621
		Contractor O&P	1	LS	0.150	33,725	33,725
		Sales Tax	1	LS	0.050	11,242	11,242
Subtotal						67,450	67,450
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,182	CY	6.00	13,090	13,090
	02315 100 1900	Backfill	1,899	CY	7.00	13,293	13,293
	02315 100 2200	Compacting (Vibrating Roller)	1,013	CY	5.00	5,063	5,063
	02315 130 0050	Bedding (River Run)	1,316	TON	18.00	23,693	23,693
	02320 200 0200	Hauling/Disposal (Excess Excavation)	718	CY	10.00	7,177	7,177
02500	02530 730 2030	HDPE Piping (18" Laid in Trench)	1,500	LF	25.00	37,500	37,500
	02530 730 2050	HDPE Piping (30" Laid in Trench)	1,015	LF	50.00	50,750	50,750
		New Manholes (48")	6	EA	3,500.00	21,000	21,000
02700	02720 200 0300	Road Aggregate Base (12" River Run)	540	TON	22.00	11,879	11,879
	02740 300 0200	AC Pavement (4")	298	TON	80.00	23,843	23,843
	02766 550 0200	Pavement Markings (6")	5,030	LF	1.50	7,545	7,545
		Traffic Control	1	LS	10,000.00	10,000	10,000
Subtotal						224,832	224,832

Subtotal	$224,832
Division 010	$67,450
Construction Subtotal	$292,282
Cost per LF HDPE Installed	$116

20% Contingency	$58,456
25% Legal, Admin., Engineering	$73,071
Total Cost of Project	$423,809
20% Bonding	$84,762
Total Estimated Cost	**$508,571**
Total Cost per LF HDPE	**$202**
CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin A: South Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	2,642	2,642
		Insurance	1	LS	0.025	1,321	1,321
		Bonding	1	LS	0.025	1,321	1,321
		Contractor O&P	1	LS	0.150	7,927	7,927
		Sales Tax	1	LS	0.050	2,642	2,642
Subtotal						15,854	15,854
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	467	CY	6.00	2,800	2,800
	02315 100 1900	Backfill	427	CY	7.00	2,992	2,992
	02315 100 2200	Compacting (Vibrating Roller)	253	CY	5.00	1,264	1,264
	02315 130 0050	Bedding (River Run)	259	TON	18.00	4,668	4,668
	02320 200 0200	Hauling/Disposal (Excess Excavation)	156	CY	10.00	1,563	1,563
02500	02530 730 2030	HDPE Piping (18" Laid in Trench)	600	LF	25.00	15,000	15,000
02700	02720 200 0300	Road Aggregate Base (12" River Run)	116	TON	22.00	2,541	2,541
	02740 300 0200	AC Pavement (4")	65	TON	80.00	5,220	5,220
	02766 550 0200	Pavement Markings (6")	1,200	LF	1.50	1,800	1,800
		New Drop Inlets	2	EA	2,500.00	5,000	5,000
		Traffic Control	1	LS	10,000.00	10,000	10,000
Subtotal						52,847	52,847
Subtotal							$52,847
Division 010							$15,854
Construction Subtotal							$68,702
Cost per LF HDPE Installed							$115
20% Contingency							$13,740
25% Legal, Admin., Engineering							$17,175
Total Cost of Project							$99,617
20% Bonding							$19,923
Total Estimated Cost							**$119,541**
Total Cost per LF HDPE							**$199**
						CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin C: Hazel Street/Maple Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	15,773	15,773
		Insurance	1	LS	0.025	7,887	7,887
		Bonding	1	LS	0.025	7,887	7,887
		Contractor O&P	1	LS	0.150	47,320	47,320
		Sales Tax	1	LS	0.050	15,773	15,773
Subtotal						94,639	94,639
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,984	CY	6.00	17,903	17,903
	02315 100 1900	Backfill	2,574	CY	7.00	18,019	18,019
	02315 100 2200	Compacting (Vibrating Roller)	1,336	CY	5.00	6,682	6,682
	02315 130 0050	Bedding (River Run)	1,838	TON	18.00	33,088	33,088
	02320 200 0200	Hauling/Disposal (Excess Excavation)	1,026	CY	10.00	10,260	10,260
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	2,935	LF	35.00	102,725	102,725
	02530 730 2050	HDPE Piping (30" Laid in Trench)	375	LF	50.00	18,750	18,750
		New Manholes (48")	7	EA	3,500.00	24,500	24,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	739	TON	22.00	16,247	16,247
	02740 300 0200	AC Pavement (4")	404	TON	80.00	32,359	32,359
	02766 550 0200	Pavement Markings (6")	6,620	LF	1.50	9,930	9,930
		Traffic Control	1	LS	25,000.00	25,000	25,000
Subtotal						315,464	315,464

Subtotal	$315,464
Division 010	$94,639
Construction Subtotal	$410,103
Cost per LF HDPE Installed	$124
20% Contingency	$82,021
25% Legal, Admin., Engineering	$102,526
Total Cost of Project	$594,649
20% Bonding	$118,930
Total Estimated Cost	**$713,579**
Total Cost per LF HDPE	**$216**
CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin C: Hazel Street/Maple Street Alternative Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK

Date Prepared: 14-Apr-04

W&K Proj. No. **03-1843-02015**

ENR: April 1 2004 7,017

Escalated to ENR

Estimate Type: [X] **Conceptual**

[ ] **Preliminary (w/o plans)**

[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	12,792	12,792
		Insurance	1	LS	0.025	6,396	6,396
		Bonding	1	LS	0.025	6,396	6,396
		Contractor O&P	1	LS	0.150	38,376	38,376
		Sales Tax	1	LS	0.050	12,792	12,792
Subtotal						76,752	76,752
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,574	CY	6.00	15,447	15,447
	02315 100 1900	Backfill	2,358	CY	7.00	16,505	16,505
	02315 100 2200	Compacting (Vibrating Roller)	1,394	CY	5.00	6,972	6,972
	02315 130 0050	Bedding (River Run)	1,431	TON	18.00	25,749	25,749
	02320 200 0200	Hauling/Disposal (Excess Excavation)	617	CY	10.00	6,172	6,172
02500	02530 730 2030	HDPE Piping (18" Laid in Trench)	3,310	LF	25.00	82,750	82,750
		New Manholes (48")	7	EA	3,500.00	24,500	24,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	637	TON	22.00	14,018	14,018
	02740 300 0200	AC Pavement (4")	360	TON	80.00	28,797	28,797
	02766 550 0200	Pavement Markings (6")	6,620	LF	1.50	9,930	9,930
		Traffic Control	1	LS	25,000.00	25,000	25,000
Subtotal						255,840	255,840

Subtotal	$255,840
Division 010	$76,752
Construction Subtotal	$332,592
Cost per LF HDPE Installed	$100
20% Contingency	$66,518
25% Legal, Admin., Engineering	$83,148
Total Cost of Project	$482,258
20% Bonding	$96,452
Total Estimated Cost	**$578,709**
Total Cost per LF HDPE	**$175**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin C: Drainage Basin C Outfall Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	5,047	5,047
		Insurance	1	LS	0.025	2,523	2,523
		Bonding	1	LS	0.025	2,523	2,523
		Contractor O&P	1	LS	0.150	15,141	15,141
		Sales Tax	1	LS	0.050	5,047	5,047
Subtotal						30,282	30,282
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	1,141	CY	6.00	6,844	6,844
	02315 100 1900	Backfill	856	CY	7.00	5,990	5,990
	02315 100 2200	Compacting (Vibrating Roller)	367	CY	5.00	1,833	1,833
	02315 130 0050	Bedding (River Run)	726	TON	18.00	13,071	13,071
	02320 200 0200	Hauling/Disposal (Excess Excavation)	570	CY	10.00	5,701	5,701
02500	02530 730 2070	HDPE Piping (42" Laid in Trench)	800	LF	80.00	64,000	64,000
		New Manhole	1	EA	3,500.00	3,500	3,500
Subtotal						100,940	100,940

Subtotal	$100,940
Division 010	$30,282
Construction Subtotal	$131,222
Cost per LF HDPE Installed	$164

20% Contingency	$26,244
25% Legal, Admin., Engineering	$32,805
Total Cost of Project	$190,272
20% Bonding	$38,054
Total Estimated Cost	**$228,326**
Total Cost per LF HDPE	**$285**
CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin C: Drainage Basin C Outfall Alternative Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	2,629	2,629
		Insurance	1	LS	0.025	1,314	1,314
		Bonding	1	LS	0.025	1,314	1,314
		Contractor O&P	1	LS	0.150	7,887	7,887
		Sales Tax	1	LS	0.050	2,629	2,629
Subtotal						15,773	15,773
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	711	CY	6.00	4,267	4,267
	02315 100 1900	Backfill	618	CY	7.00	4,326	4,326
	02315 100 2200	Compacting (Vibrating Roller)	326	CY	5.00	1,630	1,630
	02315 130 0050	Bedding (River Run)	434	TON	18.00	7,808	7,808
	02320 200 0200	Hauling/Disposal (Excess Excavation)	305	CY	10.00	3,047	3,047
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	800	LF	35.00	28,000	28,000
		New Manhole	1	EA	3,500.00	3,500	3,500
Subtotal						52,577	52,577

Subtotal	$52,577
Division 010	$15,773
Construction Subtotal	$68,350
Cost per LF HDPE Installed	$85

20% Contingency	$13,670
25% Legal, Admin., Engineering	$17,088
Total Cost of Project	$99,108
20% Bonding	$19,822
Total Estimated Cost	**$118,930**
Total Cost per LF HDPE	**$149**
CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin D: Oak Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02010**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	8,981	8,981
		Insurance	1	LS	0.025	4,491	4,491
		Bonding	1	LS	0.025	4,491	4,491
		Contractor O&P	1	LS	0.150	26,943	26,943
		Sales Tax	1	LS	0.050	8,981	8,981
Subtotal						53,887	53,887
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	1,562	CY	6.00	9,370	9,370
	02315 100 1900	Backfill	1,318	CY	7.00	9,225	9,225
	02315 100 2200	Compacting (Vibrating Roller)	651	CY	5.00	3,256	3,256
	02315 130 0050	Bedding (River Run)	990	TON	18.00	17,819	17,819
	02320 200 0200	Hauling/Disposal (Excess Excavation)	595	CY	10.00	5,950	5,950
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	885	LF	35.00	30,975	30,975
	02530 730 2050	HDPE Piping (30" Laid in Trench)	775	LF	50.00	38,750	38,750
02700	02720 200 0300	Road Aggregate Base (12" River Run)	387	TON	22.00	8,503	8,503
	02740 300 0200	AC Pavement (4")	210	TON	80.00	16,796	16,796
	02766 550 0200	Pavement Markings (6")	3,320	LF	1.50	4,980	4,980
		New Manholes (48")	4	EA	3,500.00	14,000	14,000
		Traffic Control	1	LS	20,000.00	20,000	20,000
Subtotal						179,623	179,623

Subtotal	$179,623
Division 010	$53,887
Construction Subtotal	$233,510
Cost per LF HDPE Installed	$141

20% Contingency	$46,702
25% Legal, Admin., Engineering	$58,378
Total Cost of Project	$338,590
20% Bonding	$67,718
Total Estimated Cost	**$406,307**
Total Cost per LF HDPE	**$245**
CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin D: Oak Street Alternative Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	6,874	6,874
		Insurance	1	LS	0.025	3,437	3,437
		Bonding	1	LS	0.025	3,437	3,437
		Contractor O&P	1	LS	0.150	20,622	20,622
		Sales Tax	1	LS	0.050	6,874	6,874
Subtotal						41,244	41,244
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	1,291	CY	6.00	7,747	7,747
	02315 100 1900	Backfill	1,182	CY	7.00	8,277	8,277
	02315 100 2200	Compacting (Vibrating Roller)	699	CY	5.00	3,497	3,497
	02315 130 0050	Bedding (River Run)	717	TON	18.00	12,914	12,914
	02320 200 0200	Hauling/Disposal (Excess Excavation)	310	CY	10.00	3,095	3,095
02500	02530 730 2030	HDPE Piping (18" Laid in Trench)	1,660	LF	25.00	41,500	41,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	320	TON	22.00	7,030	7,030
	02740 300 0200	AC Pavement (4")	181	TON	80.00	14,442	14,442
	02766 550 0200	Pavement Markings (6")	3,320	LF	1.50	4,980	4,980
		New Manholes (48")	4	EA	3,500.00	14,000	14,000
		Traffic Control	1	LS	20,000.00	20,000	20,000
Subtotal						137,482	137,482
Subtotal							$137,482
Division 010							$41,244
Construction Subtotal							$178,726
Cost per LF HDPE Installed							$108
20% Contingency							$35,745
25% Legal, Admin., Engineering							$44,681
Total Cost of Project							$259,153
20% Bonding							$51,831
Total Estimated Cost							**$310,983**
Total Cost per LF HDPE							**$187**
						CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin D: West Alder Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,727	1,727
		Insurance	1	LS	0.025	863	863
		Bonding	1	LS	0.025	863	863
		Contractor O&P	1	LS	0.150	5,180	5,180
		Sales Tax	1	LS	0.050	1,727	1,727
Subtotal						10,360	10,360
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	193	CY	6.00	1,156	1,156
	02315 100 1900	Backfill	151	CY	7.00	1,055	1,055
	02315 100 2200	Compacting (Vibrating Roller)	92	CY	5.00	459	459
	02315 130 0050	Bedding (River Run)	87	TON	18.00	1,573	1,573
	02320 200 0200	Hauling/Disposal (Excess Excavation)	99	CY	10.00	986	986
02500	02530 730 2060	HDPE Piping (36" Laid in Trench)	160	LF	65.00	10,400	10,400
02700	02720 200 0300	Road Aggregate Base (12" River Run)	44	TON	22.00	968	968
	02740 300 0200	AC Pavement (4")	23	TON	80.00	1,856	1,856
	02766 550 0200	Pavement Markings (6")	320	LF	1.50	480	480
		Adjust Manhole	1	EA	600.00	600	600
		Traffic Control	1	LS	15,000.00	15,000	15,000
Subtotal						34,533	34,533
Subtotal							$34,533
Division 010							$10,360
Construction Subtotal							$44,893
Cost per LF HDPE Installed							$281
20% Contingency							$8,979
25% Legal, Admin., Engineering							$11,223
Total Cost of Project							$65,094
20% Bonding							$13,019
Total Estimated Cost							**$78,113**
Total Cost per LF HDPE							**$488**
						CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin E: Willow Street to Cedar Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	16,133	16,133
		Insurance	1	LS	0.025	8,066	8,066
		Bonding	1	LS	0.025	8,066	8,066
		Contractor O&P	1	LS	0.150	48,398	48,398
		Sales Tax	1	LS	0.050	16,133	16,133
Subtotal						96,796	96,796
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,653	CY	6.00	15,915	15,915
	02315 100 1900	Backfill	2,221	CY	7.00	15,548	15,548
	02315 100 2200	Compacting (Vibrating Roller)	1,079	CY	5.00	5,397	5,397
	02315 130 0050	Bedding (River Run)	1,695	TON	18.00	30,517	30,517
	02320 200 0200	Hauling/Disposal (Excess Excavation)	1,029	CY	10.00	10,289	10,289
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	1,195	LF	35.00	41,825	41,825
	02530 730 2050	HDPE Piping (30" Laid in Trench)	1,500	LF	50.00	75,000	75,000
	02530 730 2060	HDPE Piping (36" Laid in Trench)	75	LF	65.00	4,875	4,875
02700	02720 200 0300	Road Aggregate Base (12" River Run)	655	TON	22.00	14,405	14,405
	02740 300 0200	AC Pavement (4")	355	TON	80.00	28,372	28,372
	02766 550 0200	Pavement Markings (6")	5,540	LF	1.50	8,310	8,310
		New Manholes (48")	6	EA	3,500.00	21,000	21,000
		Adjust Manhole	2	EA	600.00	1,200	1,200
		Traffic Control	1	LS	50,000.00	50,000	50,000
Subtotal						322,653	322,653

Subtotal	$322,653
Division 010	$96,796
Construction Subtotal	$419,448
Cost per LF HDPE Installed	$151
20% Contingency	$83,890
25% Legal, Admin., Engineering	$104,862
Total Cost of Project	$608,200
20% Bonding	$121,640
Total Estimated Cost	**$729,840**
Total Cost per LF HDPE	**$263**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin E: Willow Street to Cedar Street Alternative Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	13,564	13,564
		Insurance	1	LS	0.025	6,782	6,782
		Bonding	1	LS	0.025	6,782	6,782
		Contractor O&P	1	LS	0.150	40,692	40,692
		Sales Tax	1	LS	0.050	13,564	13,564
Subtotal						81,383	81,383
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,344	CY	6.00	14,064	14,064
	02315 100 1900	Backfill	2,078	CY	7.00	14,544	14,544
	02315 100 2200	Compacting (Vibrating Roller)	1,148	CY	5.00	5,739	5,739
	02315 130 0050	Bedding (River Run)	1,381	TON	18.00	24,852	24,852
	02320 200 0200	Hauling/Disposal (Excess Excavation)	702	CY	10.00	7,020	7,020
02500	02530 730 2030	HDPE Piping (18" Laid in Trench)	1,195	LF	25.00	29,875	29,875
	02530 730 2040	HDPE Piping (24" Laid in Trench)	1,500	LF	35.00	52,500	52,500
	02530 730 2050	HDPE Piping (30" Laid in Trench)	75	LF	50.00	3,750	3,750
02700	02720 200 0300	Road Aggregate Base (12" River Run)	579	TON	22.00	12,729	12,729
	02740 300 0200	AC Pavement (4")	321	TON	80.00	25,694	25,694
	02766 550 0200	Pavement Markings (6")	5,540	LF	1.50	8,310	8,310
		New Manholes (48")	6	EA	3,500.00	21,000	21,000
		Adjust Manhole	2	EA	600.00	1,200	1,200
		Traffic Control	1	LS	50,000.00	50,000	50,000
Subtotal						271,278	271,278

Subtotal	$271,278
Division 010	$81,383
Construction Subtotal	$352,662
Cost per LF HDPE Installed	$127
20% Contingency	$70,532
25% Legal, Admin., Engineering	$88,165
Total Cost of Project	$511,359
20% Bonding	$102,272
Total Estimated Cost	**$613,631**
Total Cost per LF HDPE	**$222**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin E: East Laurel Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,985	1,985
		Insurance	1	LS	0.025	992	992
		Bonding	1	LS	0.025	992	992
		Contractor O&P	1	LS	0.150	5,954	5,954
		Sales Tax	1	LS	0.050	1,985	1,985
Subtotal						11,909	11,909
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	356	CY	6.00	2,133	2,133
	02315 100 1900	Backfill	309	CY	7.00	2,163	2,163
	02315 100 2200	Compacting (Vibrating Roller)	163	CY	5.00	815	815
	02315 130 0050	Bedding (River Run)	217	TON	18.00	3,904	3,904
	02320 200 0200	Hauling/Disposal (Excess Excavation)	118	CY	10.00	1,178	1,178
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	400	LF	35.00	14,000	14,000
02700	02720 200 0300	Road Aggregate Base (12" River Run)	88	TON	22.00	1,936	1,936
	02740 300 0200	AC Pavement (4")	48	TON	80.00	3,867	3,867
	02766 550 0200	Pavement Markings (6")	800	LF	1.50	1,200	1,200
		New Manholes (48")	1	EA	3,500.00	3,500	3,500
		Traffic Control	1	LS	5,000.00	5,000	5,000
Subtotal						39,696	39,696
Subtotal							$39,696
Division 010							$11,909
Construction Subtotal							$51,604
Cost per LF HDPE Installed							$129
20% Contingency							$10,321
25% Legal, Admin., Engineering							$12,901
Total Cost of Project							$74,826
20% Bonding							$14,965
Total Estimated Cost							**$89,791**
Total Cost per LF HDPE							**$224**
						CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin E: East Laurel Street Alternative Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,672	1,672
		Insurance	1	LS	0.025	836	836
		Bonding	1	LS	0.025	836	836
		Contractor O&P	1	LS	0.150	5,015	5,015
		Sales Tax	1	LS	0.050	1,672	1,672
Subtotal						10,031	10,031
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	311	CY	6.00	1,867	1,867
	02315 100 1900	Backfill	285	CY	7.00	1,995	1,995
	02315 100 2200	Compacting (Vibrating Roller)	169	CY	5.00	843	843
	02315 130 0050	Bedding (River Run)	173	TON	18.00	3,112	3,112
	02320 200 0200	Hauling/Disposal (Excess Excavation)	75	CY	10.00	746	746
02500	02530 730 2030	HDPE Piping (18" Laid in Trench)	400	LF	25.00	10,000	10,000
02700	02720 200 0300	Road Aggregate Base (12" River Run)	77	TON	22.00	1,694	1,694
	02740 300 0200	AC Pavement (4")	44	TON	80.00	3,480	3,480
	02766 550 0200	Pavement Markings (6")	800	LF	1.50	1,200	1,200
		New Manholes (48")	1	EA	3,500.00	3,500	3,500
		Traffic Control	1	LS	5,000.00	5,000	5,000
Subtotal						33,435	33,435
Subtotal							$33,435
Division 010							$10,031
Construction Subtotal							$43,466
Cost per LF HDPE Installed							$109
20% Contingency							$8,693
25% Legal, Admin., Engineering							$10,866
Total Cost of Project							$63,026
20% Bonding							$12,605
Total Estimated Cost							**$75,631**
Total Cost per LF HDPE							**$189**
						CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin F: East Oak Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	13,129	13,129
		Insurance	1	LS	0.025	6,564	6,564
		Bonding	1	LS	0.025	6,564	6,564
		Contractor O&P	1	LS	0.150	39,386	39,386
		Sales Tax	1	LS	0.050	13,129	13,129
Subtotal						78,773	78,773
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,181	CY	6.00	13,087	13,087
	02315 100 1900	Backfill	1,713	CY	7.00	11,989	11,989
	02315 100 2200	Compacting (Vibrating Roller)	674	CY	5.00	3,370	3,370
	02315 130 0050	Bedding (River Run)	1,543	TON	18.00	27,766	27,766
	02320 200 0200	Hauling/Disposal (Excess Excavation)	676	CY	10.00	6,763	6,763
02500	02530 730 2050	HDPE Piping (30" Laid in Trench)	165	LF	50.00	8,250	8,250
	02530 730 2060	HDPE Piping (36" Laid in Trench)	1,675	LF	65.00	108,875	108,875
02700	02720 200 0300	Road Aggregate Base (12" River Run)	501	TON	22.00	11,032	11,032
	02740 300 0200	AC Pavement (4")	265	TON	80.00	21,185	21,185
	02766 550 0200	Pavement Markings (6")	1,840	LF	1.50	2,760	2,760
		New Manholes (48")	5	EA	3,500.00	17,500	17,500
		Traffic Control	1	LS	30,000.00	30,000	30,000
Subtotal						262,576	262,576

Subtotal	$262,576
Division 010	$78,773
Construction Subtotal	$341,349
Cost per LF HDPE Installed	$186

20% Contingency	$68,270
25% Legal, Admin., Engineering	$85,337
Total Cost of Project	$494,955
20% Bonding	$98,991
Total Estimated Cost	**$593,947**
Total Cost per LF HDPE	**$323**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin F: East Oak Street/Sherwood Road Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	4,885	4,885
		Insurance	1	LS	0.025	2,443	2,443
		Bonding	1	LS	0.025	2,443	2,443
		Contractor O&P	1	LS	0.150	14,656	14,656
		Sales Tax	1	LS	0.050	4,885	4,885
Subtotal						29,312	29,312
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	675	CY	6.00	4,050	4,050
	02315 100 1900	Backfill	552	CY	7.00	3,866	3,866
	02315 100 2200	Compacting (Vibrating Roller)	253	CY	5.00	1,266	1,266
	02315 130 0050	Bedding (River Run)	444	TON	18.00	7,996	7,996
	02320 200 0200	Hauling/Disposal (Excess Excavation)	291	CY	10.00	2,913	2,913
02500	02530 730 2050	HDPE Piping (30" Laid in Trench)	675	LF	50.00	33,750	33,750
02700	02720 200 0300	Road Aggregate Base (12" River Run)	167	TON	22.00	3,675	3,675
	02740 300 0200	AC Pavement (4")	90	TON	80.00	7,178	7,178
	02766 550 0200	Pavement Markings (6")	675	LF	1.50	1,013	1,013
		New Manholes (48")	2	EA	3,500.00	7,000	7,000
		New Drop Inlets	2	EA	2,500.00	5,000	5,000
		Traffic Control	1	LS	20,000.00	20,000	20,000
Subtotal						97,706	97,706

Subtotal	$97,706
Division 010	$29,312
Construction Subtotal	$127,018
Cost per LF HDPE Installed	$188

20% Contingency	$25,404
25% Legal, Admin., Engineering	$31,754
Total Cost of Project	$184,176
20% Bonding	$36,835
Total Estimated Cost	**$221,011**
Total Cost per LF HDPE	**$327**
CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin G: Harrison Street and Laurel Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. 03-1843-02015
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,098	1,098
		Insurance	1	LS	0.025	549	549
		Bonding	1	LS	0.025	549	549
		Contractor O&P	1	LS	0.150	3,293	3,293
		Sales Tax	1	LS	0.050	1,098	1,098
Subtotal						6,586	6,586
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	39	CY	6.00	233	233
	02315 100 1900	Backfill	34	CY	7.00	237	237
	02315 100 2200	Compacting (Vibrating Roller)	13	CY	5.00	65	65
	02315 130 0050	Bedding (River Run)	31	TON	18.00	557	557
	02320 200 0200	Hauling/Disposal (Excess Excavation)	6	CY	10.00	59	59
02500	02530 730 2040	HDPE Piping (12" Laid in Trench)	175	LF	20.00	3,500	3,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	19	TON	22.00	424	424
	02740 300 0200	AC Pavement (4")	17	TON	80.00	1,353	1,353
	02766 550 0200	Pavement Markings (6")	350	LF	1.50	525	525
		Traffic Control	1	LS	15,000.00	15,000	15,000
Subtotal						21,952	21,952

Subtotal	$21,952
Division 010	$6,586
Construction Subtotal	$28,538
Cost per LF HDPE Installed	$163
20% Contingency	$5,708
25% Legal, Admin., Engineering	$7,134
Total Cost of Project	$41,380
20% Bonding	$8,276
Total Estimated Cost	**$49,656**
Total Cost per LF HDPE	**$284**
CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin G: Pine Street and Franklin Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	4,369	4,369
		Insurance	1	LS	0.025	2,184	2,184
		Bonding	1	LS	0.025	2,184	2,184
		Contractor O&P	1	LS	0.150	13,107	13,107
		Sales Tax	1	LS	0.050	4,369	4,369
Subtotal						26,213	26,213
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	750	CY	6.00	4,500	4,500
	02315 100 1900	Backfill	630	CY	7.00	4,410	4,410
	02315 100 2200	Compacting (Vibrating Roller)	308	CY	5.00	1,540	1,540
	02315 130 0050	Bedding (River Run)	478	TON	18.00	8,608	8,608
	02320 200 0200	Hauling/Disposal (Excess Excavation)	292	CY	10.00	2,915	2,915
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	360	LF	35.00	12,600	12,600
	02530 730 2050	HDPE Piping (30" Laid in Trench)	430	LF	50.00	21,500	21,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	186	TON	22.00	4,084	4,084
	02740 300 0200	AC Pavement (4")	101	TON	80.00	8,052	8,052
	02766 550 0200	Pavement Markings (6")	1,580	LF	1.50	2,370	2,370
		Adjust Manholes	3	EA	600.00	1,800	1,800
		Traffic Control	1	LS	15,000.00	15,000	15,000
Subtotal						87,378	87,378

Subtotal	$87,378
Division 010	$26,213
Construction Subtotal	$113,592
Cost per LF HDPE Installed	$144

20% Contingency	$22,718
25% Legal, Admin., Engineering	$28,398
Total Cost of Project	$164,708
20% Bonding	$32,942
Total Estimated Cost	**$197,650**
Total Cost per LF HDPE	**$250**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin G: Fir Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,629	1,629
		Insurance	1	LS	0.025	814	814
		Bonding	1	LS	0.025	814	814
		Contractor O&P	1	LS	0.150	4,887	4,887
		Sales Tax	1	LS	0.050	1,629	1,629
Subtotal						9,774	9,774
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	267	CY	6.00	1,600	1,600
	02315 100 1900	Backfill	192	CY	7.00	1,345	1,345
	02315 100 2200	Compacting (Vibrating Roller)	80	CY	5.00	400	400
	02315 130 0050	Bedding (River Run)	167	TON	18.00	2,999	2,999
	02320 200 0200	Hauling/Disposal (Excess Excavation)	163	CY	10.00	1,628	1,628
02500	02530 730 2080	HDPE Piping (48" Laid in Trench)	160	LF	100.00	16,000	16,000
02700	02720 200 0300	Road Aggregate Base (12" River Run)	53	TON	22.00	1,162	1,162
	02740 300 0200	AC Pavement (4")	27	TON	80.00	2,165	2,165
	02766 550 0200	Pavement Markings (6")	320	LF	1.50	480	480
		Adjust Manholes	3	EA	600.00	1,800	1,800
		Traffic Control	1	LS	3,000.00	3,000	3,000
Subtotal						32,579	32,579

Subtotal	$32,579
Division 010	$9,774
Construction Subtotal	$42,353
Cost per LF HDPE Installed	$265

20% Contingency	$8,471
25% Legal, Admin., Engineering	$10,588
Total Cost of Project	$61,411
20% Bonding	$12,282
Total Estimated Cost	**$73,694**
Total Cost per LF HDPE	**$461**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin G: Fir Street Alternative Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	864	864
		Insurance	1	LS	0.025	432	432
		Bonding	1	LS	0.025	432	432
		Contractor O&P	1	LS	0.150	2,592	2,592
		Sales Tax	1	LS	0.050	864	864
Subtotal						5,183	5,183
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	142	CY	6.00	853	853
	02315 100 1900	Backfill	124	CY	7.00	865	865
	02315 100 2200	Compacting (Vibrating Roller)	65	CY	5.00	326	326
	02315 130 0050	Bedding (River Run)	87	TON	18.00	1,562	1,562
	02320 200 0200	Hauling/Disposal (Excess Excavation)	47	CY	10.00	471	471
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	160	LF	35.00	5,600	5,600
02700	02720 200 0300	Road Aggregate Base (12" River Run)	35	TON	22.00	774	774
	02740 300 0200	AC Pavement (4")	19	TON	80.00	1,547	1,547
	02766 550 0200	Pavement Markings (6")	320	LF	1.50	480	480
		Adjust Manholes	3	EA	600.00	1,800	1,800
		Traffic Control	1	LS	3,000.00	3,000	3,000
Subtotal						17,278	17,278
Subtotal							$17,278
Division 010							$5,183
Construction Subtotal							$22,462
Cost per LF HDPE Installed							$140
20% Contingency							$4,492
25% Legal, Admin., Engineering							$5,615
Total Cost of Project							$32,569
20% Bonding							$6,514
Total Estimated Cost							**$39,083**
Total Cost per LF HDPE							**$244**
						CALL	

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin G: Franklin Street to Elm Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	13,259	13,259
		Insurance	1	LS	0.025	6,629	6,629
		Bonding	1	LS	0.025	6,629	6,629
		Contractor O&P	1	LS	0.150	39,776	39,776
		Sales Tax	1	LS	0.050	13,259	13,259
Subtotal						79,552	79,552
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,391	CY	6.00	14,347	14,347
	02315 100 1900	Backfill	2,034	CY	7.00	14,236	14,236
	02315 100 2200	Compacting (Vibrating Roller)	1,025	CY	5.00	5,123	5,123
	02315 130 0050	Bedding (River Run)	1,499	TON	18.00	26,974	26,974
	02320 200 0200	Hauling/Disposal (Excess Excavation)	880	CY	10.00	8,795	8,795
	02530 730 2060	HDPE Piping (18" Laid in Trench)	250	LF	25.00	6,250	6,250
	02530 730 2040	HDPE Piping (24" Laid in Trench)	1,290	LF	35.00	45,150	45,150
	02530 730 2050	HDPE Piping (30" Laid in Trench)	1,050	LF	50.00	52,500	52,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	592	TON	22.00	13,020	13,020
	02740 300 0200	AC Pavement (4")	323	TON	80.00	25,810	25,810
	02766 550 0200	Pavement Markings (6")	5,180	LF	1.50	7,770	7,770
		New Manholes (48")	4	EA	3,500.00	14,000	14,000
		Adjust Manholes	2	EA	600.00	1,200	1,200
		Traffic Control	1	LS	30,000.00	30,000	30,000
Subtotal						265,175	265,175

Subtotal	$265,175
Division 010	$79,552
Construction Subtotal	$344,727
Cost per LF HDPE Installed	$133
20% Contingency	$68,945
25% Legal, Admin., Engineering	$86,182
Total Cost of Project	$499,855
20% Bonding	$99,971
Total Estimated Cost	**$599,826**
Total Cost per LF HDPE	**$232**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin G: Franklin Street to Elm Street Alternative Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	10,333	10,333
		Insurance	1	LS	0.025	5,166	5,166
		Bonding	1	LS	0.025	5,166	5,166
		Contractor O&P	1	LS	0.150	30,998	30,998
		Sales Tax	1	LS	0.050	10,333	10,333
Subtotal						61,997	61,997
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	2,014	CY	6.00	12,087	12,087
	02315 100 1900	Backfill	1,845	CY	7.00	12,915	12,915
	02315 100 2200	Compacting (Vibrating Roller)	1,091	CY	5.00	5,456	5,456
	02315 130 0050	Bedding (River Run)	1,119	TON	18.00	20,148	20,148
	02320 200 0200	Hauling/Disposal (Excess Excavation)	483	CY	10.00	4,829	4,829
	02530 730 2060	HDPE Piping (18" Laid in Trench)	2,590	LF	25.00	64,750	64,750
02700	02720 200 0300	Road Aggregate Base (12" River Run)	499	TON	22.00	10,969	10,969
	02740 300 0200	AC Pavement (4")	282	TON	80.00	22,533	22,533
	02766 550 0200	Pavement Markings (6")	5,180	LF	1.50	7,770	7,770
		New Manholes (48")	4	EA	3,500.00	14,000	14,000
		Adjust Manholes	2	EA	600.00	1,200	1,200
		Traffic Control	1	LS	30,000.00	30,000	30,000
Subtotal						206,656	206,656

Subtotal	$206,656
Division 010	$61,997
Construction Subtotal	$268,653
Cost per LF HDPE Installed	$104
20% Contingency	$53,731
25% Legal, Admin., Engineering	$67,163
Total Cost of Project	$389,547
20% Bonding	$77,909
Total Estimated Cost	**$467,456**
Total Cost per LF HDPE	**$180**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin H: Ocean View Drive Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	2,615	2,615
		Insurance	1	LS	0.025	1,308	1,308
		Bonding	1	LS	0.025	1,308	1,308
		Contractor O&P	1	LS	0.150	7,846	7,846
		Sales Tax	1	LS	0.050	2,615	2,615
Subtotal						15,691	15,691
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	111	CY	6.00	667	667
		Clean & Regrade Drainage Ditches	3,330	LF	10.00	33,300	33,300
	02315 100 1900	Backfill	82	CY	7.00	576	576
	02315 100 2200	Compacting (Vibrating Roller)	29	CY	5.00	144	144
	02315 130 0050	Bedding (River Run)	79	TON	18.00	1,428	1,428
	02320 200 0200	Hauling/Disposal (Excess Excavation)	29	CY	10.00	289	289
	02530 730 2040	HDPE Piping (24" Laid in Trench)	60	LF	35.00	2,100	2,100
	02530 730 2050	HDPE Piping (30" Laid in Trench)	120	LF	50.00	6,000	6,000
02700	02720 200 0300	Road Aggregate Base (12" River Run)	43	TON	22.00	944	944
	02740 300 0200	AC Pavement (4")	23	TON	80.00	1,856	1,856
	02766 550 0200	Pavement Markings (6")	0	LF	1.50	0	0
		Traffic Control	1	LS	5,000.00	5,000	5,000
Subtotal						52,304	52,304

Subtotal	$52,304
Division 010	$15,691
Construction Subtotal	$67,995
Cost per LF HDPE Installed	$378
20% Contingency	$13,599
25% Legal, Admin., Engineering	$16,999
Total Cost of Project	$98,593
20% Bonding	$19,719
Total Estimated Cost	**$118,312**
Total Cost per LF HDPE	**$657**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin H: Ocean View Drive Outfall Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,488	1,488
		Insurance	1	LS	0.025	744	744
		Bonding	1	LS	0.025	744	744
		Contractor O&P	1	LS	0.150	4,463	4,463
		Sales Tax	1	LS	0.050	1,488	1,488
Subtotal						8,927	8,927
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	100	CY	6.00	600	600
	02315 100 1900	Backfill	73	CY	7.00	509	509
	02315 100 2200	Compacting (Vibrating Roller)	25	CY	5.00	125	125
	02315 130 0050	Bedding (River Run)	71	TON	18.00	1,276	1,276
	02320 200 0200	Hauling/Disposal (Excess Excavation)	33	CY	10.00	335	335
	02530 730 2050	HDPE Piping (30" Laid in Trench)	150	LF	50.00	7,500	7,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	37	TON	22.00	817	817
	02740 300 0200	AC Pavement (4")	20	TON	80.00	1,595	1,595
		Slope Stabilization	1	LS	15,000.00	15,000	15,000
		Traffic Control	1	LS	2,000.00	2,000	2,000
Subtotal						29,756	29,756

Subtotal	$29,756
Division 010	$8,927
Construction Subtotal	$38,683
Cost per LF HDPE Installed	$258
20% Contingency	$7,737
25% Legal, Admin., Engineering	$9,671
Total Cost of Project	$56,091
20% Bonding	$11,218
Total Estimated Cost	**$67,309**
Total Cost per LF HDPE	**$449**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin I: Cedar Street Project

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	3,997	3,997
		Insurance	1	LS	0.025	1,998	1,998
		Bonding	1	LS	0.025	1,998	1,998
		Contractor O&P	1	LS	0.150	11,990	11,990
		Sales Tax	1	LS	0.050	3,997	3,997
Subtotal						23,979	23,979
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	840	CY	6.00	5,040	5,040
	02315 100 1900	Backfill	759	CY	7.00	5,310	5,310
	02315 100 2200	Compacting (Vibrating Roller)	503	CY	5.00	2,515	2,515
	02315 130 0050	Bedding (River Run)	380	TON	18.00	6,832	6,832
	02320 200 0200	Hauling/Disposal (Excess Excavation)	398	CY	10.00	3,980	3,980
02500	02530 730 2040	HDPE Piping (24" Laid in Trench)	700	LF	35.00	24,500	24,500
02700	02720 200 0300	Road Aggregate Base (12" River Run)	154	TON	22.00	3,388	3,388
	02740 300 0200	AC Pavement (4")	85	TON	80.00	6,767	6,767
	02766 550 0200	Pavement Markings (6")	1,400	LF	1.50	2,100	2,100
		New Manholes (48")	2	EA	3,500.00	7,000	7,000
		New Drop Inlets	1	EA	2,500.00	2,500	2,500
		Traffic Control	1	LS	10,000.00	10,000	10,000
Subtotal						79,931	79,931

Subtotal	$79,931
Division 010	$23,979
Construction Subtotal	$103,910
Cost per LF HDPE Installed	$148

20% Contingency	$20,782
25% Legal, Admin., Engineering	$25,978
Total Cost of Project	$150,670
20% Bonding	$30,134
Total Estimated Cost	**$180,803**
Total Cost per LF HDPE	**$258**
	CALL

ENGINEER'S OPINION OF PROBABLE COST

Project: **FORT BRAGG STORM DRAINAGE MASTER PLAN**

Drainage Basin J: Highway 1 Projects

Winzler & Kelly Consulting Engineers

Prepared By: MGK
Date Prepared: 14-Apr-04
W&K Proj. No. **03-1843-02015**
ENR: April 1 2004 7,017
Escalated to ENR

Estimate Type: [X] **Conceptual**
[ ] **Preliminary (w/o plans)**
[ ] **Design Development @** 0 **% Complete**

Division	Item No.	Description	Qty	Units	Equipment $/Unit	Equipment Total	Total
010 000		**General Requirements**					
		Mobilization/Demobilization	1	LS	0.050	1,319	1,319
		Insurance	1	LS	0.025	660	660
		Bonding	1	LS	0.025	660	660
		Contractor O&P	1	LS	0.150	3,958	3,958
		Sales Tax	1	LS	0.050	1,319	1,319
Subtotal						7,917	7,917
02300		**Earth/Site Work**					
	02315 900 0110	Trench Excavation	129	CY	6.00	773	773
	02315 100 1900	Backfill	85	CY	7.00	597	597
	02315 100 2200	Compacting (Vibrating Roller)	10	CY	5.00	48	48
	02315 130 0050	Bedding (River Run)	112	TON	18.00	2,021	2,021
	02320 200 0200	Hauling/Disposal (Excess Excavation)	56	CY	10.00	563	563
	02530 730 2060	HDPE Piping (36" Laid in Trench)	60	LF	65.00	3,900	3,900
	02530 730 2080	HDPE Piping (48" Laid in Trench)	60	LF	100.00	6,000	6,000
02700	02720 200 0300	Road Aggregate Base (12" River Run)	36	TON	22.00	799	799
	02740 300 0200	AC Pavement (4")	19	TON	80.00	1,508	1,508
	02766 550 0200	Pavement Markings (6")	120	LF	1.50	180	180
		Traffic Control	1	LS	10,000.00	10,000	10,000
Subtotal						26,390	26,390
Subtotal							$26,390
Division 010							$7,917
Construction Subtotal							$34,307
Cost per LF HDPE Installed							$286
20% Contingency							$6,861
25% Legal, Admin., Engineering							$8,577
Total Cost of Project							$49,745
20% Bonding							$9,949
Total Estimated Cost							**$59,694**
Total Cost per LF HDPE							**$497**
						CALL	