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July 15, 2013

California Department of Water Resources
Division of Integrated Regional Water Management
Financial Assistance Branch
Post Office Box 942836
Sacramento, CA 94236

Attn: Laura McLean

Subject: **Proposition 1E Integrated Regional Water Management Grant Program**
Stormwater Flood Management Grant, Round 2, 2013
City of Ontario Francis Street Storm Drain and Ely Basin Flood Control and Aquifer Recharge Project

Dear Ms. McLean,

The City of Ontario (City) submitted an application for funding through the subject program and it did not receive sufficient scoring to qualify for funding. Upon review of the proposal evaluation provided by DWR and comments received at the public workshop of July 11, 2013, the City requests that DWR consider the following:

1. Work Plan

As presented in the 2012 Guidelines, Section V.G "a score of 4 points will be awarded where the criterion is fully addressed but is not supported by thorough documentation or sufficient rationale". Based on this criterion, the City should receive 4 points under the Work Plan category for the following reasons:

DWR Comment: The work plan discusses the project goals and objectives but does not relate the project to the IRWM plan.

City Response: As presented in Attachments 1 (IRWM Plan Consistency) and 9 (Integrated Water Management Programs and Projects within the South Coast Hydraulic Region, Regional Water Quality Control Board Santa Ana Region), the application indicates that the project is consistent with the 2010 adopted Santa Ana Region IRWM plan. In particular, the project provides additional water

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supply through recharging captured stormwater, promotes sustainable water solutions by partnering with local agencies (such as IEUA, SAWPA and San Bernardino County Flood Control District), commits City funds to construct the project, engages stakeholders by improve regional integration and coordination, and maintains quality of life within the City through enhanced flood protection. In addition to the City project inclusion in the IRWM plan as amended in 2012, the project was selected for funding in the Proposition 84, IRWM grant by the Santa Ana Watershed Project Authority, who administers the IRWM plan for this region.

DWR Comment: The task descriptions lack adequate detail to determine if the work can be implemented as proposed. For example, construction details are vague and lack specific construction materials, equipment, and methods. Some of these details exist in the budget section but are not thoroughly explained in the work plan.

City Response: The City has delivered numerous public works projects of similar nature implementing a work plan comparable to the plan presented. As stated above, construction materials, equipment, and methods are presented in the budget section of the application and include reinforced concrete pipe for storm drains, precast concrete manhole shafts, iron manhole frame and covers, Portland Cement Concrete for cast in-place structures, aggregate for bedding, and base and asphalt concrete pavement for street repair. Construction equipment includes dozers, scrapers, excavators, loaders, cranes, sheep-foot rollers for compaction, shoring, shielding, and related equipment. Construction methods include grading, shoring, pipe placement, backfill, complication, forming, installation of materials, and street resurfacing.

DWR Comment: Some aspects of the project are simply not addressed. For example, the disposition of the 500,000 cubic yards of cut material from basin excavation is not discussed, other than that they will be "disposed" on-site. Yet, the project site map does not clearly show available area adjacent to the existing recharge ponds to dispose of this large amount of soil.

City Response: As presented in Task 9, the project includes additional excavation of materials from existing basins. All of the excavated materials would be hauled to a proposed grade separation project located at Milliken Avenue and Mission Boulevard approximately 3 miles from the project site. Construction of the grade separation project is schedule set to begin construction in 2014. The budget section of the application includes sufficient costs ($12 per cubic yard to excavate and haul materials offsite).

DWR Comment: In another example, the work plan does not identify the current functions of the Ely Basins, other affected parties such as the owners and operators of the basins, or any coordination that may be necessary.

City Response: To the contrary, under the Goals and Objectives and Integrated Elements of Project sections, the application advises that the site currently operates as a flood control and aquifer recharge facility, owned by San Bernardino County Flood Control District and operated and maintained by Inland Empire Utilities Agency, both agencies are project partners. As advised, operations of the basin will continue to provide flood protection and groundwater recharge; the project will only enhance both flood protection and water conservation. Portions of the 2010 Recharge Master Plan Update (the entire plan was referenced in the work plan section and was enclosed in Attachment 3) that demonstrate current operations and performance of the basin prior to project implementation are

enclosed as Attachment A. Recharge general operations are discussed in Section 5.2.1.1 and channel general operations are discussed in Section 5.2.1.2.2. As presented in the application, the operation program will continue without any proposed modifications. The project is only creating greater operational capacities in the basins and diverting greater quantities of storm water for local groundwater recharge that will not impact the normal operations of the basins.

DWR Comment: The list of required permits is vague and does not include their current statuses, but it appears that the applicant has not yet applied for an NPDES permit or a permit to modify a recharge basin from the RWQCB. The applicant states that it has not yet begun CEQA review for the project, and there is no prediction regarding what type of CEQA document will be needed.

City Response: A list of permitting agencies for regulatory compliance was provided in the application and includes the City, County of San Bernardino Flood Control District, Inland Empire Utility Agency, and the Regional Water Quality Control Board. The City advised that it has not yet begun efforts to acquire these permits nor had CEQA compliance processing begun. A comprehensive list of required permits will be determined at the conclusion of environmental compliance processing.

Although the City has not yet completed an initial study that will determine the appropriate CEQA compliance processing required for the project, it is anticipated that a Mitigated Negative Declaration will likely be the appropriate process for CEQA compliance.

NPDES permit are normally applied for and acquired at the conclusion of design and design approval and prior to construction. The City intends to acquire the NPDES permit at the appropriate time in the project schedule.

DWR Comment: Although the proposal states that the project design is 90% complete, no hydrology and hydraulics report, nor any plans or specifications, are included with the application.

City Response: As presented in Attachment 3, the application advises that construction drawings are 90% complete and that project specific preliminary hydrology and hydraulics are also complete. Each is enclosed as Attachments B and C, respectively. During the DWR workshops, DWR advised that bulk data submission are discouraged. Since the drawings and reports were of considerable size, these documents were not enclosed. The City advised that they are available upon request; DWR made no request for additional information.

DWR Comment: No scientific or technical information is submitted to support the feasibility of meeting the goals and objectives of this project.

City Response: The project conveyance system has been sized to capture and convey 100-year storm runoff from the drainage tributary identified in the application, deliver it to an existing channel that subsequently delivers storm flows to the Ely Basins to be recharged in the existing basins that will be expanded by 310 acre-feet. For specific project characteristics, see Attachment 3. DWR appears to be penalizing the City for "lack of technical justification" in both the Work Plan for Technical Justification that would appear to be inappropriate.

DWR Comment: The work plan does not address data management, as described in the IRWM Plan Standard in the 2012 Guidelines.

City Response: As presented in Attachment 3, the basins are already in use and are operated and maintained by Inland Empire Utilities Agency (IEUA). IEUA already manages data for basin operations consistent with the IRWM Plan standards. IEUA generates recharge master Plan Updates to document recharge activities in the basin, a sample table from application Attachment 3 in enclosed as Attachment D, demonstrating the ongoing data management.

DWR Comment: The monitoring program, described in Subtask 9.4, is very vague and deliverables are poorly defined.

City Response: Data is collected on a continuous basis that documents all flows that enter the basins and all flows that pass through the basins without recharging. This ongoing program will continue with or without the project. In addition to the existing program, enhanced monitoring system will be installed as described in Subtask 9.4. Basin performance will be documented by the Recharge Master Plan Report updates; the latest update is enclosed in Application Attachment 3.

DWR Comment: The work plan does not include maps that show the project location.

City Response: Numerous maps are included throughout the application in Attachments 3 and 7, including a regional map (highlighting project location, water service boundaries, and Chino Basin limits), Project Exhibit (highlighting detailed location of proposed improvements, storm drain tributary area, flood protection benefit area, and existing drainage systems), and a flood inundation map (highlighting the extents of the flooded areas experienced during a 100-year storm event).

2. Budget

As presented in the 2012 SWFM PSP, Section VI., Table 3, "A score of 4 points will be awarded where the Budgets for all the projects in the Proposal have detailed cost information as described in Attachment 4 and the costs are considered reasonable but the supporting documentation for some of the Budget categories of Exhibit B are not fully supported or lack detail." Based on this criterion, the City should receive 4 points under the Budget category for the following reasons:

DWR Comment: The budget for the project does not have detailed cost information, many of the costs cannot be verified as reasonable, and supporting documentation is lacking for all of the budget categories. No labor costs, hourly wage rates, hours, labor categories, or other details are provided for any of the tasks. There is a list of costs for construction expenses, but the work plan does not include this level of detail so it is difficult to relate the costs to the task descriptions in the work plan. No cost breakdown is provided for any of the other tasks. Grant administration, environmental compliance, construction administration, and construction contingency costs are estimated only as percentages of the construction costs based on "historic City projects," but no other documentation, such as the costs for past City projects, is included with the budget. The budget detail provided is not consistent with the work plan; work plan steps identified under Project Design and Engineering (Category 5) and subtasks in Task (construction) are not shown in the budget. It is therefore not possible to determine if the budget for these activities are reasonable.

City Response: When budgeting projects, including development of the City's Capital Improvement program, standard percentages are used for project administration, environmental

compliance, construction administration, and construction contingency costs. These same common procedures were applied during application preparation consistent with the public contracting code (industry standard). To estimate the construction costs for a proposed project, the City reviews recent bid schedules and prepares an engineer's estimate for the proposed project. The engineers estimate was included in Attachment 4. In response DWR's comment, unit numbers provided in the detailed cost estimate are broken down as follows: 60% for material cost, 20% for labor cost, 10% for overhead, and 10% for profit.

DWR Comment: It also appears that the total proposed budget may not meet the minimum SWFM funding match requirement of at least 50% of the total project cost. The application proposes to finance the project with both Proposition 1E SWFM and Proposition 84 IRWM grants. As a result, the combined funding match is 48%. (See summary budget table in Attachment 4.) In addition, the construction costs in the detailed construction cost table are rounded up by $20,000; this rounded total is the amount used in the summary budget table.

City Response: The City commits to the minimum funding amount of 50% of the total project cost. The City misunderstood the match funding requirements related to multiple state funding sources. Revised budget is enclosed as Attachment E.

3. Schedule

As presented in the 2012 SWFM PSP, Section VI., Table 3, "A score of 5 points will be awarded if the schedule is consistent with the Work Plan and Budget, reasonable, and demonstrates a readiness to begin construction or implementation no later than October 2014." Based on this criterion, the City should receive 5 points under the Schedule category for the following reasons:

DWR Comment: The schedule is generally reasonable, indicates a readiness to begin construction no later than by October 2014, but is not consistent with the tasks presented in the work plan. An inconsistency exists with the work plan in that the schedule contains a subtask for obtaining a permit from the U.S. Army Corps of Engineers, which is not described in the work plan. Additionally three tasks, Development of Financing, Development of Project Management Plan, and Progress Reports and Final Report Submittals are not found in the project schedule.

City Response: Reference to US Army Corps of Engineers and SANBAG are errors. The reference should have been to the Regional Water Quality Control Board, as presented in Work Plan Task 7; however, it should be noted that sufficient time has been allotted to complete the necessary permitting process. Other items mentioned above (Development of Financing, Development of Project Management, and Project Progress Reports and Final Reports) are included in the Project Administration task. Otherwise, the schedule is consistent with the Work Plan presented. Revised schedule is enclosed as Attachment F.

4. Monitoring, Assessment, and Performance Measures

As presented in the 2012 Guidelines, Section V.F, "A score of 3 points will be awarded where the criterion is less than fully addressed and documentation or rationales are incomplete or insufficient." Based on this criterion, the City should receive 3 points under the Schedule category for the following reasons:

DWR Comment: The criterion is marginally addressed and documentation is incomplete and insufficient. The proposed monitoring concepts are appropriate for the benefits claimed but monitoring targets are not clearly identified nor quantified and do not offer practical means for monitoring project performance.

City Response: As advised, the basins are currently operated by the project partner, IEUA, and a comprehensive data management program is already in place. As presented in Attachment 3, Subtask 9.4, the City proposes to install additional water level monitoring/logging and groundwater quality monitoring equipment to identify, quantify, and record performance related to basin improvements. These systems will sufficiently monitor and record project performance data.

It appears DWR is reducing scoring for monitoring in both this section and the Work Plan section. If so, please reconsider.

DWR Comment: For example, the target for water quality is "detectable improvement in groundwater quality," but no target water quality indicators are identified.

City Response: Areas overlying the lower Chino Basin historically consisted of dairy farm uses that continue to degrade water quality of the drinking water supplies. The project will capture higher quality water for basin recharge. Water recharged in the Ely Basins will additionally benefit from natural attenuation further improving water quality. Thereafter, the higher quality water supplies will blend with existing water supplies resulting in improved water quality. If this method is compared with other methods of water treatment, artificial groundwater recharge is ecologically sustainable and more cost effective than chemically induced treatment (coagulation, ozone floc filtration, the application of reverse osmosis, ultraviolet beams, ultra-filtration, or activated charcoal).

DWR Comment: The only flood control target identified is for the maximum flood event, and the water recharge target appears to be a single averaged value. In addition, no method is proposed for identifying or establishing benchmarks or baselines. For example, the Ely Basins appear to already have been modified and used to recharge storm water and possibly recycled water; this baseline condition is not documented in the application. Without knowing the baseline condition, the recharge benefit of the project cannot be estimated.

City Response: Storm drain systems are required to capture and convey 100-year storm intensities per City standards and the mitigation target the City desires to achieve for the project. Storms of a lesser magnitude will be accommodated by the project since it has been designed for a more severe flooding event. Further, 1 in 10 and 1 in 25 year events were considered in the hydrology analysis; however, the system is designed for 100-year flood protection.

DWR's comment related to recharge is correct, the proposal consider average rainfall events. During an average year, the drainage tributary generates 772 ac-ft of total volume after losses are considered. It is estimated that 20 rain event are needed to generate the total volume. Therefore, approximately 40 ac-ft of volume is generated during each rain event. The additional volume that the project creates is 310 ac-ft. Therefore, more than 7 consecutive rain events must occur to occupy the entire new volume. Such an event is extremely unlikely in the Ontario area. In conclusion, the additional volume is sufficient to accommodate rain event from the tributary area on a consistent and reliable basis.

Regarding the baseline conditions, the 2010 Recharge Master Plan Update was included in Attachment 3. On Tables 5-1 (Existing Regional Conservation Basin Parameters) and 6-3 (Supplemental Water Recharge Capacity Estimates), the existing Ely Basins management data is provided including volume, percolation rate, operating range and parameters, control elements, average recharge rate, supplemental water recharge capacity, and additional technical data. As presented in Table 5-1, the annual recharge estimate for storm water is 1570 AF/YR. The referenced tables are enclosed as Attachment D.

DWR Comment: Although measuring tools are described, they would not effectively monitor project performance or target progress. The methods for using these tools are not described and some of the methods, such as photographic documentation, as described, do not appear to allow quantitative assessment. Therefore, the proposed monitoring program will not effectively measure the project's degree of success in meeting the claimed physical benefits.

City Response: As presented in Work Plan Subtask 9.4, the City proposes to supplement the existing site equipment with water level monitoring/logging and groundwater quality monitoring equipment to identify, quantify, and record performance. The combined system will sufficiently monitor and record project performance data.

5. Technical Justification

As presented in the 2012 SWFM PSP, Section VI., Table 3, "A score of 3 points will be awarded to a proposal that appears to be technically justified to achieve the claimed benefits but lacks documentation that demonstrates the technical adequacy of the project(s) and/or physical benefits are not well described." Based on this criterion, the City should receive 3 points under the Technical Justification category for the following reasons:

DWR Comment: The technical justification criterion is marginally addressed and documentation is incomplete and insufficient. Technical justification lacks documentation that demonstrates or supports the technical adequacy of the project, and the physical benefits are not well described. No technical analysis of flood conditions or benefits is provided. A description of conditions, a flood inundation map, photographs, and newspaper articles are the only documentation submitted. No quantitative analysis and no record of the historical frequency of flooding or the damage/costs incurred are included.

City Response: The City included extensive technical justification including photographs of actual flooding events, groundwater recharge estimates, F-RAM analysis, green house gas emissions calculations, and the hydrology report; which, as stated in the application, would be available upon request and DWR made no request. As documented, significant amounts of flooding have occurred in the project area and the project will collect, capture, and convey storm water to downstream conveyance facilities and to recharge facilities. It appears DWR is reducing scoring for Technical Justification in both this section and the Work Plan, the City is being penalized twice. As such, the results are inappropriate.

DWR Comment: No technical analysis of recharge benefits is provided. No baseline is established; the recharge benefits table does not show how much water is recharged in the Ely Basins without the project. The applicant assumes that all water (772 AF/YR) that enters the basins will be

recharged without loss, but no supporting calculations, models, or other supporting evidence is provided. For example, recharge benefits could have been supported by calculations of net increase in recharge by calculating the marginal increase from the project against the baseline (without project) condition. Also, increasing the storage volume of a basin alone is not sufficient to demonstrate that the basin will offer increased groundwater recharge. If the volume cannot be infiltrated before the following storm displaces it, increased recharge may not be realized.

City Response: Baselines established by the Inland Empire Utilities Agency (IEUA), one of the City's project partners, have been included in the 2010 Recharge Master Plan Update, shown in Table 5-1, Existing Regional Conservation Basin Parameters, and included in Attachment 3. As presented in Table 5-1, the annual recharge estimate for storm water is 1570 AF/YR. As shown in Attachment 7, on the Annual Stormwater Recharge Estimate table, a loss rate of 43% (per the Chino Basin Watermaster, 2010 Recharge Master Plan) has been applied to an average rainfall year and the resultant recharge estimate is 772 AF/YR.

Again, during an average year, the drainage tributary generates 772 ac-ft of total volume after losses are considered. It is estimated that 20 rain event are needed to generate the total volume. Therefore, approximately 40 ac-ft of volume is generated during each rain event. The additional volume that the project creates is 310 ac-ft. Therefore, more than 7 consecutive rain events must occur to occupy the entire new volume. Such an event is extremely unlikely in the Ontario area. As a result, lost recharge is very unlikely.

DWR Comment: The proposal also claims benefits of reduced greenhouse gases and improved air quality. Although the applicant shows that for each AF of water recharged, considerable energy is saved (and thus GHG emissions) from offsetting water imported from the delta, the applicant has not considered project construction emissions, which would negatively offset the savings. Also, to the extent that the quantity of recharge is not adequately supported, as noted above, the GHG emissions reductions (per AF of increased supply) would need to be adjusted based on the amount of verified recharge.

City Response: Construction emissions are one-time events occurring the first year only; ongoing GHG emissions reduction would continue indefinitely and would far exceed GHG emissions from project construction. Construction emission impacts, albeit important, would only slightly impact the estimates presented in the application. In previous discussions, the City has already demonstrated the reliability of recharge on a consistent and reliable basis.

DWR Comment: Finally, the proposal claims that the project will reduce pollutants including sediment, nutrients, trash, metals, bacteria, virus, oil, grease, organics and pesticides, but provides no technical information to justify this claim. No water quality data for the storm water runoff or groundwater is provided for either existing conditions or expected project improvements."

City Response: Groundwater recharge improves water quality by processes of natural attenuation. First flush pollutants can be mitigated through various Best Management Practice including detention and infiltration. Additionally, the basin maintenance program will annually dispose of trash and sediment build-up. Again, the basins are already part of IEUA's current maintenance program that will continue in perpetuity.

6. Benefits and Cost Analysis

As presented in the 2012 SWFM PSP, Section VI., Table 3, a score of 7-8 points will be awarded to projects that demonstrate the following: "Collectively the proposal is likely to provide a high level of benefits in relationship to cost, but the quality of the analysis or clear and complete documentation is lacking." Based on this criterion, the City should receive 8 points under the Benefits and Cost Analysis category for the following reasons:

DWR Comment: Collectively the proposal is likely to provide a high level of benefits in relationship to cost, but the quality of the analysis or clear and complete documentation is lacking. The Net Present Value (NPV) of costs is $15.136 million. The NPV of FDR benefits is estimated to be $55.44 million, and the estimated NPV of water supply benefits is $8.47 million.

City Response: No comment.

DWR Comment: The F-RAM application includes flood damages for 1 in 10, 1 in 25 and 1 in 100 year events. An area inundation map is provided for the 1 in 100 year event. It is not clear how event damages were developed for the 1 in 10 and 1 in 25 year events.

City Response: The hydrology report for the 1 in 10 and 1 in 25 year events together with the 100-year event are presented in the project hydrology analysis. Damage estimates were prepared using runoff from each storm event (100, 25, and 10) together with runoff depths calculated at intersection. It appears that DWR is again reducing scoring within this category and the Technical Justification category for similar data omissions. The repeated deduction should be reconsidered.

DWR Comment: The F-RAM application suggests an estimated annual damages (EAD) reduction of $10.404 million which would be worth $164 million in NPV. The Table 11 EAD calculation, resulting in an EAD of $3.518 million, is faulty. The analysis starts with an event at which some damage occurs and the interval probabilities are not calculated correctly. Furthermore, the Table 11 analysis assumes a "probability of structural failure" without project that does not apply in this case. A corrected EAD of $8.56 million is equivalent to $135 million in NPV terms.

City Response: The City is unable to replicate the discovered error. However, even incorporating the error, the results are similar and have only a slight impact on the benefit cost analysis.

DWR Comment: The stormwater recharge benefit might be discounted from the State perspective to the extent that the water would be captured and used by other people downstream.

City Response: Runoff from the drainage tributary is lost to the Chino Basin, the Santa Ana region, and ultimately to Pacific Ocean and thus provides no benefit to this region or any other jurisdiction. Further, the goal of stormwater capture and recharge is consistent with the Santa Ana Watershed Project Authority's IRWM Plan.

DWR Comment: Still, if only the FDR benefits are taken, then this still appears to be an economical project. A higher score is not provided because information regarding how event damages is calculated, especially for the 1 in 10 and 1 in 25 year events, is not provided.

City Response: Again, the 1 in 10 and 1 in 25 year events are included in the hydrology analysis.

7. Program Preferences

As presented in the 2012 SWFM PSP, Section VI., Table 3, points will be awarded as follows: "one half point will be awarded for each Program Preference (including the statewide priorities listed in Table 1 of the 2012 guidelines) that will be met through the implementation of the proposal, for a maximum of 5 points. Program preference points will be granted if it is clear that the preferences will be met upon implementation of the proposal."

DWR Comment: The applicant meets 3 program preferences and 4 statewide preferences: Include Regional Projects, Effectively Integrate Water Management Programs, Contribute to CALFED Objectives, Drought Preparedness, Use and Reuse Water More Efficiently, Climate Change Response Actions, and Practice Integrated Flood Management

City Response: No comment.

In summary, the City requests that our score be amended from 43 points to 61 points and reconsider the City's Application for funding. Thank you for your consideration.

Sincerely,

Louis Abi-younes, P.E.
City Engineer

Attachment:
A – Portions of 2010 Chino Basin Watermaster Recharge Master Plan Update
B – Storm Drain Plans
C – Preliminary Hydrology and Hydraulics Report
D – Tables 5-1 and 6-3 from of 2010 Chino Basin Watermaster Recharge Master Plan Update
E – Revised Budget
F – Revised Schedule

cc. Cindy Hackett, City of Ontario
Michael Thornton, TKE Engineering, Inc.

Appendix A

2010 Recharge Master Plan Update

Volume I – Final Report

Prepared for

Chino Basin Watermaster
Chino Basin Water Conservation District
Inland Empire Utilities Agency

June 2010

Prepared by

Wildermuth Environmental Inc.
Black & Veatch Corporation
Wagner & Bonsignore
Sierra Water Group

2010 Recharge Master Plan Update

Volume I – Final Report

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June 2010

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Section 5 – Storm Water Recharge Enhancement Opportunities

5.1 Introduction

The CBWCD is a part of the team undertaking the RMPU. The RMPU is being coordinated by Watermaster through its engineer, WEI.

The first task of the CBWCD is in two parts: Part 1 is to identify and comment on current storm water recharge facilities and operations, and evaluate the effectiveness of local storm water facilities and policies intended to improve storm water recharge; Part 2 is to identify and perform preliminary conceptual project evaluations of potential improvements to existing facilities and new facilities located in places where there is uncaptured flow leaving the Chino Basin to determine if projects are potentially viable and warrant further consideration.

This first task analyses will determine if storm water is currently being captured and recharged by local storm water facilities that is unaccounted for in the Chino Basin Surface Water Simulation R4 model developed and operated by WEI and if there is a significant amount of available and obtainable storm water that could be directed to recharge facilities. An increase in storm water recharge in an amount greater than previously accounted for in a base period condition would represent an increase in supply to the Chino Basin, thus augmenting safe yield for the same base period condition. Additional recharge could offset overdraft as well as decrease the amount of supplemental water purchased by Watermaster to maintain hydrologic balance in the basin. The addition of new or previously unaccounted for storm water recharge would lessen the projected decline of the calculated annual safe yield.

The second task of CBWCD is to evaluate the conceptual projects identified in the first phase of project evaluations, and additional project alternatives identified with WEI, develop a regional Recharge Distribution System and estimate its capability to cost effectively improve storm water recharge in the Chino Basin.

The regional Recharge Distribution System developed with WEI is comprised of various improvements, enlargements and reoperations of existing facilities and construction of new diversion and recharge facilities to increase the amount of storm water recharge in the Chino Basin. The improvements would enable existing facilities which currently operated nearly exclusively for flood control purposes to operate in a multipurpose capacity to also divert and regulate storm water flows for transferred to other recharge facilities.

Conceptual project evaluations for alternatives and project components developed by the RMP update team are being performed to develop an economic basis for comparison of projects or project components. This evaluation will enable further discussions of project viability and ultimately lead to decisions of project implementation.

5.2 Existing Storm Water Management and Recharge

There is a long history of storm water recharge in the Chino Basin. The results of some previous analyses suggest that the opportunity to significantly increase recharge is limited, primarily due to the nature of the timing of precipitation and runoff. The flow in creeks and channels is usually less than the inlet capacity of the existing recharge basins, meaning that most of the time all of the flow can be captured with existing facilities. However, in large storm events some recharge basins are unable to divert all available flow because the rate of flow greatly exceeds the capacity of intake structures. Consequently recharge opportunities are lost.

The majority of data regarding current physical and operational parameters of regional basins presently utilized for the analysis of storm water recharge is readily available. The data is available primarily through WEI, San Bernardino County Flood Control District (SBCFCD), and Inland Empire Utilities Agency (IEUA), the operator of the basins. WEI prepared a "Chino Basin Recharge Facilities Operation Procedures" manual (ROM) for the Groundwater Recharge Coordinating Committee in March 2006. This document is the most complete available reference for the regional basins presently utilized for recharge. In some cases data was found in WEI documents prepared prior to the ROM. The information contained herein, discussed in section 5.2.1, is based in part on the information contained in the ROM.

Additional basins are described that were not included in the March 2006 document because they are primarily "flow through" basins that have been concluded to have poor infiltration rates and are accordingly operated for flood control purposes. Current physical and operational parameters for these basins are not as readily available. The physical parameters contained herein for non-recharge basins were primarily obtained from the SBCFCD, where available. The majority of data was gleaned from available construction drawings as well as the SBCFCD Project Systems Inventory Zone 1 Index which was completed in 1976, and personal communication with SBCFCD staff.

Local storm water recharge sites within the Chino Basin are discussed in section 5.2.2. These sites were identified by individual cities in response to a data request letter mailed in March 2009. Collection of local storm water management information proved to be difficult because such sites are largely associated with development projects and are accordingly privately owned and maintained. The cities hadn't previously prepared inventories of such sites and in some cases still do not have the staff or the budget to prepare an inventory for the purposes of this RMP. The majority of the data contained herein was taken from portions of Water Quality Management Plans (WQMP) provided by each contributing entity. Most of the WQMP portions provided contain all relevant data regarding the physical parameters of the storm water retention facilities as well as their tributary drainage areas. Facilities identified by the various cities, that were unaccompanied by provided portions of a WQMP, were mapped using an ArcGIS program. The facility and its tributary drainage area, with contributions from city storm drains, were then delineated using ArcGIS, 2007 aerial imagery, USGS 7.5 minute quadrangles, and city storm drain atlases (when available).

5.2.1 Existing Regional Storm Water Recharge Facilities and Policies Related to Storm Water Management and Recharge

Existing regional recharge basins developed for use in the Chino Basin recharge system (see Figure 5-1) are operated both for peak flood discharge attenuation as well as for the recharge of storm and supplemental water. The majority of the facilities are owned independently by either SBCFCD or CBWCD. The system is operated primarily by IEUA and is managed in order to benefit the flood control interests of SBCFCD, to recharge storm water and supplemental water for CBWCD and Watermaster in Chino Basin.

Recharge basins are served by eight main concrete lined channels and storm drains that collect storm water runoff throughout the Chino Basin. A total of 46 regional basins are classified as recharge basins to the Chino Groundwater Basin, totaling over 3,700 acre-ft of storage volume. The basins are further distinguished as either conservation or multi-purpose basins. There are 27 conservation basins operated to recharge storm water and supplemental water. The 19 multi-purpose basins are operated primarily for peak flood discharge attenuation and secondarily for the recharge of storm and supplemental water. Tables 5-1 and 5-2 identify the available physical and operational parameters for each regional recharge basin. Basins are grouped according to the water supply channel that is the primary source for the basin.

An additional 9 regional basins, with a total storage volume of over 2,600 acre-ft, are identified in Table 5-3 which are within the Chino Basin boundary, but are not operated for groundwater recharge purposes. These basins are not operated for groundwater recharge largely due to poor soil infiltration rates. These basins are primarily flow through basins that attenuate water for flood control purposes. Further study is required to determine if any improvements could be made to these basins in order to increase their recharge capabilities. According to personal communication with IEUA staff, Princeton Basin could potentially infiltrate recharge if properly maintained and operated as a recharge basin. CBWCD found that Lower Cucamonga and Chris Basins were underlain by a thick clay layer. The Wineville Basin was studied and determined to not be viable due to shallow clay lenses, however recent experience with Lower Day Basin indicates the clay lenses may result from gravel mining activity and remediation may be possible. Jurupa Basin was studied and found to percolate poorly. It is essentially used currently for water transfers to RP3 Basins, and is used to some degree as a settling basin prior to pumping to RP3. According to personal communication with SBCFCD staff, Merrill and Linden Basins are being evaluated for potential use as multi-purpose facilities. Currently they are being operated as flood control facilities.

5.2.1.1 General Operations for Recharge Basins

Conservation basins are generally operated according to rule curves which define a target water surface elevation and storage for each basin throughout the year. Basin operation depths vary by season depending on the availability of supplemental and storm water, but are generally maintained at or below a maximum depth. Rule curve designations for conservation basins are shown in columns L through Q on Table 5-1.

Multi-purpose basins are operated based on storm forecasting and the goal of limiting losses

of supplemental water. Accordingly, the basins are operated to limit supplemental water losses by limiting storage to the volume of water that can be percolated out of the basin in seven days. If the total volume of a basin can percolate in seven days, the maximum allowable storage is maintained with one foot of freeboard. Rule curve designations for multi-purpose basins are shown in columns I through P on Table 5-2.

The following are current general operational practices for recharge basins:

Conservation Mode

- Monitor depth of water in basins either on site or remotely through SCADA.
- Monitor infiltration rates to determine delivery rate.
- Inspect diversion and inlet structures to maintain functionality.
- Monitor water depth at rubber dams for signs of clogging.
- Unclog inlet structures and rubber dams as needed.
- Reduce flow rate to match infiltration capacity as water level reaches maximum level allowed in rule curve.

Pre-Storm Mode

- Assess basin states and forecast storm intensity using the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service website.
- If a forecast calls for measureable rainfall at 30% chance of rain or greater, 2-3 days before forecasted storm event, determine if expected storm will be significant and what actions are to be taken.
- A significant storm is considered to be 0.3 inches of rainfall per hour or 2.0 inches per 24 hours.
- Pre-Storm mode begins when potentially significant storm has been forecasted to occur within 7 days by NOAA.
- If significant storm is pending:
    - SBCFCD will contact IEUA coordinator.
    - Cease or curtail all supplemental water deliveries.
    - Cease diversions.
    - Open outlet gates at multipurpose basins to drain them and fully restore flood control capacity.

Storm Mode

- Rubber dams to be deflated (depending on when in the season a storm is occurring).
- Basins operated according to separate rules.
- Do not deliver supplemental water.
- When a significant storm is over or nearly over the SBCFCD will authorize transition

from Storm Mode to Conservation Mode:

- First phase
  - Inspect water turbidity for suspended mud (currently a visual observation).
  - Inspect basins, determine water level, and assess available storage.
  - Close outlets and/or open inlets at conservation basins.
- Second phase
  - Re-inflate the rubber dams

Tables 5-1 and 5-2 also include the main control elements for the transfer of water from either the channels to the basins, from basin to basin, or through a configuration of cells within a basin. The operation of each control element varies with a forecasted storm's severity. The typical settings for the first storm, non-significant storm, and significant storm are shown in columns W through Y on Table 5-1 and columns V through X on Table 5-2. Control elements are also operated based on flood control operation alert modes. The alert mode can be green, yellow, or red depending on a storm's severity. In general, the basins are operated in green and yellow alert modes during dry periods and non-significant storms. Basins are operated in red alert mode in the event of a significant storm. The control elements are operated either manually or remotely by the IEUA operator in green mode. In the yellow alert mode the control element settings are basically the same as in green mode, the yellow alert mode is essentially a signal from the IEUA operator to SBCFCD that the operator is aware of a forecasted storm and the proper measures have been taken to prepare the basins for the storm. The red alert mode signals control of the system by SBCFCD and includes a series of automatic system setting changes that are required by SBCFCD for flood control purposes.

IEUA developed automatic control settings (through the SCADA system) that are dependent on water surface elevations in order to maximize recharge during the green and yellow operational alert modes while allowing for proper flood control precautions. These settings would not function in the red alert mode. The flood control valve automation modes are described below in the more detailed descriptions of operations within the various storm channel systems. The automation modes allow automatic inlet gate operation under certain water level conditions. Prior to the development and implementation of the automation modes, the IEUA operator was required to manually change flow control valve positions using the SCADA system.

The five inflatable rubber dams also can be operated according to three mode settings. The rubber dams can be set to either maintain a desired water depth in the channel (level mode), a desired pressure on the dam (pressure mode), or manually inflated or deflated (manual mode). The result is a controlled release over the dam and/or through the inlet of a recharge basin. During a large storm event the rubber dams are set to level mode in order to maintain a desired water level. The dams have a failsafe measure in the form of an auto-deflate float switch that is designed as a control measure to deflate a dam once water overtops the depth of the float trigger. The automatic setting information for each rubber dam is shown in Table 5-

4.

Some of the basins, as indicated below, follow a procedure during particular storm events in order to limit the amount of debris, dust, dirt, and pollutants that can accumulate in channels from urban impervious areas (such as streets and parking lots) entering the recharge basins, thus minimizing maintenance. Such an event is referred to as a first flush opportunity. The rate of accumulation of debris and pollutants can vary depending on the area tributary to each basin. However, the current operating procedure for first flush opportunities is performed only in advance of the first storm event of the season or following a 30 day period lacking rainfall runoff. This is accomplished by closing inlet gates to the recharge basins for the first two hours of such an event.

5.2.1.2 General Operations for Recharge Basins

5.2.1.2.1 San Antonio Creek System

The IEUA Groundwater Recharge Coordinator will be in close contact with the Army Corps of Engineers regarding the discharge of storm water from San Antonio Dam during all operational modes.

First Flush Opportunity

In advance of the first flush opportunity, an IEUA Operator closes the following inlet gates for the San Antonio Creek System:

- SAC-CHW-A to College Heights West.
- SAC-CHE-A to College Heights East.
- SAC-UPL-A to Upland Basin.
- SAC-MT1-A to Montclair No. 1.
- SAC-BRK-A to Brooks Street Basin.

When the IEUA Groundwater Recharge Coordinator determines that the turbidity of the storm water is acceptable (visual observation) and significant inlet clogging debris has passed the site, an IEUA Operator can divert storm water into the College Heights, Upland, Montclair, and Brooks Street Basins. The IEUA Operator will then use the SCADA system to open the aforementioned inlet gates.

Storm Water Capture

College Heights Basins:

- Basins are only used when water is released from San Antonio Dam by Army Corp of Engineers.

Upland Basin:

- Water is conveyed to the basin via City of Upland storm drains.

- Basin is also used for water released from San Antonio Dam by Army Corp of Engineers.

Montclair Basins:

- The inlet gate SAC-MT1-A from San Antonio Channel will generally remain open to divert storm water into Montclair No. 1 (MT1) until the inlet gate is closed when the water surface elevations in all four basins are equal to or greater than their spill elevation to the next basin and open when any of these are lower than its spill elevation to the next basin (Montclair No. 1: elevation 1127.6, Montclair No. 2: elevation 1102.4, Montclair No. 3: elevation 1055.46, Montclair No. 4: elevation 1037.0).

Brooks Basin:

- In auto-mode, inlet gate SAC-BRK-A from San Antonio Channel closes when the Brooks Basin water level sensor (LT-0208) is greater than or equal to elevation 898.5 and opens when water level sensor LT-0208 is greater than or equal to elevation 913.0, about two feet before spilling towards an adjacent property.
- In auto-mode, inlet gate from the West State Street storm drain closes when LT-0208 is greater than or equal to elevation 907.9 (the flow line elevation of the West State St Storm Drain is 907.88) and opens when LT-0208 is less than 907.8, and also opens when LT-0208 is greater than or equal to elevation 913 (allows for outflow if basin is too full from street runoff).

5.2.1.2.2 West Cucamonga Channel System

First Flush Opportunity

Basins in the West Cucamonga Channel System are all multi-use basins (flow through), which require no special provisions for first flush opportunities. A first flush bypass is not applicable.

Storm Water Capture

The following are the procedures to operate the 7th and 8th Street and Ely Basins for the recharge of storm water for a storm that has a non-significant precipitation forecast:

7th and 8th Street Basins:

- Close sluice gate 7TH-WCC-M. This gate should remain closed throughout the storm unless the SBCFCD directs the IEUA Operator to open it during or following the storm.
- In auto-mode, the outlet gate to 7th Street Basin 8SS-7TH-A opens when the 8th Street Basin water level sensor (LT-0501) is greater than or equal to elevation 1139.5 and closes when LT-0501 is less than or equal to elevation 1139.
- The automated outlet gate to the continuation of the West Cucamonga Creek Channel opens when the 7th Street Basin water level sensor (LT-0502) is greater than or equal

to elevation 1134.5 and closes when LT-0502 drops to elevation 1134.0 (Outlet spillway elevation = 1134.0).

Ely Basins:

- Automated outlet gate to the continuation of the West Cucamonga Creek Channel EL3-WCC-A opens when the Ely Basin No. 3 water level sensor (LT-0602) is greater than or equal to elevation 835.5 and closes when LT-0602 is less than or equal to elevation 835.0 (Outlet spillway elevation is 837.0, CBWCD and SBCFCD contract establishes elevation 835.0 as approved water surface elevation for storage and recharge).

The following are the procedures to operate the 7th and 8th Street and Ely Basins for the recharge of storm water for a storm that has a significant precipitation forecast:

7th and 8th Street Basins:

- The 8SS-7TH-A, 7TH-WCC-A, and 8SN-8SS-M gates should be opened 24 hours prior to the storm's arrival and the basins should be fully drained to restore full flood control function before the storm starts.
- Near the end of the significant storm, the IEUA Groundwater Recharge Coordinator can, through coordination with SBCFCD, close sluice gates 8SS-7TH-A and 7TH-WCC-A.

Ely Basins:

- The EL3-WCC-A gate should be opened 24 hours prior to the storm's arrival and the basins should be drained to the elevation of the gate (829 feet msl) in order to restore full flood control function before the storm starts. EL3-WCCA should be closed before the storm begins. Automated sluice gate EL3-WCC-A is programmed to open when the water level in the Ely 3 Basin (EL3) reaches elevation 835 feet msl. The SBCFCD is responsible to ensure that EL3-WCC-A is either closed or open pursuant to SBCFCD storm operations procedures.
- Near the end of the significant storm, the IEUA Groundwater Recharge Coordinator can, through coordination with SBCFCD, close sluice gate EL3-WCC-A.

5.2.1.2.3 Riverside Drive Drain

First Flush Opportunity

There are no special provisions for a first flush opportunity.

Storm Water Capture

Grove Basin:

- The basin spills to the street, accordingly the outlet is kept closed for non-significant storms.
- The outlet flow control gate to Grove Ave. closes when the Basin's water level sensor

Appendix B

IMPROVEMENT PLANS FOR
FRANCIS STREET STORM DRAIN AND STREET REHABILITATION PROJECT
IN THE CITY OF ONTARIO

GENERAL NOTES:

1. ALL WORK SHALL BE DONE IN STRICT CONFORMANCE WITH THE CURRENT CITY OF ONTARIO STANDARD SPECIFICATIONS AND STANDARD DRAWINGS.
2. ANY CONTRACTOR PERFORMING WORK ON THIS PROJECT SHALL FAMILIARIZE HIMSELF WITH THE SITE AND SHALL BE SOLELY RESPONSIBLE FOR ANY DAMAGE TO EXISTING FACILITIES RESULTING DIRECTLY OR INDIRECTLY FROM HIS OPERATIONS, WHETHER OR NOT THEY ARE SHOWN ON THESE PLANS.
3. ALL OBSTRUCTIONS WITHIN THE AREA TO BE IMPROVED ARE TO BE REMOVED OR RELOCATED AT THE DIRECTION OF THE ENGINEER. UTILITIES ARE TO BE RELOCATED BY THEIR RESPECTIVE OWNERS. THE CONTRACTOR IS REFERRED TO SECTION 5 OF THE STANDARD SPECIFICATIONS.
4. UTILITY LINE LOCATIONS SHOWN WERE OBTAINED FROM AVAILABLE RECORDS AND WERE NOT LOCATED IN THE FIELD, UNLESS OTHERWISE NOTED. THE CONTRACTOR IS REFERRED TO SECTION 5 OF THE STANDARD SPECIFICATIONS.
5. IN CASE OF ANY ACCIDENTS INVOLVING SAFETY MATTERS COVERED BY SECTION 6409.1(B) OF THE CALIFORNIA LABOR CODE, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE STATE DIVISION OF OCCUPATIONAL SAFETY AND HEALTH.
6. STATE LAW (SB 3019) REQUIRES THE CONTRACTOR TO CONTACT UNDERGROUND SERVICE ALERT AND OBTAIN AN IDENTIFICATION NUMBER PRIOR TO THE ISSUANCE OF CITY'S ENCROACHMENT PERMIT. THE CONTRACTOR SHALL NOTIFY UNDERGROUND SERVICE ALERT (1-800-422-4133), 2 WORKING DAYS MINIMUM IN ADVANCE OF ANY CONSTRUCTION ACTIVITIES THAT CAN AFFECT ANY UNDERGROUND UTILITIES.
7. THE CONTRACTOR SHALL OBTAIN A NO-FEE TRAFFIC CONTROL PERMIT 48 HOURS PRIOR TO TIME OF CONSTRUCTION WITHIN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR IS REFERRED TO SECTION 7-10.3 OF THE STANDARD SPECIFICATION.
8. THE CONTRACTOR SHALL RENEW OR REPLACE ANY EXISTING TRAFFIC SIGNAL CONTROL LOOPS, TRAFFIC STRIPING AND/OR PAVEMENT MARKINGS, WHICH DURING HIS OPERATIONS HAVE BEEN EITHER REMOVED OR THE EFFECTIVENESS OF WHICH HAS BEEN REDUCED. RENEWAL OF PAVEMENT STRIPING AND MARKINGS SHALL BE DONE IN CONFORMANCE WITH SECTION 310-5.6 OF THE STANDARD SPECIFICATIONS. ALL REGULATORY, WARNING, AND GUIDE SIGNS SHALL BE DIAMOND VIP GRADE.
9. PAVEMENT SHALL NOT BE CONSTRUCTED UNTIL ALL UNDERGROUND UTILITIES HAVE BEEN INSTALLED, TESTED, AND APPROVED BY THE ENGINEER.
10. SEWER AND DRAINAGE MANHOLES, AND WATER VALVES SHALL BE RAISED TO GRADE BY THE PAVING CONTRACTOR.
11. STRUCTURAL SECTIONS SHOWN ON PLANS ARE ASSUMED (BASED ON R-VALUE OF 50). AT THE COMPLETION OF ROUGH GRADING OPERATIONS, A SOILS REPORT INCLUDING R-VALUES SHALL BE PREPARED BY A QUALIFIED GEOTECHNICAL ENGINEER. THE RECOMMENDED STRUCTURAL SECTIONS SHALL BE SUBMITTED FOR THE ENGINEER'S REVIEW AND APPROVAL.
12. ALL SUBGRADE MATERIAL SHALL HAVE A MINIMUM R-VALUE OF 65 IF SOIL TEST YIELDS R-VALUE OF LESS THAN 65, THE LOWER R-VALUE SHALL BE USED FOR STRUCTURAL SECTION DESIGN.
13. ALL SIDEWALK OBSTRUCTIONS SHALL HAVE SIDEWALK TRANSITION CONSTRUCTED PER CITY OF ONTARIO STANDARD DRAWING NO. 125.
14. IT IS THE CONTRACTORS RESPONSIBILITY TO INSURE ALL CURBS AND GUTTERS HAVE BEEN CONSTRUCTED TO PLAN GRADES IN AREAS BELOW 0.50% FIELD VERIFICATION FOR THOSE AREAS IS REQUIRED. THE CITY OF ONTARIO WILL REQUIRE THE REMOVAL AND RECONSTRUCTION OF CURBS AND GUTTERS WHICH ARE NOT SATISFACTORY.
15. AN APPROVED SET OF PLANS SHALL BE AT THE JOBSITE AT ALL TIMES DURING CONSTRUCTION.
16. STATIONING IS ALONG THE CENTERLINE OF THE STREET, UNLESS OTHERWISE NOTED.
17. THE CONTRACTOR SHALL POSSESS A CLASS "A" CONTRACTOR'S LICENSE ISSUED BY THE STATE OF CALIFORNIA AT THE TIME THIS CONTRACT IS AWARDED.
18. CONTRACTOR IS RESPONSIBLE FOR PRESERVATION AND/OR PERPETUATION OF ALL EXISTING MONUMENTS WHICH CONTROL SUBDIVISIONS, TRACTS, BOUNDARIES, STREETS, HIGHWAYS, OTHER RIGHTS-OF-WAY, EASEMENTS, OR PROVIDE SURVEY CONTROL WHICH WILL BE DISTURBED OR REMOVED DUE TO CONTRACTOR'S WORK. CONTRACTOR SHALL PROVIDE A MINIMUM OF 10 WORKING DAYS NOTICE TO PROJECT ENGINEER/SURVEYOR PRIOR TO DISTURBANCE OR REMOVAL OF EXISTING MONUMENTS. PROJECT ENGINEER/SURVEYOR SHALL COORDINATE WITH CONTRACTOR TO RESET MONUMENTS OR PROVIDE PERMANENT WITNESS MONUMENTS AND FILE THE REQUIRED DOCUMENTATION WITH THE COUNTY SURVEYOR PURSUANT TO BUSINESS AND PROFESSIONS CODE SECTION 8771.
19. THE CONTRACTOR SHALL PROVIDE THE ENGINEER A COMPLETE SET OF "AS-BUILT" DRAWINGS AFTER THE COMPLETION OF CONSTRUCTION.
20. WHERE UTILITIES NEED TO BE SUPPORTED, SAID SUPPORTS SHALL BE IN ACCORDANCE WITH L.A.C.F.C.D. STANDARD 2-D173.1, .2, OR .3 UNLESS OTHERWISE INDICATED.
21. DESIGN OF THE PIPE SHOWN HEREON IS BASED ON THE ASSUMPTION THE PIPE WILL BE INSTALLED IN ACCORDANCE WITH CASE III BEDDING AS SHOWN ON L.A.C.F.C.D. STANDARD 2-D177, UNLESS OTHERWISE SHOWN. "W" VALUE SHALL BE AS SPECIFIED ON L.A.C.F.C.D. STANDARD 2-D177 FOR CASE III BEDDING, NOTES 3(A), 3(B), AND 3(C). IF THE "W" VALUE AT THE TOP OF THE PIPE IS EXCEEDED, THE BEDDING SHALL BE MODIFIED AND/OR PIPE OF ADDITIONAL STRENGTH SHALL BE PROVIDED. THE PROPOSED MODIFICATION SHALL BE APPROVED BY THE ENGINEER.

* SEE GENERAL NOTES 11 & 12

STREET CONSTRUCTION NOTES:

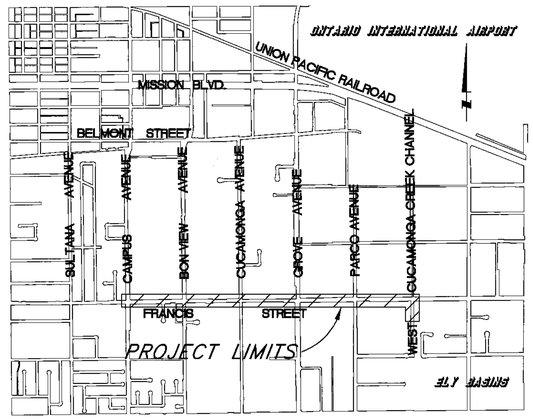
		QUANTITIES
* (1)	CONSTRUCT 6" A.C. PAVEMENT	382,760 SF
* (2)	CONSTRUCT 8" CRUSHED AGGREGATE BASE	382,760 SF
(3)	CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "B"	4,824 LF
(4)	CONSTRUCT CROSS GUTTER AND SPANDREL PER CITY OF ONTARIO STD. DWG. NO. 120	2,550 SF
(5)	CONSTRUCT 5' P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121 & 125	25,000 SF
(6)	CONSTRUCT WHEELCHAIR RAMP PER CITY OF ONTARIO STD. DWG. NO. 127	6 EA
(7)	CONSTRUCT COMMERCIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 117, WIDTH PER PLAN	4,730 SF
(8)	CONSTRUCT 4" WIDE, VARIABLE HEIGHT CURB BEHIND SIDEWALK, POUR MONOLITHIC WITH SIDEWALK.	745 LF
(9)	CONSTRUCT SPECIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 119.	5,100 SF
(10)	ADJUST WATER VALVE TO GRADE	14 EA
(11)	ADJUST SEWER OR STORM DRAIN MANHOLE TO GRADE	10 EA
(12)	ADJUST GTE OR EDISON VAULT TO GRADE (BY OTHERS)	8 EA
(13)	CONSTRUCT PARKWAY DRAIN NO. 1 PER CITY OF ONTARIO STD. DWG. NO. 309, TYPE PER PLAN	2 EA
(14)	RELOCATE POWER POLE (BY OTHERS)	6 EA
(15)	RELOCATE AIR VALVE / BLOWOFF BEHIND NEW CURB PER CITY OF ONTARIO STD. DWG. NO. 413,414, OR 415	1 EA
(16)	INSTALL FIRE HYDRANT ASSEMBLY PER CITY OF ONTARIO STD. DWG. NO. 402 OR 403.	2 EA
(17)	EXTEND WATER SERVICE AND RELOCATE EXISTING METER AND BOX BEHIND CURB PER CITY OF ONTARIO STD. DWG. NO. 407,408 & 409.	5 EA
(18)	CONSTRUCT 6" CURB ONLY PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "A"	160 LF
(19)	CONSTRUCT 3' RIBBON GUTTER PER DETAIL ON SHEET 8.	50 LF
(20)	CONSTRUCT 6" P.C.C. PAVEMENT	360 SF
(21)	INSTALL 36"x36" CATCH BASIN PER BROOKS PRODUCTS OR APPROVED EQUAL.	1 EA
(22)	INSTALL 12" P.V.C. (SCH 40) PIPE	10 LF
(23)	INSTALL 6' CHAIN LINK FENCE PER APWA STD 600-1.	217 LF
(24)	INSTALL 12' WIDE CHAIN LINK GATE PER APWA STD 600-1.	2 EA
(25)	CONSTRUCT 8" AC BERM PER CITY OF ONTARIO STD. DWG. NO. 116	78 LF
(26)	ADJUST FIRE HYDRANT TO GRADE	6 EA
(27)	RELOCATE EXIST. C.L. FENCE TO R/W	575 LF

STORM DRAIN CONSTRUCTION NOTES:

		QUANTITIES
1	CONSTRUCT 18" R.C.P. STORM DRAIN, D-LOAD PER PLAN	125 LF
2	CONSTRUCT 24" R.C.P. STORM DRAIN, D-LOAD PER PLAN	540 LF
3	CONSTRUCT 30" R.C.P. STORM DRAIN, D-LOAD PER PLAN	120 LF
4	CONSTRUCT 36" R.C.P. STORM DRAIN, D-LOAD PER PLAN	86 LF
5	NOT USED	0 LF
6	CONSTRUCT 48" R.C.P. STORM DRAIN, D-LOAD PER PLAN	192 LF
7	CONSTRUCT 63" R.C.P. STORM DRAIN, D-LOAD PER PLAN	154 LF
8	CONSTRUCT 66" R.C.P. STORM DRAIN, D-LOAD PER PLAN	61 LF
9	CONSTRUCT 72" R.C.P. STORM DRAIN, D-LOAD PER PLAN	96 LF
10	CONSTRUCT 84" R.C.P. STORM DRAIN, D-LOAD PER PLAN	1,540 LF
11	CONSTRUCT 108" R.C.P. STORM DRAIN, D-LOAD PER PLAN	1,274 LF
12	CONSTRUCT 120" R.C.P. STORM DRAIN, D-LOAD PER PLAN	2,560 LF
13	CONSTRUCT 132" R.C.P. STORM DRAIN, D-LOAD PER PLAN	1,789 LF
14	CONSTRUCT CHANNEL CONNECTION PER DETAILS ON SHEETS 25 & 26	105 LF
15	CONSTRUCT CATCH BASIN PER CITY OF ONTARIO STD. DWG. 302 & 303, W PER PLAN	26 EA
16	CONSTRUCT LOCAL DEPRESSION PER CITY OF ONTARIO STD. DWG. 304	3,122 SF
17	CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1	13 EA
18	CONSTRUCT MANHOLE PER APWA STD. DWG. 322-1	7 EA
19	CONSTRUCT BRICK & MORTAR PLUG (>66")	3 EA
20	CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 331-2	1 EA
21	CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 332-1, CASE PER PLAN	7 EA
22	CONSTRUCT STANDARD R.C.P. CONNECTION PER SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT STD. SP 220.	1 EA
23	CONSTRUCT CONCRETE COLLAR PER APWA STD. DWG. 380-2.	14 EA
24	CONSTRUCT TRANSITION STRUCTURE PER APWA STD. DWG. 342-1	4 EA
25	CONSTRUCT 12'x8' R.C.B. STORM DRAIN PER CALTRANS STD. PLAN D80	20 LF
26	CONSTRUCT 6'x4' R.C.B. STORM DRAIN PER CALTRANS STD. PLAN D80	21 LF
27	CONSTRUCT SEWER MANHOLE PER CITY STD. 201	1 EA
28	REPLACE CHANNEL WALL PER SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT STD. SP 192E.	1,000 SF
29	RECONSTRUCT EXIST. 6' C.L. FENCE PER SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT STD. DWG. II	90 LF
30	CONSTRUCT PRESSURE SHAFT AND MANHOLE COVER PER APWA STD. DWG. 211-1 AND 328-1	1 EA

REMOVAL NOTES:

		QUANTITIES
(A)	REMOVE EXISTING A.C. PAVEMENT	200,000 SF
(B)	REMOVE EXISTING CURB AND GUTTER	1,680 LF
(C)	REMOVE EXISTING SIDEWALK/DRIVE APPROACH	6,900 SF
(D)	REMOVE EXISTING AC BERM	3,400 LF
(E)	REMOVE EXISTING RETAINING WALL	650 LF
(F)	REMOVE EXISTING CROSS GUTTER	60 SF
(G)	REMOVE EXISTING CATCH BASIN (GRATED INLET) AND PLUG PIPE	1 EA
(H)	REMOVE EXISTING CHAIN LINK FENCE	340 LF
(J)	REMOVE EXISTING STORM DRAIN PIPE	1,040 LF
(K)	REMOVE EXISTING CATCH BASIN	4 EA
(L)	REMOVE EXISTING MANHOLE	7 EA
(M)	PLUG & ABANDON STORM DRAIN PIPE	11 EA
(N)	REMOVE EXISTING AIR VALVE	1 EA
(P)	REMOVE EXISTING VALVE COVER & SEAL WITH SLURRY	8 EA
(Q)	REMOVE EXISTING FIRE HYDRANT ASSEMBLY, SALVAGE FIRE HYDRANT HEAD	2 EA
(R)	REMOVE EXISTING TREE / BUSH	13 EA
(S)	REMOVE EXISTING CONFLICTING ABANDONED UTILITY	60 LF



VICINITY MAP

N. T. S.

SHEET INDEX

SHT. NO.	DESCRIPTION
1	TITLE SHEET
2	TYPICAL SECTIONS
3	FRANCIS STREET - BON VIEW AVENUE TO STA. 45+00
4	FRANCIS STREET - STA. 45+00 TO STA. 55+00
5	FRANCIS STREET - STA. 55+00 TO GROVE AVENUE
6	CUCAMONGA AVENUE
7	BON VIEW AVENUE
8	STREET CONSTRUCTION DETAILS
9	INTERSECTION DETAIL - FRANCIS STREET & CUCAMONGA AVENUE
10	SIGNING AND STRIPING - CAMPUS AVENUE TO STA. 43+00
11	SIGNING AND STRIPING - CUCAMONGA AVENUE
12	SIGNING AND STRIPING - STA. 43+00 TO GROVE AVENUE
13	STORM DRAIN - STA. 11+77.87 TO STA. 18+40.04
14	STORM DRAIN - STA. 18+40.04 TO STA. 28+00
15	STORM DRAIN - STA. 28+00 TO STA. 38+00
16	STORM DRAIN - STA. 38+00 TO STA. 48+00
17	STORM DRAIN - STA. 48+00 TO STA. 57+00
18	STORM DRAIN - STA. 57+00 TO STA. 67+00
19	STORM DRAIN - STA. 67+00 TO STA. 77+00
20	STORM DRAIN - STA. 77+00 TO STA. 85+53.01
21	STORM DRAIN - LATERAL PROFILES
22	STORM DRAIN - LATERAL PROFILES
23	STORM DRAIN - LATERAL PROFILES
24	STORM DRAIN - LATERAL PROFILES
25	STORM DRAIN CONSTRUCTION DETAILS
26	STORM DRAIN CONSTRUCTION DETAILS - CHANNEL CONNECTION
27	STORM DRAIN CONSTRUCTION DETAILS - CHANNEL CONNECTION
28	STORM DRAIN CONSTRUCTION DETAILS - CHANNEL CONNECTION
29	STREET LIGHTING - BON VIEW TO STA. 55+00
30	STREET LIGHTING - STA. 55+00 TO GROVE
31	WATER LINE ABANDONMENT
32	WATER LINE ABANDONMENT

NOTICE TO CONTRACTORS

CONSTRUCTION CONTRACTOR AGREES THAT IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, CONSTRUCTION CONTRACTOR WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS, AND CONSTRUCTION CONTRACTOR FURTHER AGREES TO DEFEND, INDEMNIFY AND HOLD DESIGN PROFESSIONAL HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF DESIGN PROFESSIONAL.

California Council of Civil Engineers & Land Surveyors

ALL CONTRACTOR AND SUBCONTRACTORS PERFORMING WORK SHOWN ON OR RELATED TO THESE PLANS SHALL CONDUCT THEIR OPERATIONS SO THAT EMPLOYEES ARE PROVIDED A SAFE PLACE TO WORK AND THE PUBLIC IS PROTECTED. ALL CONTRACTORS AND SUBCONTRACTORS SHALL COMPLY WITH THE "OCCUPATIONAL SAFETY AND HEALTH REGULATIONS" OF THE U.S. DEPARTMENT OF LABOR AND WITH THE STATE OF CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS "CONSTRUCTION SAFETY ORDERS". THE CIVIL ENGINEER SHALL NOT BE RESPONSIBLE IN ANY WAY FOR THE CONTRACTOR OR SUBCONTRACTORS COMPLIANCE WITH SAID REGULATIONS AND ORDERS.

PRIVATE ENGINEER'S NOTICES TO CONTRACTORS

THE EXISTENCE AND APPROXIMATE LOCATION OF ANY UNDERGROUND UTILITIES OR STRUCTURES SHOWN ON THESE PLANS HAVE BEEN OBTAINED BY A SEARCH OF AVAILABLE RECORDS. TO THE BEST OF OUR KNOWLEDGE, THERE ARE NO EXISTING UTILITIES OR STRUCTURES EXCEPT AS SHOWN ON THESE PLANS. THE ENGINEER ASSUMES NO LIABILITY AS TO THE EXACT LOCATION OF SAID LINES NOR FOR UTILITIES OR IRRIGATION LINES WHOSE LOCATIONS ARE NOT SHOWN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING ALL UTILITY AND IRRIGATION COMPANIES PRIOR TO WORK ON EXCAVATION TO DETERMINE EXACT LOCATION OF ALL LINES AFFECTING THIS WORK, WHETHER OR NOT SHOWN HERON, AND FOR ANY DAMAGE OR PROTECTION OF THESE LINES.

THE CONTRACTOR SHALL CALL IN A LOCATION REQUEST TO UNDERGROUND SERVICE ALERT (U.S.A.) PHONE 1-800-422-4133 TWO (2) WORKING DAYS PRIOR TO DIGGING. NO CONSTRUCTION PERMIT ISSUED BY THE CITY OF ONTARIO ENGINEERING DEPARTMENT SHALL BE VALID INVOLVING UNDERGROUND FACILITIES UNLESS THE APPLICANT HAS AN INQUIRY IDENTIFICATION NUMBER ISSUED BY U.S.A.

LEGEND

- CONSTRUCT P.C.C. SIDEWALK, DRIVEWAY
- CONSTRUCT A.C. PAVEMENT
- EXISTING STREET LIGHT
- EXISTING MANHOLE
- EXISTING FIRE HYDRANT
- (18" W) EXISTING UTILITY LINE
- EXISTING UTILITY POLE
- DIRECTION OF DRAINAGE
- (990) EXISTING CONTOUR (ELEVATION)
- PROPOSED FIRE HYDRANT
- PROPOSED STREET LIGHT

LIST OF ABBREVIATIONS

∢ PT	ANGLE POINT
AC	ASPHALT CONCRETE
BC	BEGIN CURVE
BCR	BEGIN CURB RETURN
C.B.	CATCH BASIN
CB	CURB
CONC.	CONCRETE
D/W	DRIVEWAY
EC	END CURVE
ECR	END CURB RETURN
EP	EDGE OF PAVEMENT
FL	FLOWLINE
FS	FINISH SURFACE
GB	GRADE BREAK
GTR.	GUTTER
HP	HIGH POINT
INV	INVERT
LT	LEFT
M.H.	MANHOLE
PCC	POINT OF COMPOUND CURVE
PRC	POINT OF REVERSE CURVE
P.C.C.	PORTLAND CEMENT CONCRETE
RT	RIGHT
S/W	SIDEWALK
ST. STA.	STREET STATION
TB	TOP OF BERM
TC	TOP OF CURB
T.F.	TOP OF FOOTING
TW	TOP OF WALL

Underground Service Alert
DIG ALERT BEFORE YOU DIG
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O Land Planning Civil Engineering Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750

Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
IMPROVEMENT PLANS FOR
FRANCIS STREET
TITLE SHEET

SHEET 1 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D130360

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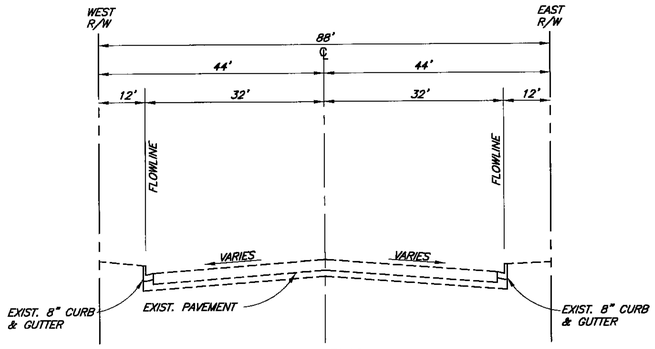
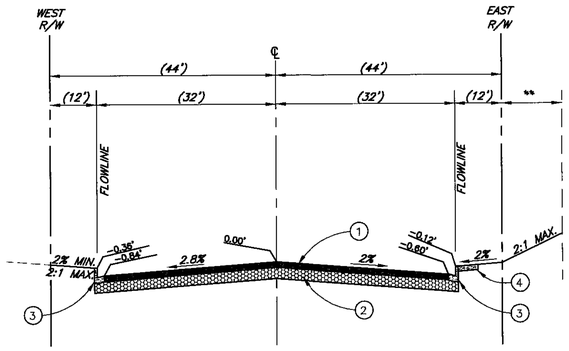


EXISTING

CAMPUS AVENUE, BON VIEW AVENUE, PARCO AVENUE

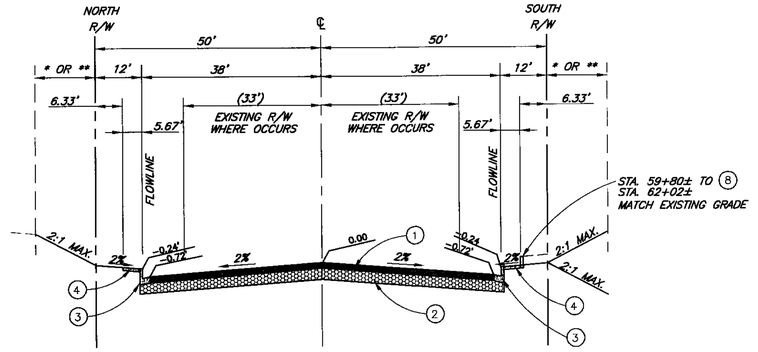
STA. 10+68 TO STA. 12+00
N.T.S.
TI=8.5



CUCAMONGA AVENUE

STA. 10+68± TO STA. 12+00
N.T.S.
TI=8.5

** GRADE TO DAYLIGHT AS NECESSARY AND REPLACE EXIST. LANDSCAPE IN KIND, SEE SPECIAL PROVISIONS

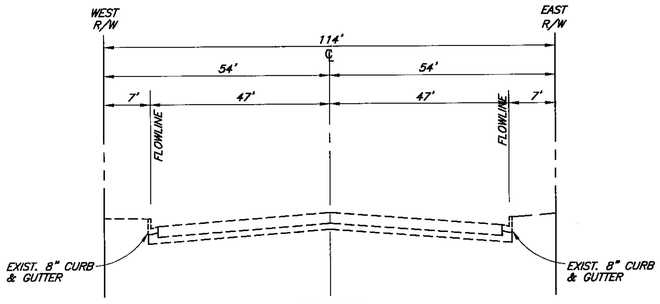


FRANCIS STREET

STA. 51+00 TO STA. 62+02±
N.T.S.
TI=10

* SEE PLAN VIEW FOR LOCATION AND DIMENSION OF TEMPORARY CONSTRUCTION AND SLOPE EASEMENTS.

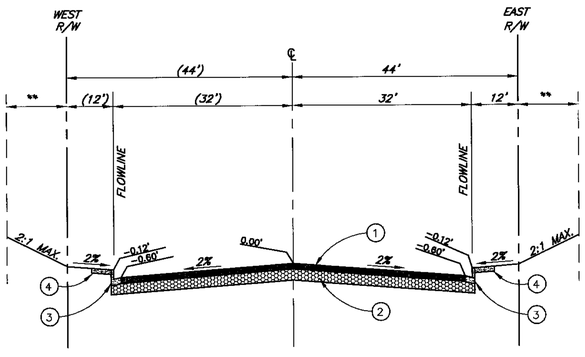
** GRADE TO DAYLIGHT AS NECESSARY AND REPLACE EXIST. LANDSCAPE IN KIND, SEE SPECIAL PROVISIONS



EXISTING

GROVE AVENUE

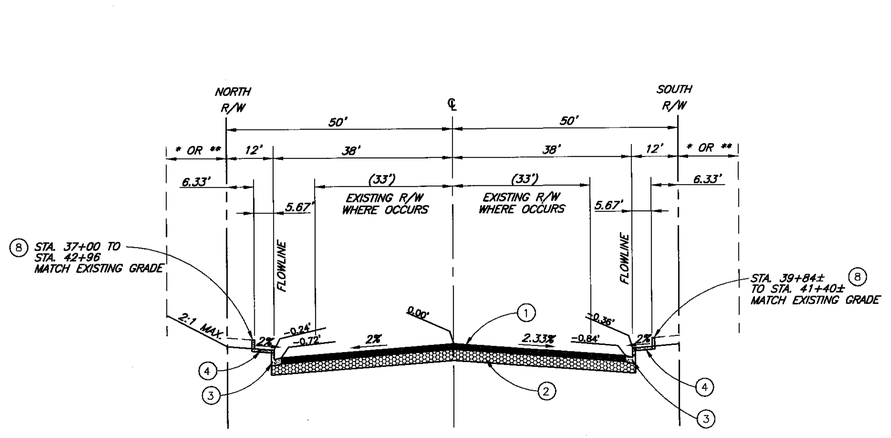
STA. 10+68 TO STA. 12+00
N.T.S.



CUCAMONGA AVENUE

STA. 6+12.53TO STA. 9+32±
N.T.S.
TI=8.5

** GRADE TO DAYLIGHT AS NECESSARY AND REPLACE EXIST. LANDSCAPE IN KIND, SEE SPECIAL PROVISIONS

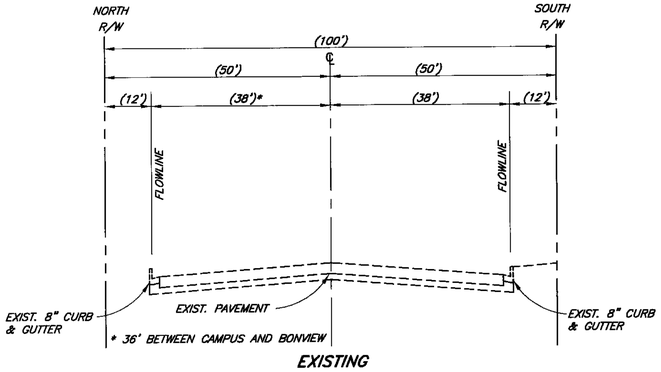


FRANCIS STREET

STA. 37+00± TO STA. 48+00
N.T.S.
TI=10

* SEE PLAN VIEW FOR LOCATION AND DIMENSION OF TEMPORARY CONSTRUCTION AND SLOPE EASEMENTS.

** GRADE TO DAYLIGHT AS NECESSARY AND REPLACE EXIST. LANDSCAPE IN KIND, SEE SPECIAL PROVISIONS



EXISTING

FRANCIS STREET

CAMPUS TO BONVIEW
GROVE TO WEST CUCAMONGA CREEK CHANNEL
N.T.S.
TI=10

STREET CONSTRUCTION NOTES

(1) CONSTRUCT 6" A.C. PAVEMENT
(2) CONSTRUCT 8" CRUSHED AGGREGATE BASE
(3) CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO 114, TYPE "B"
(4) CONSTRUCT 5' P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121 & 125
(8) CONSTRUCT 4" WIDE, VARIABLE HEIGHT CURB BEHIND SIDEWALK, POUR MONOLITHIC WITH SIDEWALK

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY ____ DATE ____
DRAWN BY ____ DATE ____
REVIEWED BY ____ DATE ____

CITY OF ONTARIO

RECOMMENDED BY ____ ASSISTANT CITY ENGINEER ____ DATE
ACCEPTED BY ____ CITY ENGINEER ____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O Land Planning Civil Engineering Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

CITY OF ONTARIO
IMPROVEMENT PLANS FOR
FRANCIS STREET
TYPICAL SECTIONS

SHEET 2 OF 32
CONTRACT ____
ACCOUNT ____
DWG. NO. D13037

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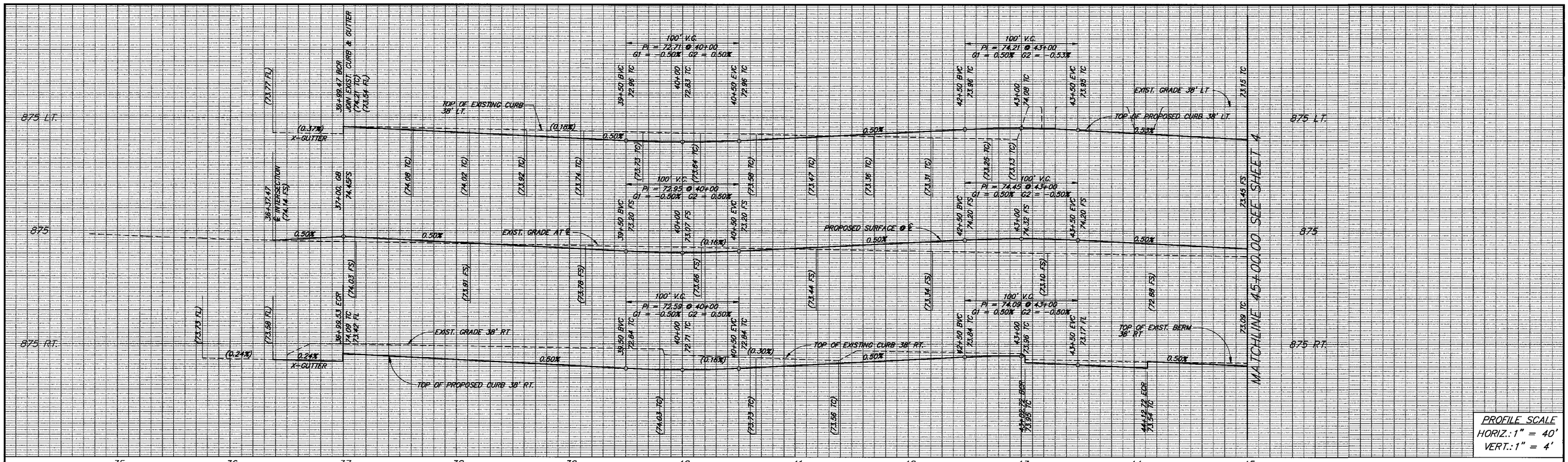
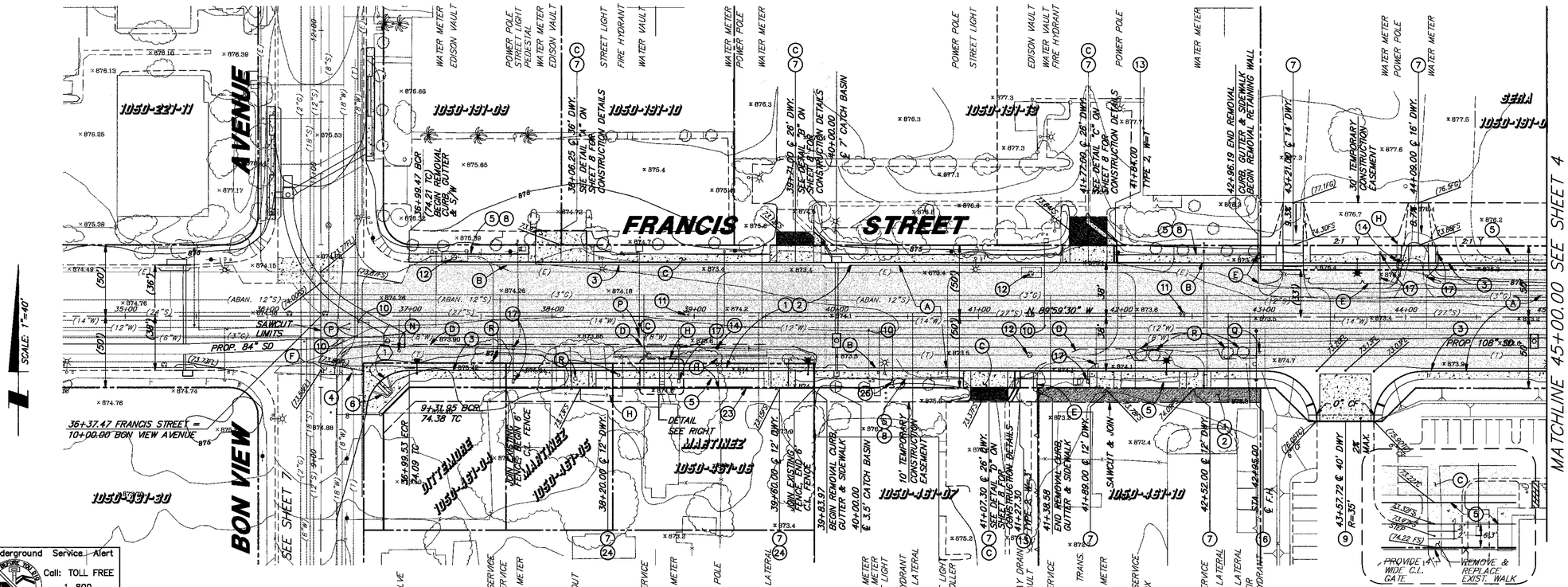


PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'



STREET CONSTRUCTION NOTES:

1. CONSTRUCT 6" A.C. PAVEMENT
2. CONSTRUCT 8" CRUSHED AGGREGATE BASE
3. CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "B"
4. CONSTRUCT CROSS GUTTER AND SPANDREL PER CITY OF ONTARIO STD. DWG. NO. 120
5. CONSTRUCT 5' P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121 & 125
6. CONSTRUCT WHEELCHAIR RAMP PER CITY OF ONTARIO STD. DWG. NO. 127
7. CONSTRUCT COMMERCIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 117, WIDTH PER PLAN
8. CONSTRUCT 4" WIDE, VARIABLE HEIGHT CURB BEHIND SIDEWALK, POUR MONOLITHIC WITH SIDEWALK.
9. CONSTRUCT SPECIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 119
10. ADJUST WATER VALVE TO GRADE
11. ADJUST SEWER OR STORM DRAIN MANHOLE TO GRADE
12. ADJUST GTE OR EDISON VAULT TO GRADE (BY OTHERS)
13. CONSTRUCT PARKWAY DRAIN NO. 1 PER CITY OF ONTARIO STD. DWG. NO. 309, TYPE PER PLAN
14. RELOCATE POWER POLE (BY OTHERS)
16. INSTALL FIRE HYDRANT ASSEMBLY PER CITY OF ONTARIO STD. DWG. NO. 402
17. EXTEND WATER SERVICE AND RELOCATE EXISTING METER AND BOX BEHIND CURB PER CITY OF ONTARIO STD. DWG. NO. 407,408 & 409.
23. INSTALL 6' CHAIN LINK FENCE PER APWA STD. 600-1
24. INSTALL 12' WIDE CHAIN LINK GATE PER APWA 600-1.
26. ADJUST FIRE HYDRANT TO GRADE.

REMOVAL NOTES:

- (A) REMOVE EXISTING A.C. PAVEMENT
- (B) REMOVE EXISTING CURB AND GUTTER
- (C) REMOVE EXISTING SIDEWALK/DRIVE APPROACH
- (D) REMOVE EXISTING AC BERM
- (E) REMOVE EXISTING RETAINING WALL
- (F) REMOVE EXISTING CROSS GUTTER
- (H) REMOVE EXISTING CHAIN LINK FENCE
- (N) REMOVE EXISTING AIR VALVE
- (P) REMOVE EXISTING VALVE COVER & SEAL WITH SLURRY
- (Q) REMOVE EXISTING FIRE HYDRANT ASSEMBLY, SALVAGE FIRE HYDRANT HEAD
- (R) REMOVE EXISTING TREE/BUSH

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
1	90°02'44"	30.00'	47.15'	30.02'

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

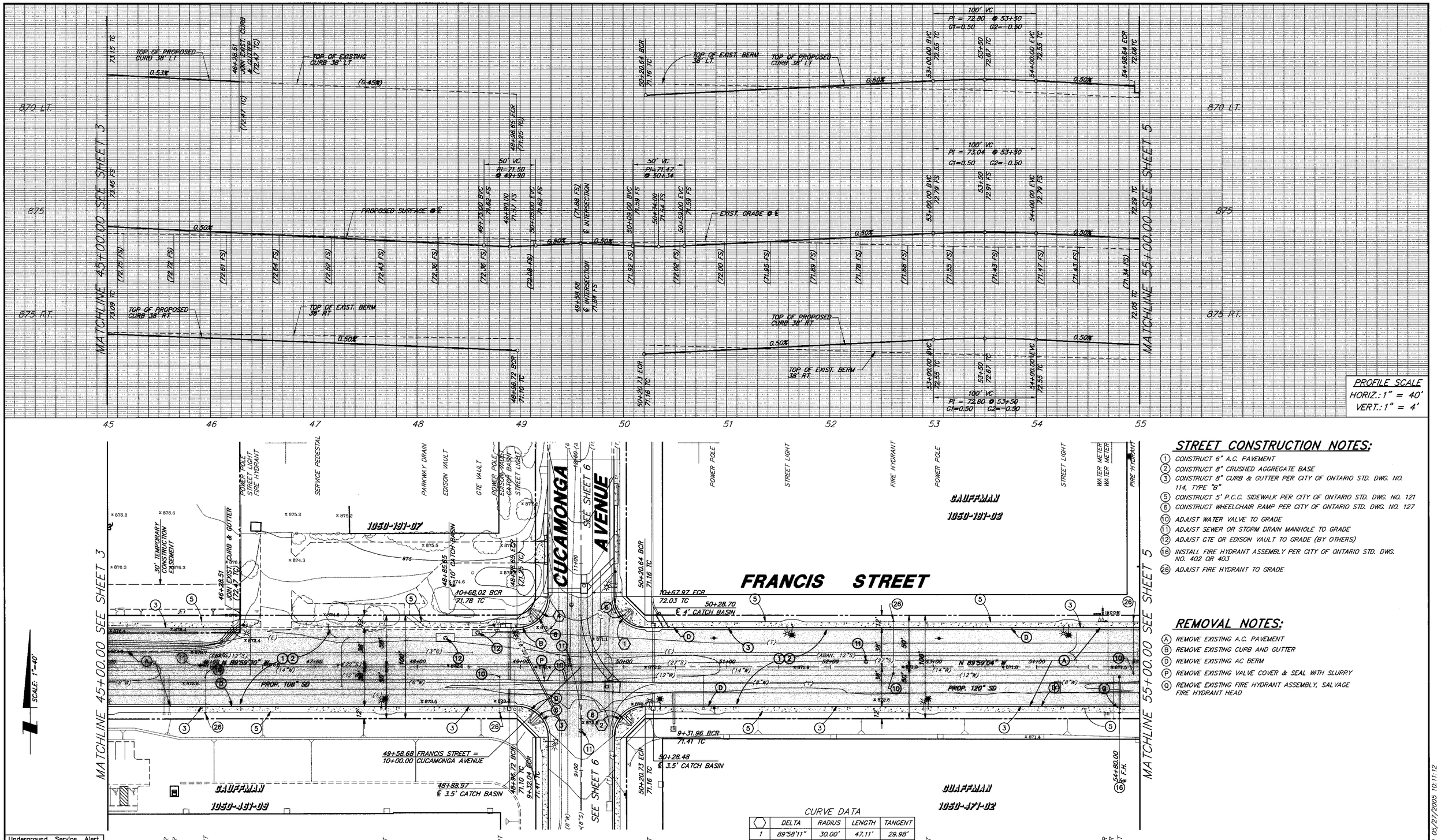
BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STREET IMPROVEMENT
FRANCIS STREET
BON VIEW AVENUE TO STA. 45+00.00

SHEET 3 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13038



STREET CONSTRUCTION NOTES:

1. CONSTRUCT 6" A.C. PAVEMENT
2. CONSTRUCT 8" CRUSHED AGGREGATE BASE
3. CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "B"
5. CONSTRUCT 5' P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121
6. CONSTRUCT WHEELCHAIR RAMP PER CITY OF ONTARIO STD. DWG. NO. 127
10. ADJUST WATER VALVE TO GRADE
11. ADJUST SEWER OR STORM DRAIN MANHOLE TO GRADE
12. ADJUST GTE OR EDISON VAULT TO GRADE (BY OTHERS)
16. INSTALL FIRE HYDRANT ASSEMBLY PER CITY OF ONTARIO STD. DWG. NO. 402 OR 403
26. ADJUST FIRE HYDRANT TO GRADE

REMOVAL NOTES:

- (A) REMOVE EXISTING A.C. PAVEMENT
- (B) REMOVE EXISTING CURB AND GUTTER
- (D) REMOVE EXISTING AC BERM
- (P) REMOVE EXISTING VALVE COVER & SEAL WITH SLURRY
- (Q) REMOVE EXISTING FIRE HYDRANT ASSEMBLY, SALVAGE FIRE HYDRANT HEAD

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
1	89°58'11"	30.00'	47.11'	29.98'
2	90°02'25"	30.00'	47.14'	30.02'
3	89°58'01"	30.00'	47.11'	29.98'
4	90°01'23"	30.00'	47.14'	30.02'

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

S&O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STREET IMPROVEMENT
FRANCIS STREET
STA. 45+00.00 TO STA. 55+00.00

SHEET 4 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. PB039

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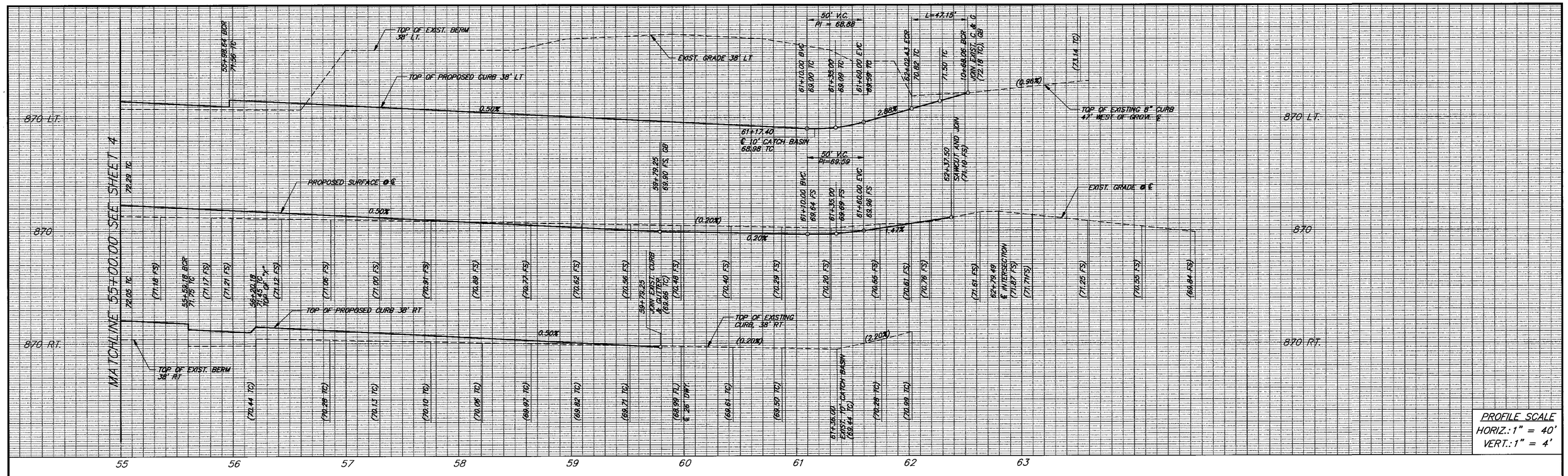
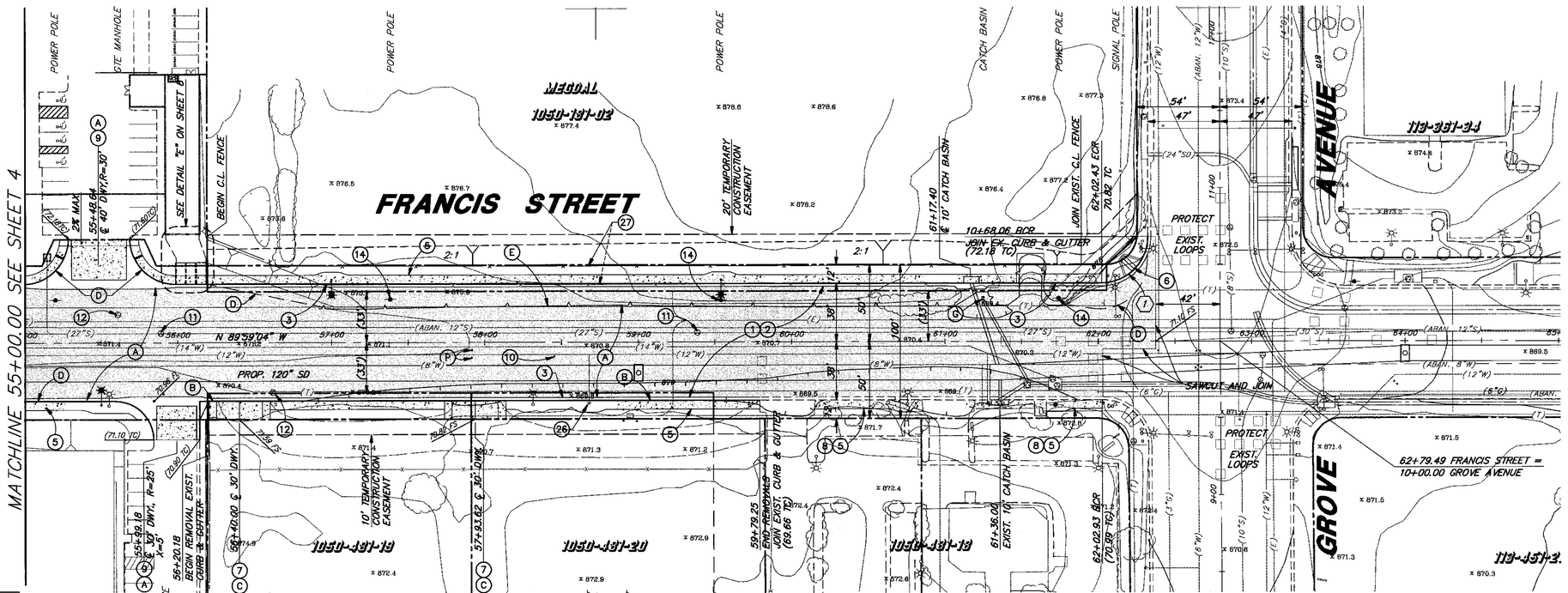


PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'



STREET CONSTRUCTION NOTES:

1. CONSTRUCT 6" A.C. PAVEMENT
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3. CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "B"
5. CONSTRUCT P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121
6. CONSTRUCT WHEELCHAIR RAMP PER CITY OF ONTARIO STD. DWG. NO. 127
7. CONSTRUCT COMMERCIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 117, WIDTH PER PLAN
8. CONSTRUCT 4" WIDE, VARIABLE HEIGHT CURB BEHIND SIDEWALK, POUR MONOLITHIC WITH SIDEWALK.
9. CONSTRUCT SPECIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 119.
10. ADJUST WATER VALVE TO GRADE
11. ADJUST SEWER OR STORM DRAIN MANHOLE TO GRADE
12. ADJUST GTE OR EDISON VAULT TO GRADE (BY OTHERS)
14. RELOCATE POWER POLE (BY OTHERS)
26. ADJUST FIRE HYDRANT TO GRADE
27. RELOCATE EXIST. C.L. FENCE TO R/W

REMOVAL NOTES:

- (A) REMOVE EXISTING A.C. PAVEMENT
- (B) REMOVE EXISTING CURB AND GUTTER
- (C) REMOVE EXISTING SIDEWALK/DRIVE APPROACH
- (D) REMOVE EXISTING AC BERM
- (E) REMOVE EXISTING RETAINING WALL
- (G) REMOVE EXISTING CATCH BASIN (GRATED INLET) AND PLUG PIPE
- (P) REMOVE EXISTING VALVE COVER & SEAL WITH SLURRY

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
1	90°02'42"	30.00'	47.15'	30.02'

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY ____ DATE ____
DRAWN BY ____ DATE ____
CHECKED BY ____ DATE ____

CITY OF ONTARIO

RECOMMENDED BY ____ ASSISTANT CITY ENGINEER ____ DATE
ACCEPTED BY ____ CITY ENGINEER ____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS, JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STREET IMPROVEMENT
FRANCIS STREET
STA. 55+00.00 TO GROVE AVENUE

SHEET 5 OF 32
CONTRACT ____
ACCOUNT ____
DWG. NO. D13040

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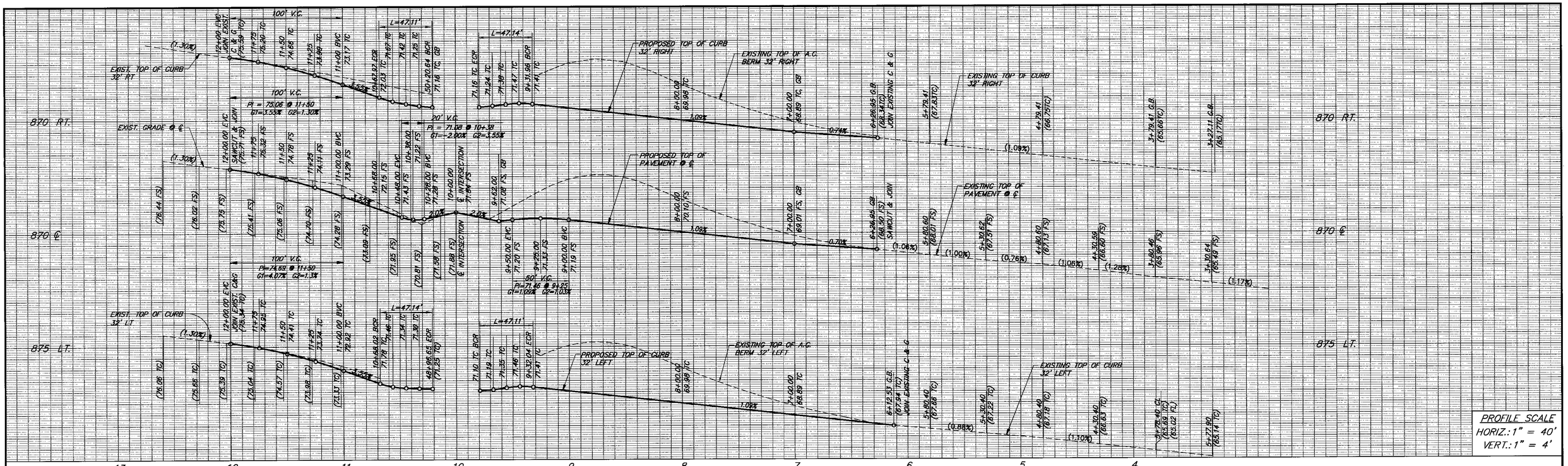

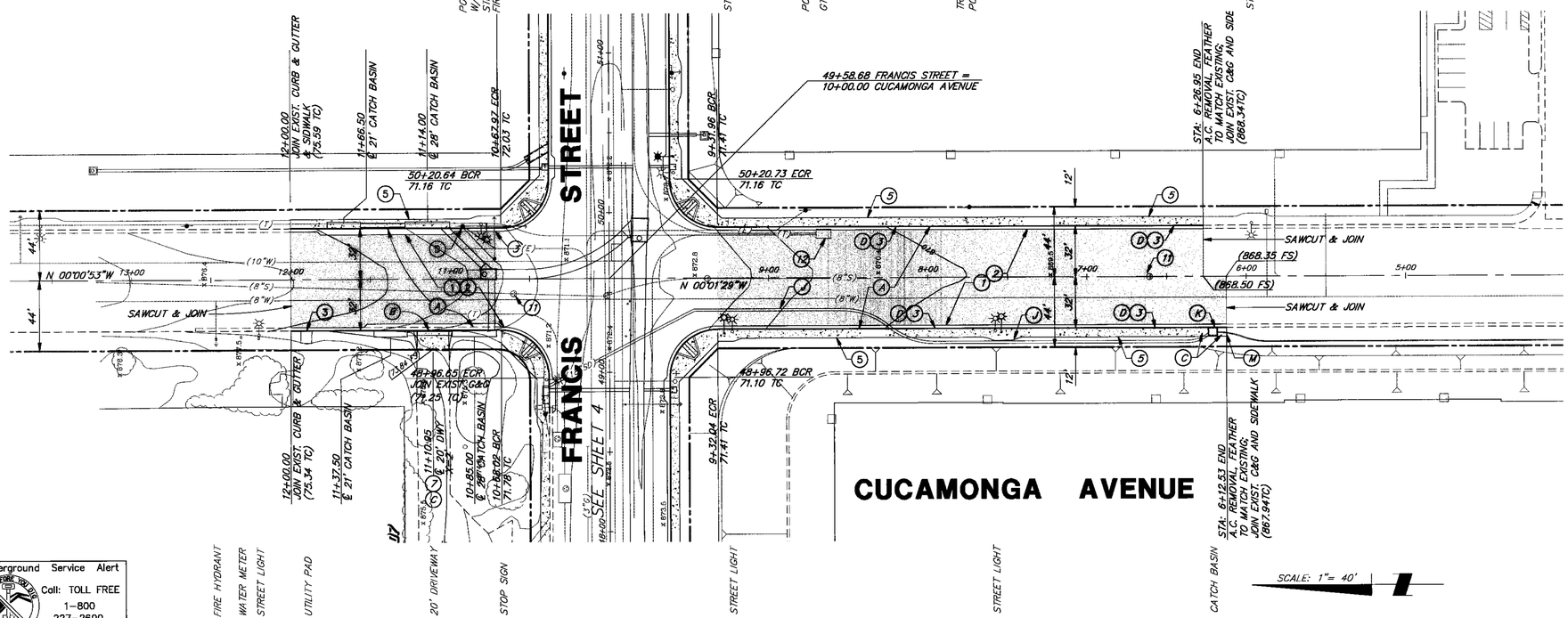

STREET CONSTRUCTION NOTES:

1. CONSTRUCT 6" A.C. PAVEMENT
2. CONSTRUCT 8" CRUSHED AGGREGATE BASE
3. CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "B"
5. CONSTRUCT 5' P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121 AND 125
7. CONSTRUCT COMMERCIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 117, WIDTH PER PLAN
11. ADJUST SEWER OR STORM DRAIN MANHOLE TO GRADE
12. ADJUST GTE OR EDISON VAULT TO GRADE (BY OTHERS)

REMOVAL NOTES:

- (A) REMOVE EXISTING A.C. PAVEMENT
- (B) REMOVE EXISTING CURB AND GUTTER
- (C) REMOVE EXISTING SIDEWALK/DRIVE APPROACH
- (D) REMOVE EXISTING A.C. BERM
- (J) REMOVE EXISTING STORM DRAIN PIPE
- (K) REMOVE EXISTING CATCH BASIN
- (M) PLUG & ABANDON STORM DRAIN PIPE

SEE SHEET 9 FOR INTERSECTION CONTOUR PLAN

PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'

Underground Service Alert
Call: TOLL FREE
1-800
227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

S&O
Land Planning
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DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STREET IMPROVEMENT
FRANCIS STREET
CUCAMONGA AVENUE

SHEET 6 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13041

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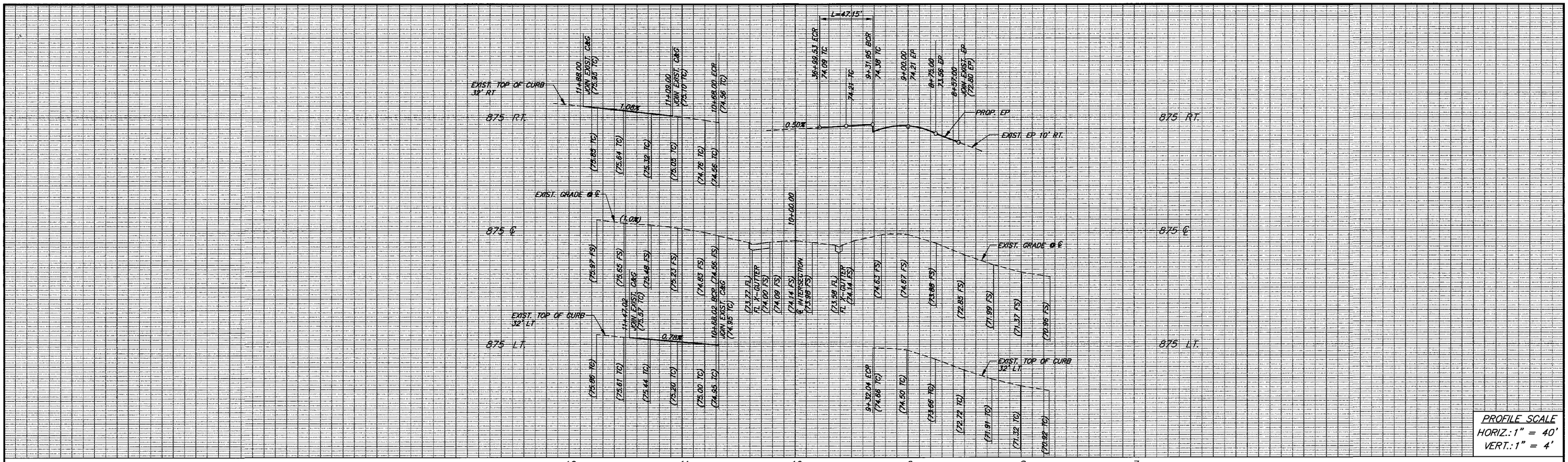

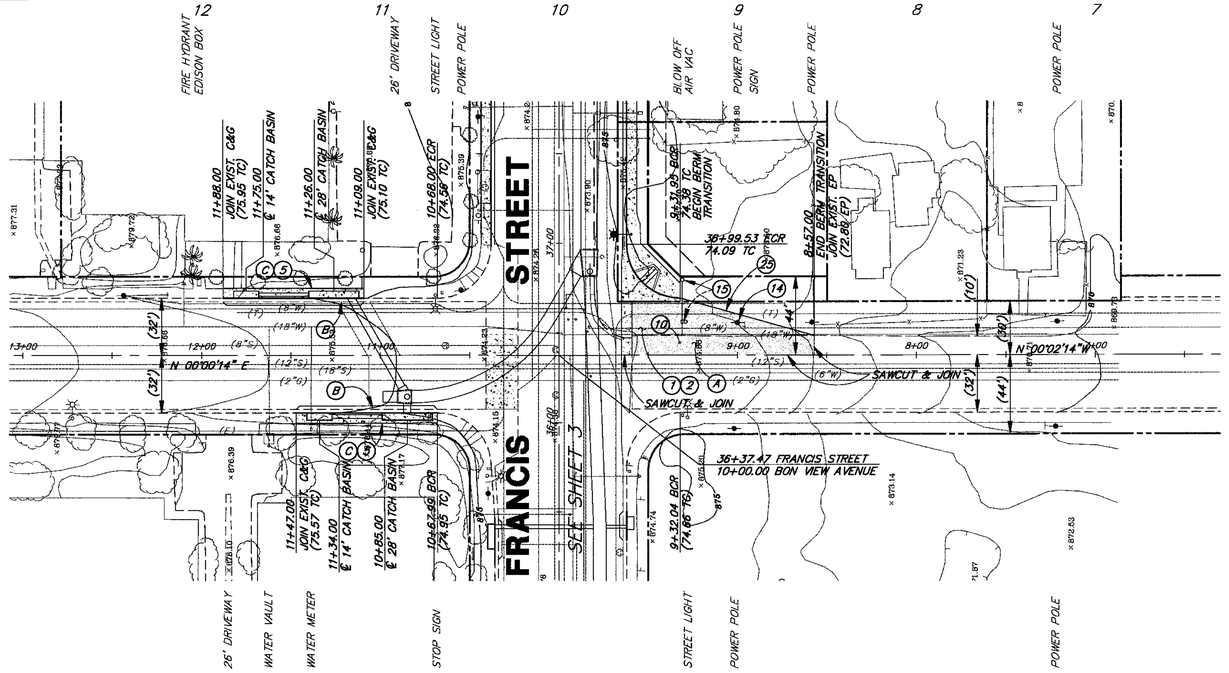

STREET CONSTRUCTION NOTES:

1. CONSTRUCT 6" A.C. PAVEMENT
2. CONSTRUCT 8" CRUSHED AGGREGATE BASE
3. CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "B"
5. CONSTRUCT 5' P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121 & 125
10. ADJUST WATER VALVE TO GRADE
14. RELOCATE POWER POLE (BY OTHERS)
15. RELOCATE AIR VALVE / BLOWOFF BEHIND NEW CURB PER CITY OF ONTARIO STD. DWG. NO. 413,414, OR 415
25. CONSTRUCT 8" AC BERM PER CITY OF ONTARIO STD. DWG. NO. 116

REMOVAL NOTES:

- (A) REMOVE EXISTING A.C. PAVEMENT
- (B) REMOVE EXISTING CURB AND GUTTER
- (C) REMOVE EXISTING SIDEWALK/DRIVE APPROACH

BON VIEW AVENUE

SCALE: 1"= 40'

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

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Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
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FAX: (909) 948-2750

Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS, JR.
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STREET IMPROVEMENT
FRANCIS STREET
BON VIEW AVENUE

SHEET 7 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13042

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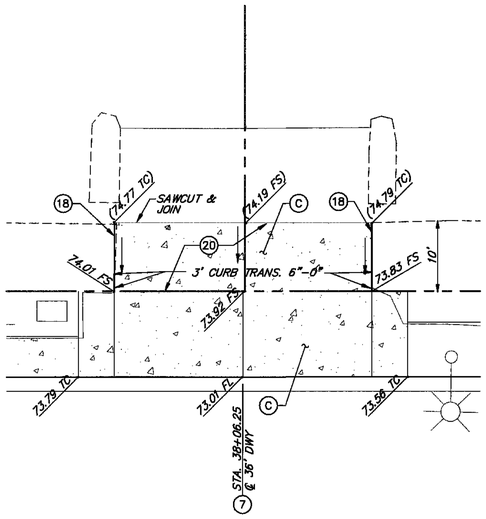
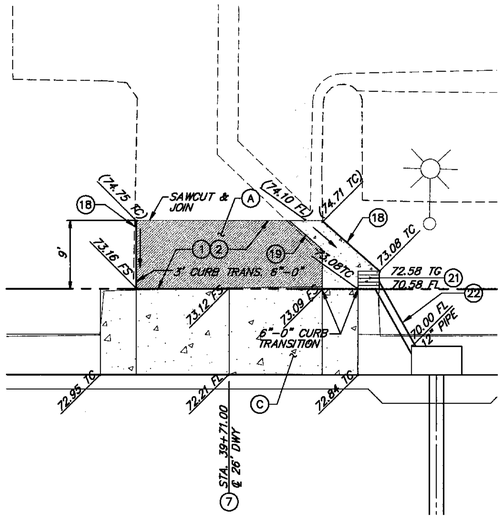
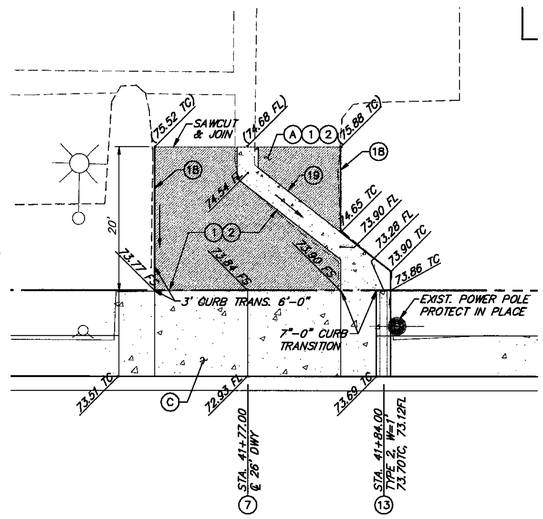


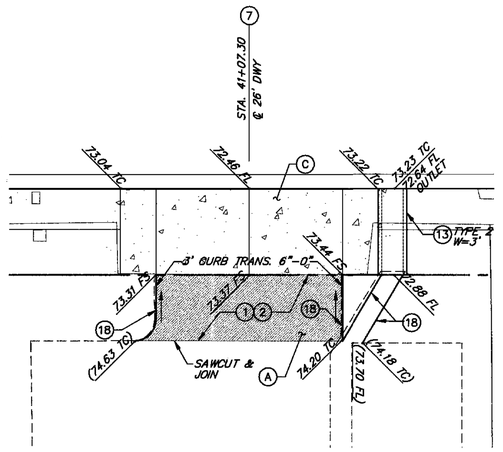
DETAIL "A"
SCALE: 1"=10'



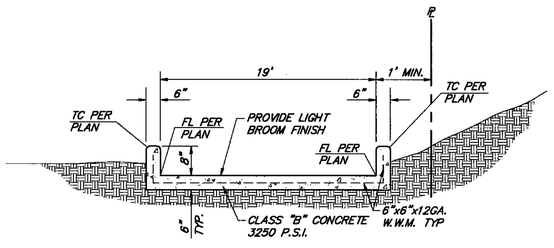
DETAIL "B"
SCALE: 1"=10'



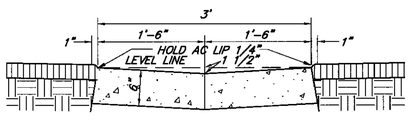
DETAIL "C"
SCALE: 1"=10'



DETAIL "D"
SCALE: 1"=10'



SECTION A-A
SCALE: N.T.S.



NOTE: WHEN RIBBON GUTTER JOINS P.C.C. PAVEMENT MAKE PAVEMENT SURFACES FLUSH (NO LIP)

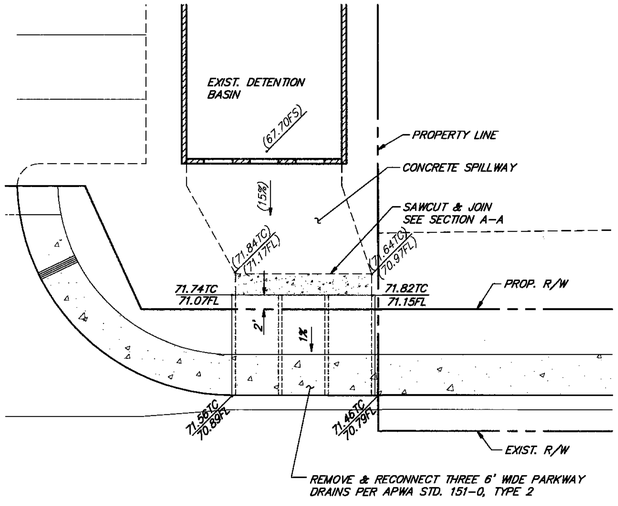
(19) 3' RIBBON GUTTER
SCALE: N.T.S.

STREET CONSTRUCTION NOTES:

(1) CONSTRUCT 6" A.C. PAVEMENT
(2) CONSTRUCT 8" CRUSHED AGGREGATE BASE
(7) CONSTRUCT COMMERCIAL DRIVEWAY APPROACH PER CITY OF ONTARIO STD. DWG. NO. 117, WIDTH PER PLAN
(13) CONSTRUCT PARKWAY DRAIN NO. 1 PER CITY OF ONTARIO STD. DWG. NO. 309, TYPE PER PLAN
(18) CONSTRUCT 6" CURB ONLY PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "A"
(19) CONSTRUCT 3' RIBBON GUTTER PER DETAIL HEREON
(20) CONSTRUCT 6" P.C.C. PAVEMENT
(21) INSTALL 36"x36" CATCH BASIN PER BROOKS PRODUCTS OR APPROVED EQUAL
(22) INSTALL 12" P.V.C. (SCH 40) PIPE

REMOVAL NOTES:

(A) REMOVE EXISTING A.C. PAVEMENT
(C) REMOVE EXISTING SIDEWALK/DRIVE APPROACH



DETAIL "E"
SCALE: 1"=10'

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

Underground Service Alert
DIG BEFORE YOU DIG
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. _____ ELEV. _____
LOCATION:

S&O Land Planning Civil Engineering Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS, JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STREET IMPROVEMENT
FRANCIS STREET
STREET CONSTRUCTION DETAILS

SHEET 8 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13043

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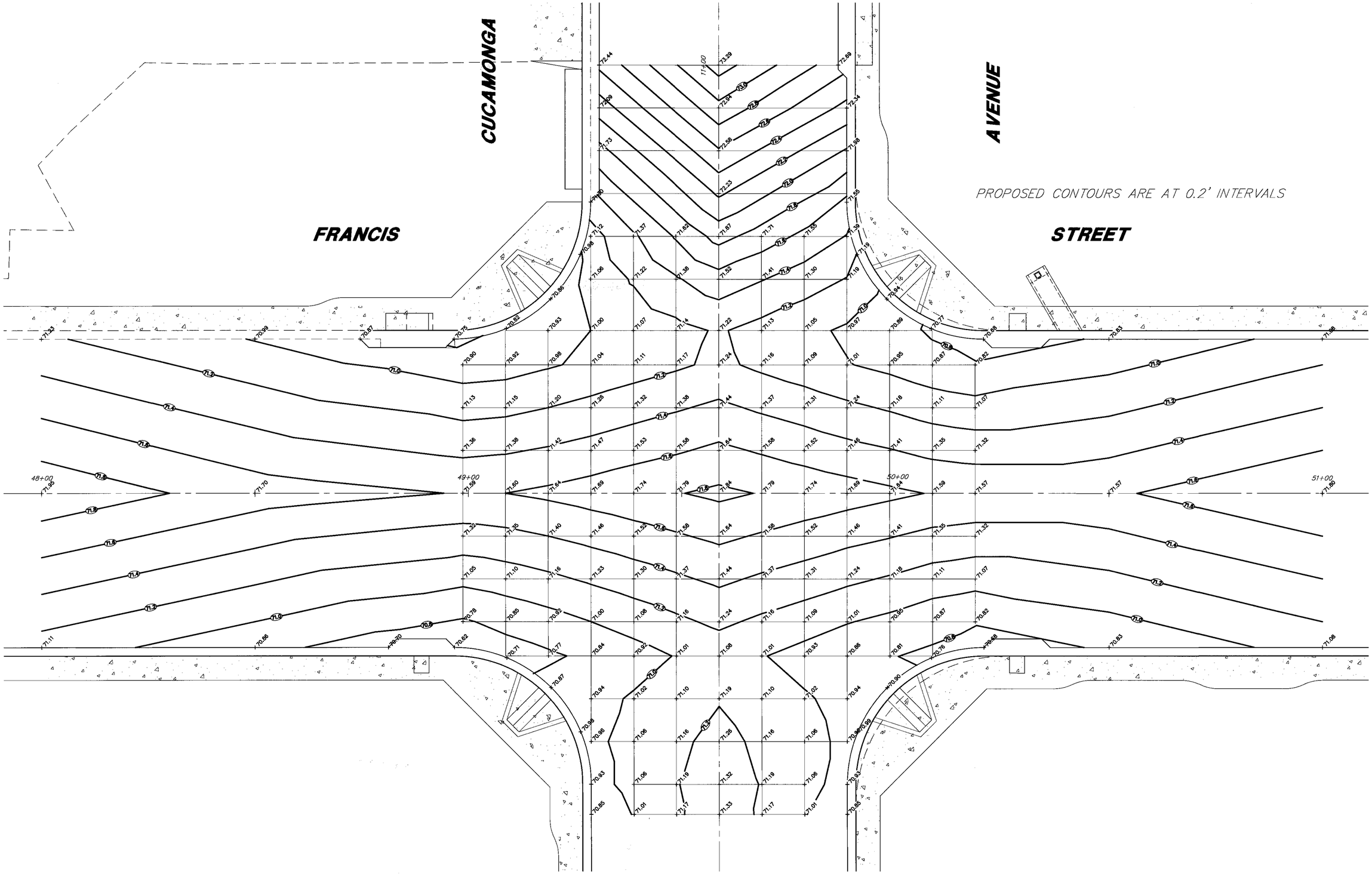

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____

DRAWN BY _____ DATE _____

CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE

ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631

LOCATION: FRANCIS ST. & SAN BERNARDIINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O
Land Planning
Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750

6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS
No.41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STREET IMPROVEMENT

FRANCIS STREET

INTERSECTION DETAIL – FRANCIS STREET & CUCAMONGA AVENUE

SHEET 9 OF 32

CONTRACT _____

ACCOUNT _____

DWG. NO. D13044

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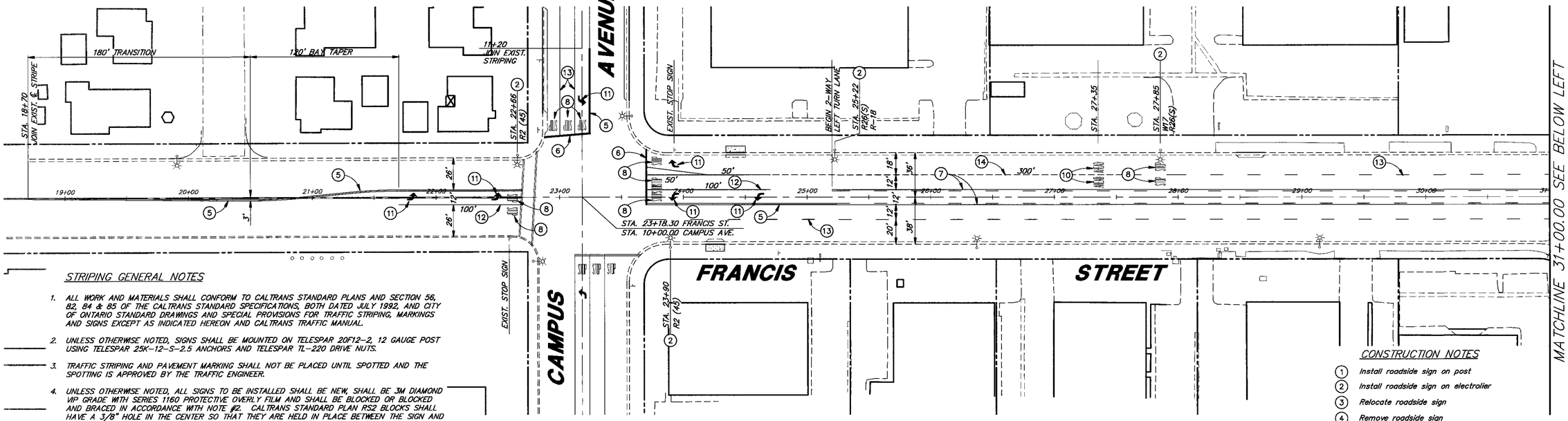

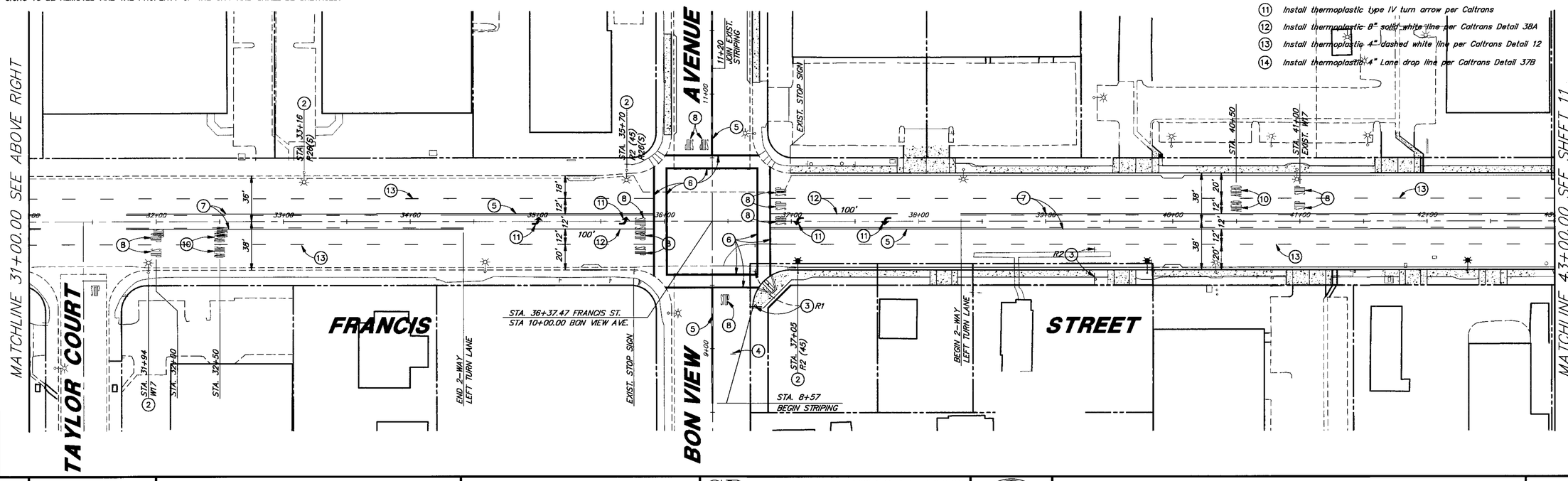

SCALE: 1"=40'

STRIPING GENERAL NOTES

1. ALL WORK AND MATERIALS SHALL CONFORM TO CALTRANS STANDARD PLANS AND SECTION 56, 82, 84 & 85 OF THE CALTRANS STANDARD SPECIFICATIONS, BOTH DATED JULY 1992, AND CITY OF ONTARIO STANDARD DRAWINGS AND SPECIAL PROVISIONS FOR TRAFFIC STRIPING, MARKINGS AND SIGNS EXCEPT AS INDICATED HEREON AND CALTRANS TRAFFIC MANUAL.
2. UNLESS OTHERWISE NOTED, SIGNS SHALL BE MOUNTED ON TELESPAR 20F12-2, 12 GAUGE POST USING TELESPAR 25K-12-S-2.5 ANCHORS AND TELESPAR TL-220 DRIVE NUTS.
3. TRAFFIC STRIPING AND PAVEMENT MARKING SHALL NOT BE PLACED UNTIL SPOTTED AND THE SPOTTING IS APPROVED BY THE TRAFFIC ENGINEER.
4. UNLESS OTHERWISE NOTED, ALL SIGNS TO BE INSTALLED SHALL BE NEW, SHALL BE 3M DIAMOND VIP GRADE WITH SERIES 1160 PROTECTIVE OVERLY FILM AND SHALL BE BLOCKED OR BLOCKED AND BRACED IN ACCORDANCE WITH NOTE #2. CALTRANS STANDARD PLAN RS2 BLOCKS SHALL HAVE A 3/8" HOLE IN THE CENTER SO THAT THEY ARE HELD IN PLACE BETWEEN THE SIGN AND THE POST BY THE CENTER MOUNTING BOLT.
5. THE CONTRACTOR SHALL DELIVER AND UNLOAD THE SALVAGE AT THE ONTARIO MUNICIPAL SERVICE CENTER, 1425 SOUTH BON VIEW AVENUE OR CITY WELL SITE NO. 9, ON THE WEST SIDE OF COLUMBIA AVENUE NORTH OF DEODAR STREET, AS DIRECTED BY THE ENGINEER.
6. EXISTING STRIPES AND PAVEMENT MARKINGS THAT CONFLICT SHALL BE REMOVED AND SANDBLASTED.
7. ALL STRIPING AND MARKING SHOWN HEREON SHALL BE THERMOPLASTIC.
8. ALL STREET SIGNS TO BE REMOVED ARE THE PROPERTY OF THE CITY AND SHALL BE SALVAGED.

CONSTRUCTION NOTES

1. Install roadside sign on post
2. Install roadside sign on electrolier
3. Relocate roadside sign
4. Remove roadside sign
5. Install thermoplastic 4" double yellow centerline per Catrans Detail 22
6. Install thermoplastic 12" solid white line
7. Install thermoplastic 2-way left turn lane per Caltrans Detail 32
8. Install thermoplastic "STOP" per Caltrans
10. Install thermoplastic "AHEAD" per Caltrans
11. Install thermoplastic type IV turn arrow per Caltrans
12. Install thermoplastic 8" solid white line per Caltrans Detail 38A
13. Install thermoplastic 4" dashed white line per Caltrans Detail 12
14. Install thermoplastic 4" Lane drop line per Caltrans Detail 37B

Underground Service Alert
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TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. _____ ELEV. _____
LOCATION:

SB&O
Land Planning
Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750

Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
SIGNING & STRIPING IMPROVEMENT
FRANCIS STREET
STA. 18+70.00 TO STA. 43+00.00

SHEET 10 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13045

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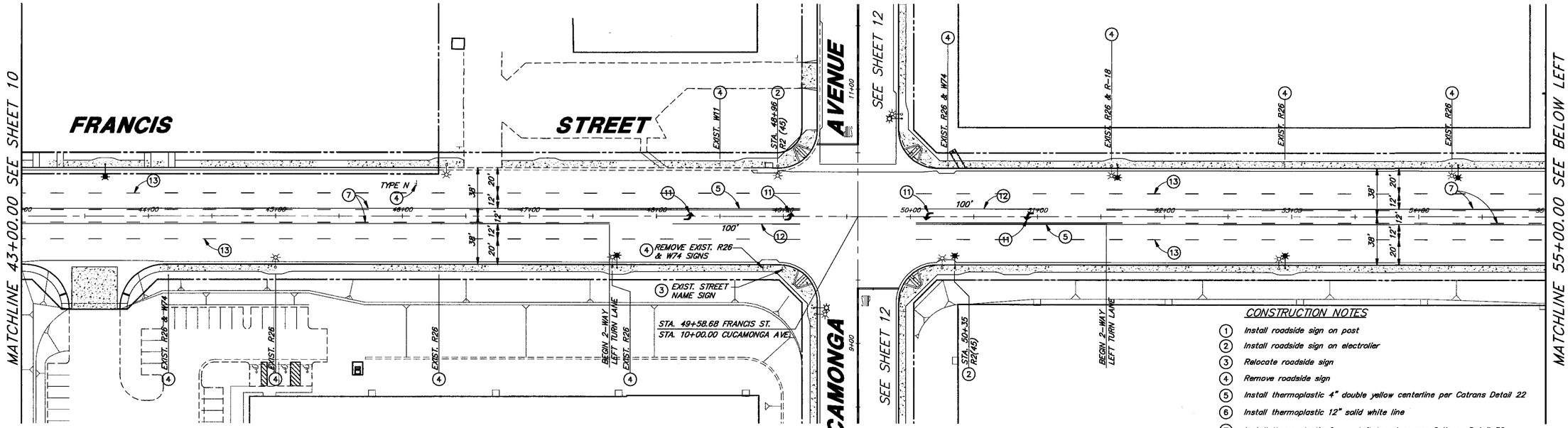
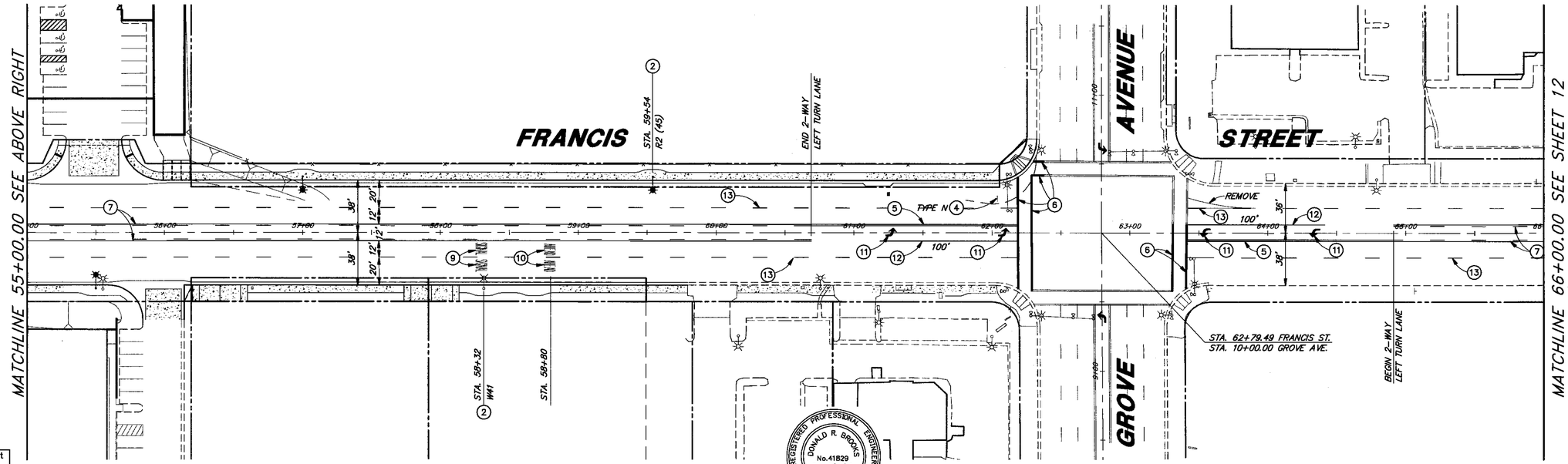


CONSTRUCTION NOTES

1. Install roadside sign on post
2. Install roadside sign on electrolier
3. Relocate roadside sign
4. Remove roadside sign
5. Install thermoplastic 4" double yellow centerline per Catrans Detail 22
6. Install thermoplastic 12" solid white line
7. Install thermoplastic 2-way left turn lane per Caltrans Detail 32
9. Install thermoplastic "SIGNAL" per Caltrans
10. Install thermoplastic "AHEAD" per Caltrans
11. Install thermoplastic type IV turn arrow per Caltrans
12. Install thermoplastic 8" solid white line per Caltrans Detail 38A
13. Install thermoplastic 4" dashed white line per Caltrans Detail 12



SCALE: 1"=40'

Underground Service Alert
Call: TOLL FREE
1-800
227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

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DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
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BENCH MARK NO. _____ ELEV. _____
LOCATION:

SB&O
Land Planning
Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750

Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS, JR.
No. 41829
Exp. 3/31/05
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
SIGNING & STRIPING IMPROVEMENT
FRANCIS STREET
STA. 43+00.00 TO STA. 66+00.00

SHEET 11 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D 13046

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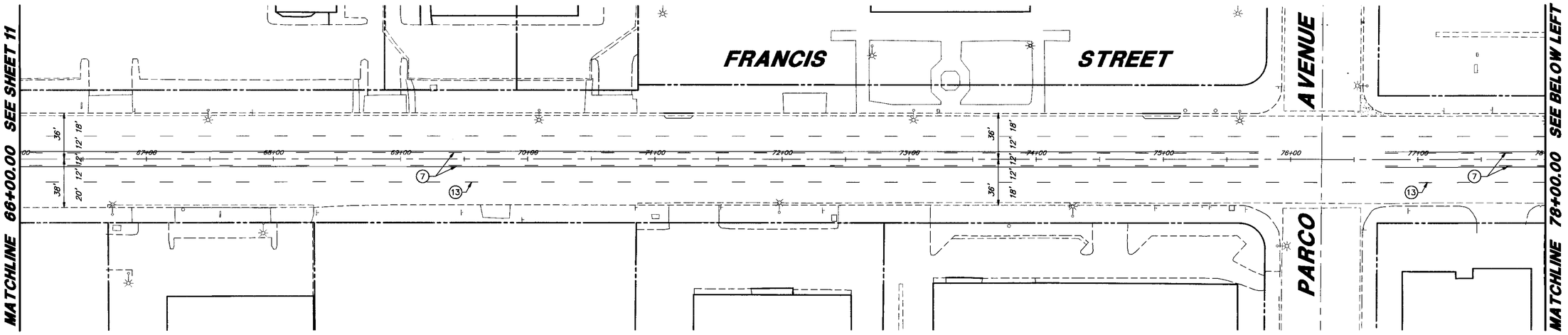

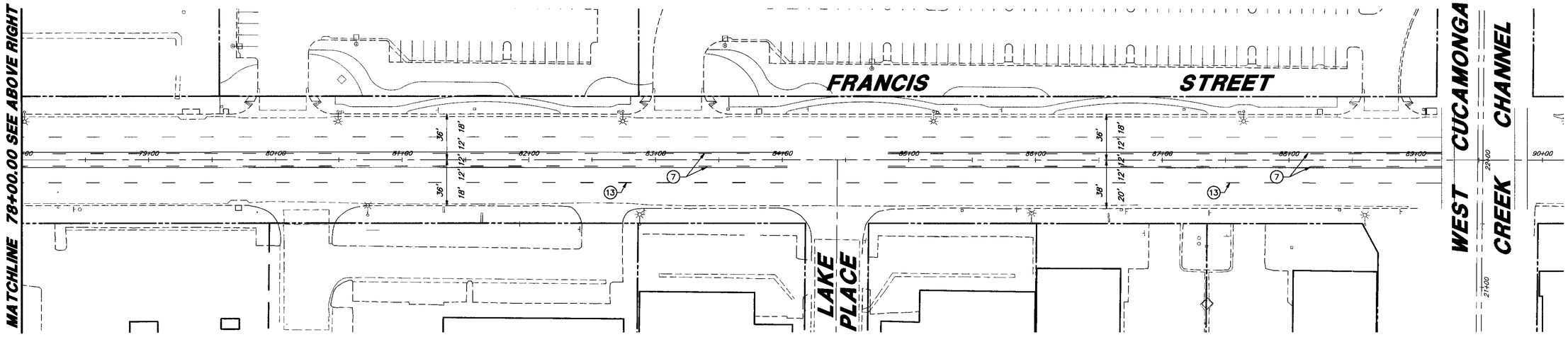

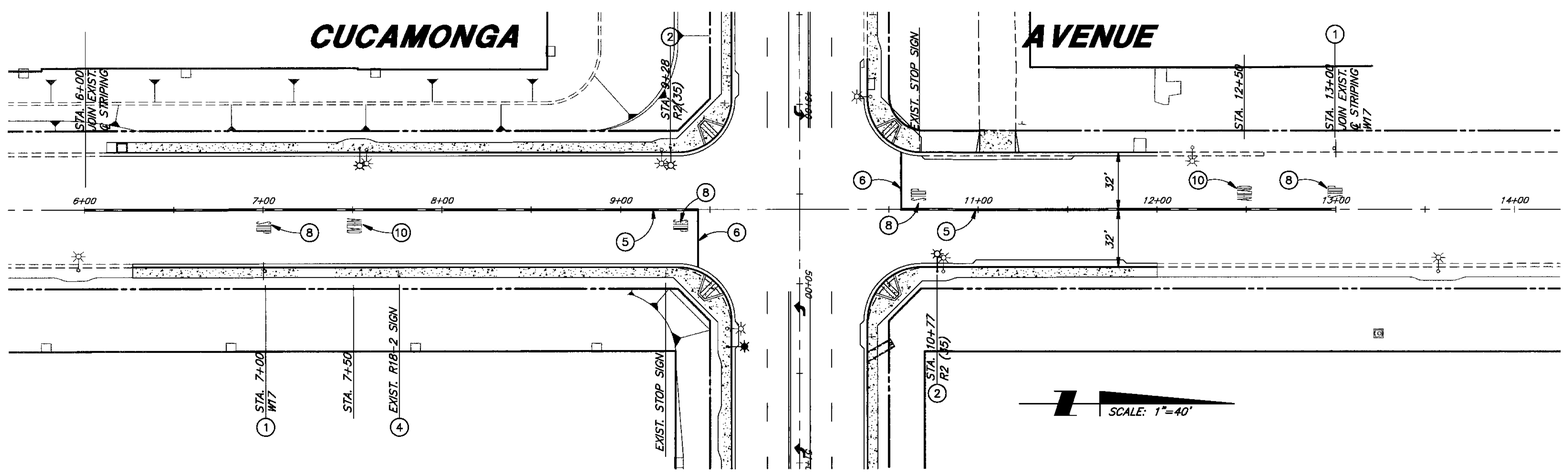

CONSTRUCTION NOTES

1. Install roadside sign on post
2. Install roadside sign on electrolier
3. Relocate roadside sign
4. Remove roadside sign
5. Install thermoplastic 4" double yellow centerline per Caltrans Detail 22
6. Install thermoplastic 12" solid white line
7. Install thermoplastic 2-way left turn lane per Caltrans Detail 32
8. Install thermoplastic "STOP" per Caltrans
10. Install thermoplastic "AHEAD" per Caltrans
11. Install thermoplastic type IV turn arrow per Caltrans
12. Install thermoplastic 8" solid white line per Caltrans Detail 38A
13. Install thermoplastic 4" dashed white line per Caltrans Detail 12

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

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DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. _____ ELEV. _____
LOCATION:

SB&O
Land Planning
Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750

Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
SIGNING & STRIPING IMPROVEMENT
FRANCIS STREET
STA. 66+00.00 TO WEST CUCAMONGA CREEK CHANNEL & CUCAMONGA AVENUE

SHEET 12 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13047

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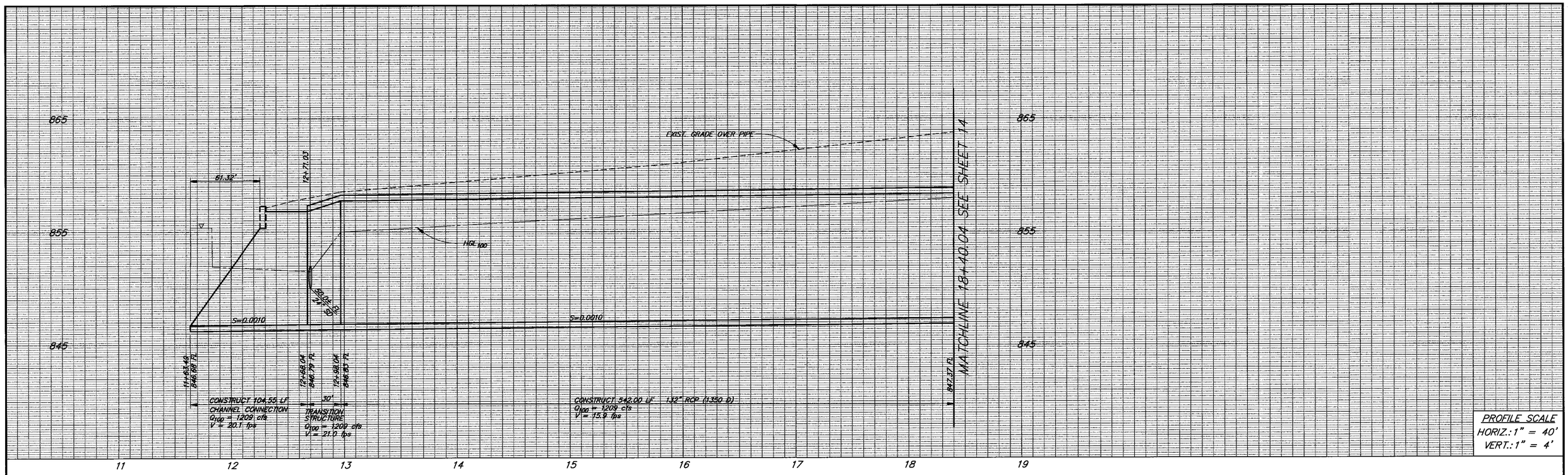


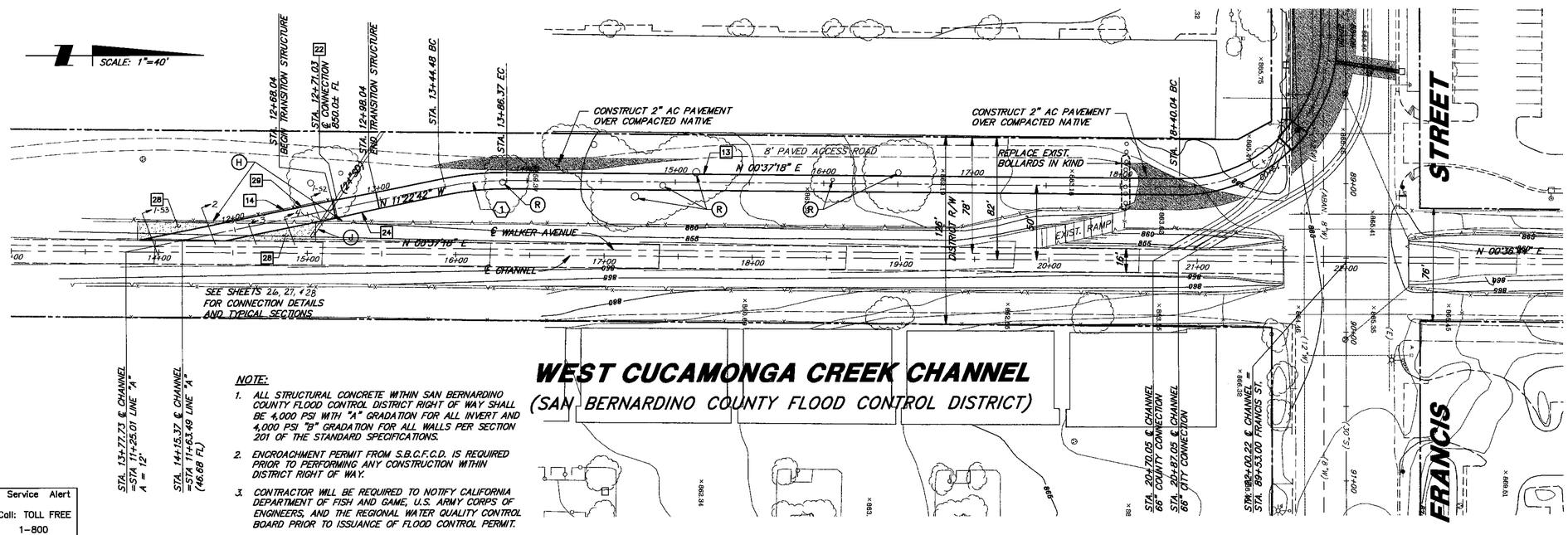
PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'

STORM DRAIN CONSTRUCTION NOTES:

13 CONSTRUCT 132" R.C.P. STORM DRAIN, D-LOAD PER PLAN
14 CONSTRUCT CHANNEL CONNECTION PER DETAIL ON SHEETS 26, 27, & 28
22 CONSTRUCT STANDARD R.C.P. CONNECTION PER SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT STD. SP220.
24 CONSTRUCT TRANSITION STRUCTURE PER APWA STD. DWG. 342-1
28 REPLACE CHANNEL WALL PER SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT STD. SP 192E.
29 RECONSTRUCT EXIST. 6' C.L. FENCE PER SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT STD. DWG. II, TIE INTO EXISTING CHANNEL FENCING.

REMOVAL NOTES

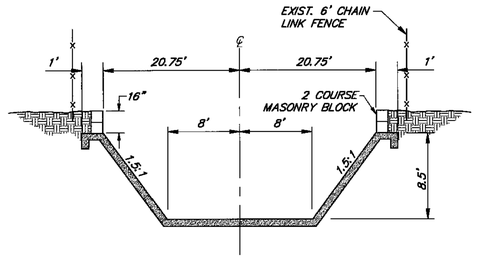
(J) REMOVE EXISTING STORM DRAIN PIPE
(R) REMOVE EXIST. TREE / BUSH
(H) REMOVE EXISTING CHAIN LINK FENCE



WEST CUCAMONGA CREEK CHANNEL
(SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT)

NOTE:

1. ALL STRUCTURAL CONCRETE WITHIN SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT RIGHT OF WAY SHALL BE 4,000 PSI WITH "A" GRADATION FOR ALL INVERT AND 4,000 PSI "B" GRADATION FOR ALL WALLS PER SECTION 201 OF THE STANDARD SPECIFICATIONS.
2. ENCROACHMENT PERMIT FROM S.B.C.F.C.D. IS REQUIRED PRIOR TO PERFORMING ANY CONSTRUCTION WITHIN DISTRICT RIGHT OF WAY.
3. CONTRACTOR WILL BE REQUIRED TO NOTIFY CALIFORNIA DEPARTMENT OF FISH AND GAME, U.S. ARMY CORPS OF ENGINEERS, AND THE REGIONAL WATER QUALITY CONTROL BOARD PRIOR TO ISSUANCE OF FLOOD CONTROL PERMIT.



EXIST. CHANNEL SECTION

NOT TO SCALE
STA. 10+00 TO STA. 19+00

CURVE DATA

⟨⟩	DELTA	RADIUS	LENGTH	TANGENT
1	12°00'00"	200.00'	41.89'	21.02'

Underground Service Alert
Call: TOLL FREE
1-800
227-2600
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REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY ____ DATE ____
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CHECKED BY ____ DATE ____

CITY OF ONTARIO

RECOMMENDED BY ____ ASSISTANT CITY ENGINEER ____ DATE
ACCEPTED BY ____ CITY ENGINEER ____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" STA. 11+63.49 TO 18+40.04

SHEET 13 OF 32
CONTRACT ____
ACCOUNT ____
DWG. NO. D13048

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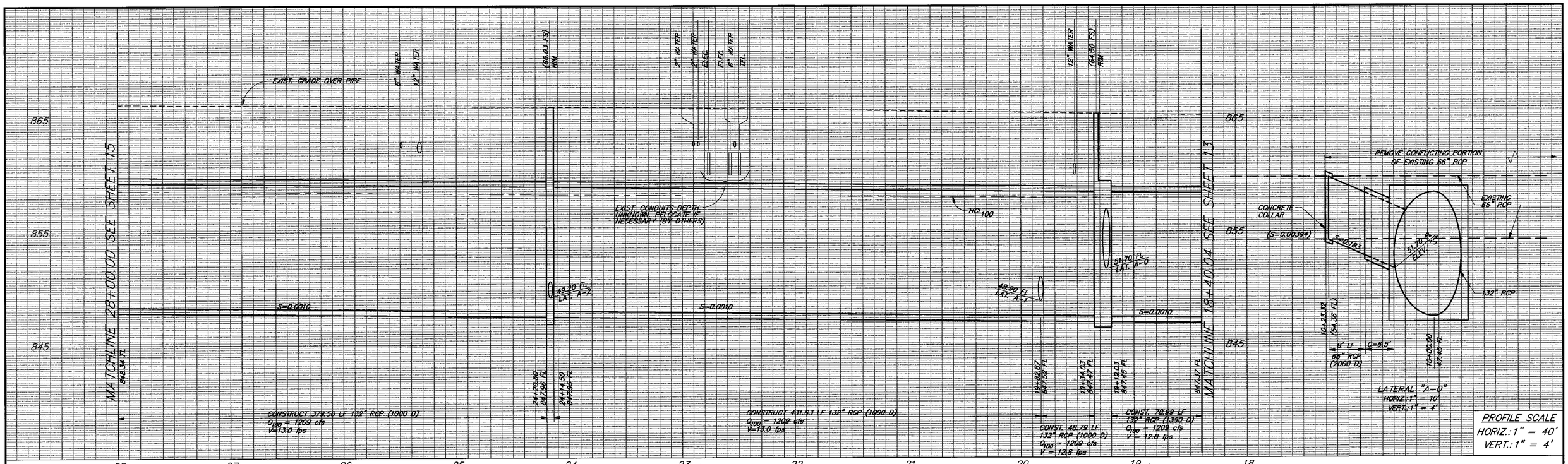
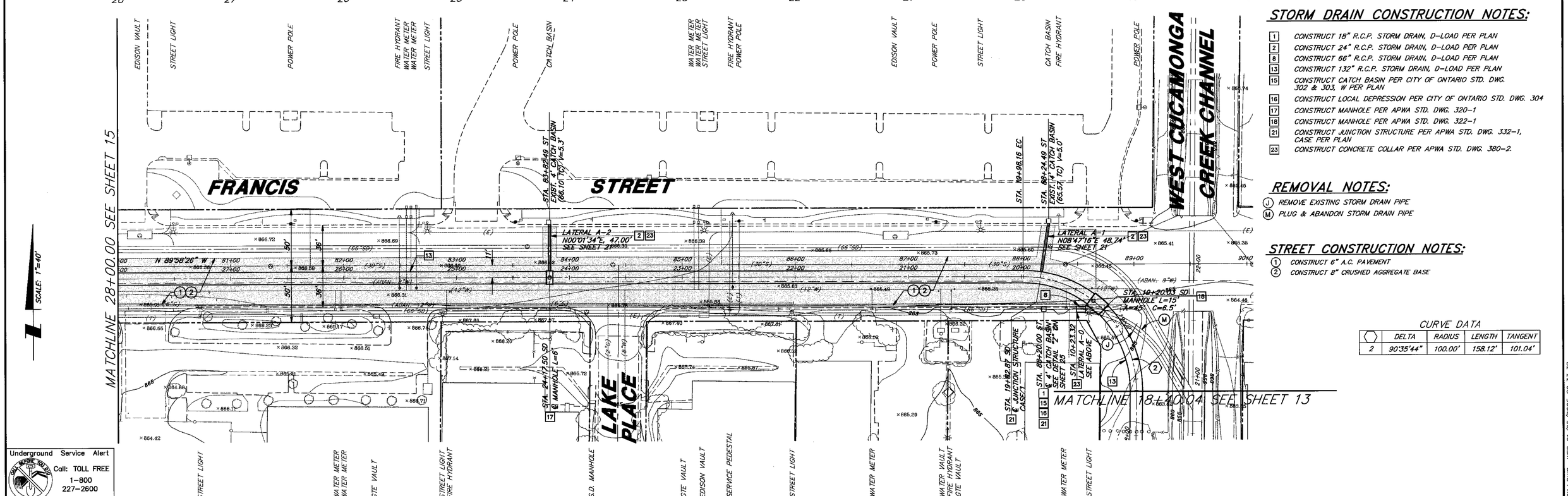


PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'



SCALE: 1"=40'

STORM DRAIN CONSTRUCTION NOTES:

1	CONSTRUCT 18" R.C.P. STORM DRAIN, D-LOAD PER PLAN
2	CONSTRUCT 24" R.C.P. STORM DRAIN, D-LOAD PER PLAN
8	CONSTRUCT 66" R.C.P. STORM DRAIN, D-LOAD PER PLAN
13	CONSTRUCT 132" R.C.P. STORM DRAIN, D-LOAD PER PLAN
15	CONSTRUCT CATCH BASIN PER CITY OF ONTARIO STD. DWG. 302 & 303, W PER PLAN
16	CONSTRUCT LOCAL DEPRESSION PER CITY OF ONTARIO STD. DWG. 304
17	CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1
18	CONSTRUCT MANHOLE PER APWA STD. DWG. 322-1
21	CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 332-1, CASE PER PLAN
23	CONSTRUCT CONCRETE COLLAR PER APWA STD. DWG. 380-2.

REMOVAL NOTES:

J	REMOVE EXISTING STORM DRAIN PIPE
M	PLUG & ABANDON STORM DRAIN PIPE

STREET CONSTRUCTION NOTES:

1	CONSTRUCT 6" A.C. PAVEMENT
2	CONSTRUCT 8" CRUSHED AGGREGATE BASE

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
2	90°35'44"	100.00'	158.12'	101.04'

MATCHLINE 18+40.04 SEE SHEET 13

Underground Service Alert
DIG ALERT
Call: TOLL FREE
1-800
227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SIB & O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

6-1-05

REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS JR.
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" STA. 18+40.04 TO STA. 28+00.00

SHEET 14 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13049

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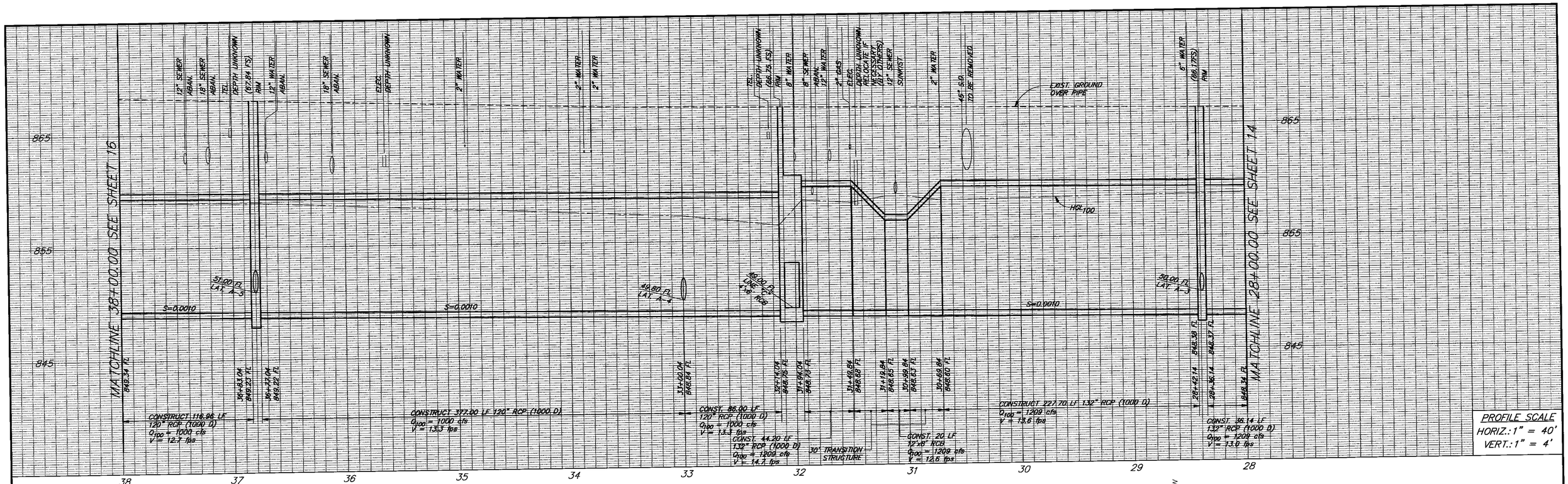
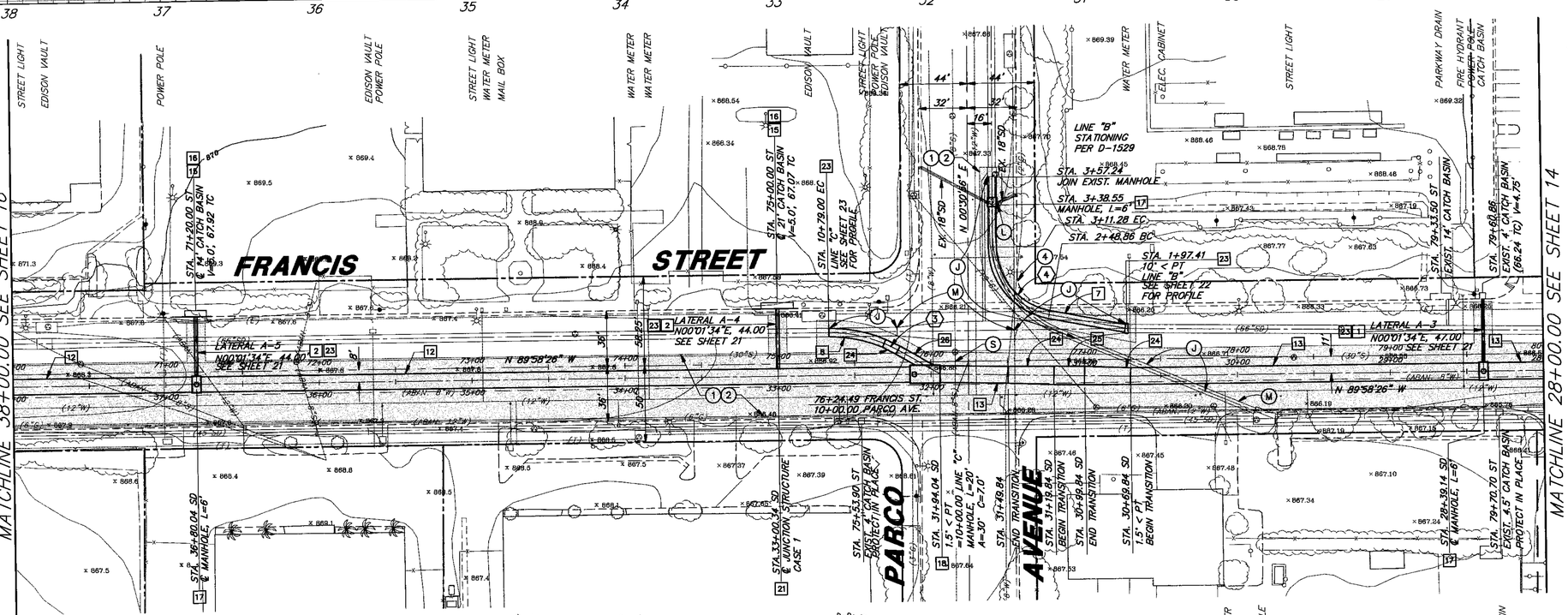


PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'



STORM DRAIN CONSTRUCTION NOTES:

1	CONSTRUCT 18" R.C.P. STORM DRAIN, D-LOAD PER PLAN
2	CONSTRUCT 24" R.C.P. STORM DRAIN, D-LOAD PER PLAN
7	CONSTRUCT 63" R.C.P. STORM DRAIN, D-LOAD PER PLAN
8	CONSTRUCT 66" R.C.P. STORM DRAIN, D-LOAD PER PLAN
12	CONSTRUCT 120" R.C.P. STORM DRAIN, D-LOAD PER PLAN
13	CONSTRUCT 132" R.C.P. STORM DRAIN, D-LOAD PER PLAN
15	CONSTRUCT CATCH BASIN PER CITY OF ONTARIO STD. DWG. 302 & 303, W PER PLAN
16	CONSTRUCT LOCAL DEPRESSION PER CITY OF ONTARIO STD. DWG. 304
17	CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1
18	CONSTRUCT MANHOLE PER APWA STD. DWG. 322-1
21	CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 332-1, CASE PER PLAN
23	CONSTRUCT CONCRETE COLLAR PER APWA STD. DWG. 380-2.
24	CONSTRUCT TRANSITION STRUCTURE PER APWA STD. DWG. 342-1
25	CONSTRUCT 12'x8' R.C.B. STORM DRAIN PER CALTRANS STD. PLAN D80
26	CONSTRUCT 6'x4' R.C.B. STORM DRAIN PER CALTRANS STD. PLAN D80

REMOVAL NOTES:

- (J) REMOVE EXISTING STORM DRAIN PIPE
- (L) REMOVE EXISTING MANHOLE
- (M) PLUG & ABANDON STORM DRAIN PIPE
- (S) REMOVE EXISTING CONFLICTING ABANDONED UTILITY

STREET CONSTRUCTION NOTES:

- (1) CONSTRUCT 6" A.C. PAVEMENT
- (2) CONSTRUCT 8" CRUSHED AGGREGATE BASE
- (4) CONSTRUCT CROSS GUTTER AND SPANDREL PER CITY OF ONTARIO STD. DWG. NO. 120

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
3	30°00'00"	90.00'	47.12'	24.12'
4	79°28'38"	45.00'	62.42'	37.41'

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY ____ DATE ____
DRAWN BY ____ DATE ____
CHECKED BY ____ DATE ____

CITY OF ONTARIO

RECOMMENDED BY ____ ASSISTANT CITY ENGINEER ____ DATE
ACCEPTED BY ____ CITY ENGINEER ____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O
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Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750

Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" STA. 28+00.00 TO STA. 38+00.00

SHEET 15 OF 32
CONTRACT ____
ACCOUNT ____
DWG. NO. D13050

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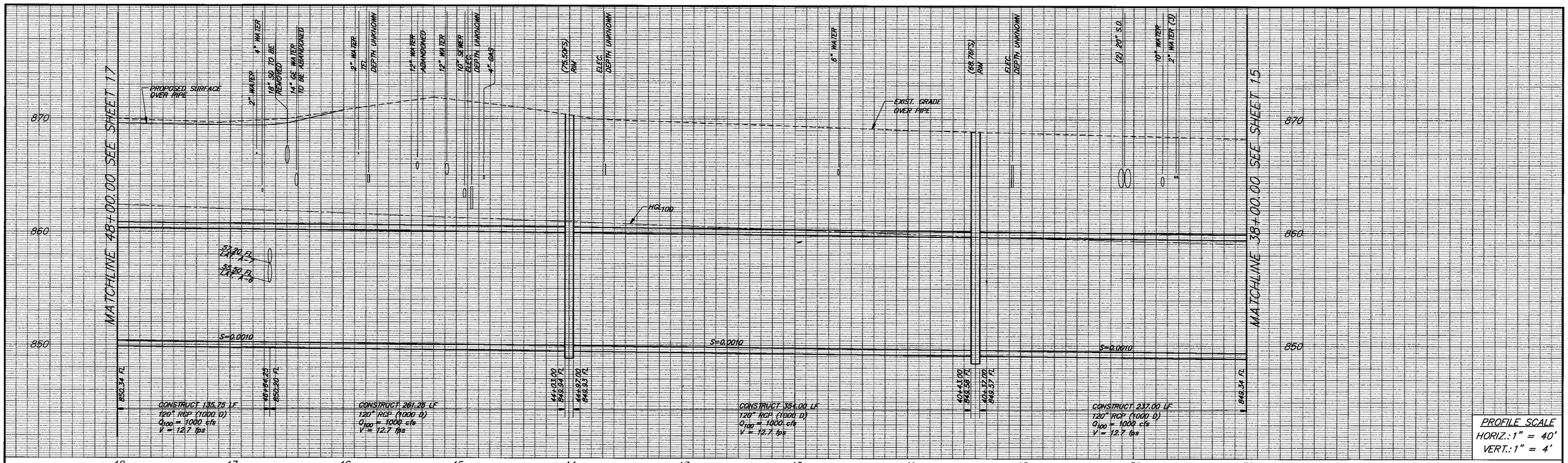
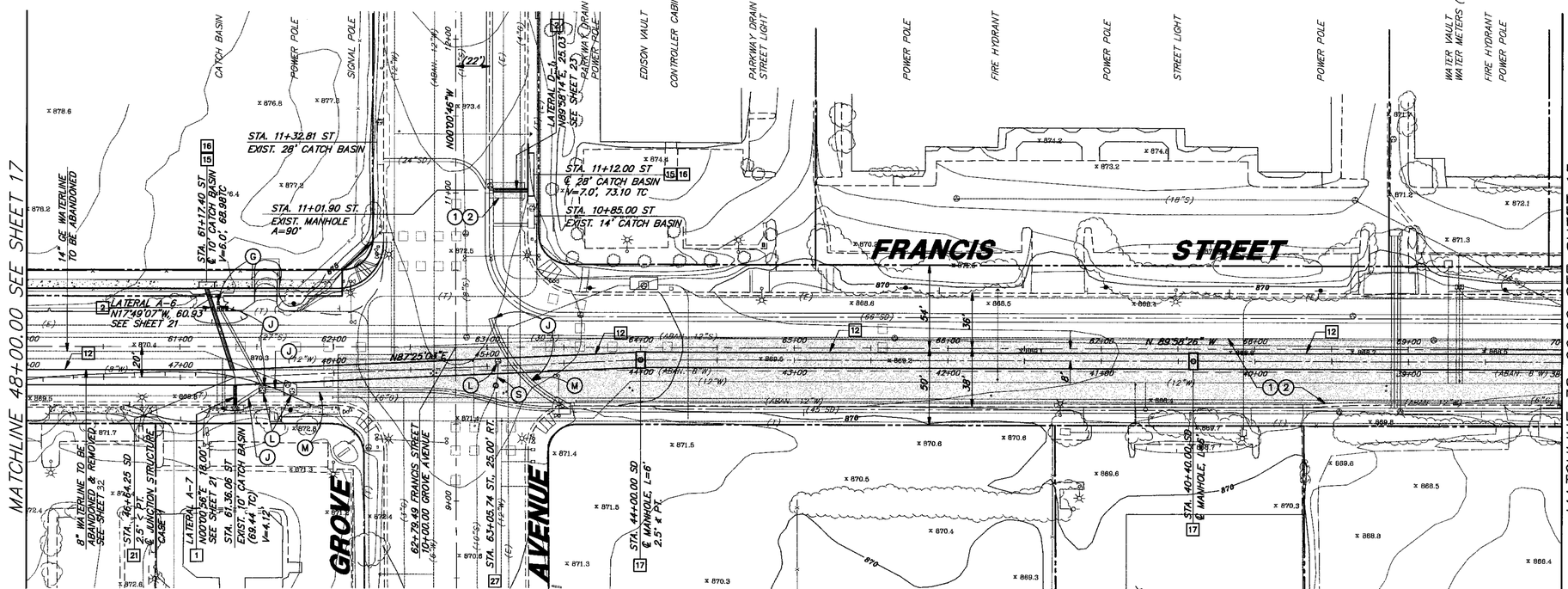


PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'



STORM DRAIN CONSTRUCTION NOTES:

1. CONSTRUCT 18" R.C.P. STORM DRAIN, D-LOAD PER PLAN
2. CONSTRUCT 24" R.C.P. STORM DRAIN, D-LOAD PER PLAN
12. CONSTRUCT 120" R.C.P. STORM DRAIN, D-LOAD PER PLAN
15. CONSTRUCT CATCH BASIN PER CITY OF ONTARIO STD. DWG. 302 & 303, W PER PLAN
16. CONSTRUCT LOCAL DEPRESSION PER CITY OF ONTARIO STD. DWG. 304
17. CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1
21. CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 332-1, CASE PER PLAN
23. CONSTRUCT CONCRETE COLLAR PER APWA STD. DWG. 380-2.
27. CONSTRUCT SEWER MANHOLE PER CITY STD. 201.

REMOVAL NOTES:

- (G) REMOVE EXISTING CATCH BASIN (GRATED INLET)
- (P) REMOVE EXISTING STORM DRAIN PIPE
- (C) REMOVE EXISTING MANHOLE
- (U) PLUG & ABANDON STORM DRAIN PIPE
- (M) REMOVE EXISTING CONFLICTING ABANDONED UTILITY
- (S) REMOVE EXISTING CONFLICTING ABANDONED UTILITY

STREET CONSTRUCTION NOTES:

1. CONSTRUCT 6" A.C. PAVEMENT
2. CONSTRUCT 8" CRUSHED AGGREGATE BASE

Underground Service Alert
DIG ALERT
Call: TOLL FREE
1-800
227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

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REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS JR
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" STA. 38+00.00 TO STA. 48+00.00

SHEET 16 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13051

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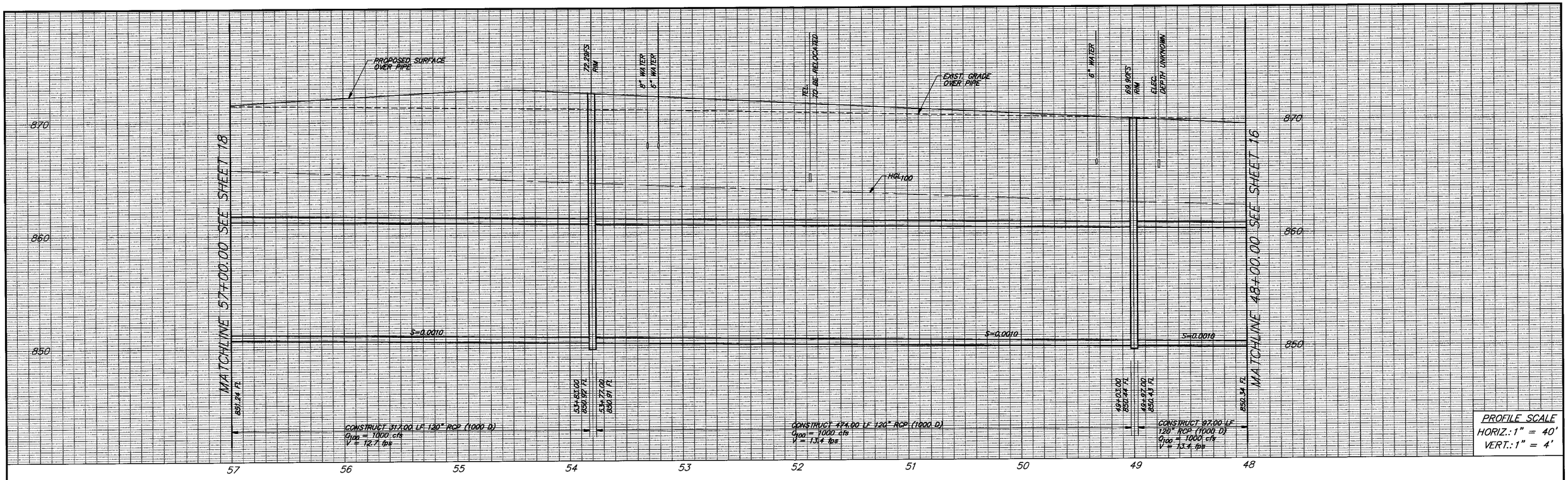
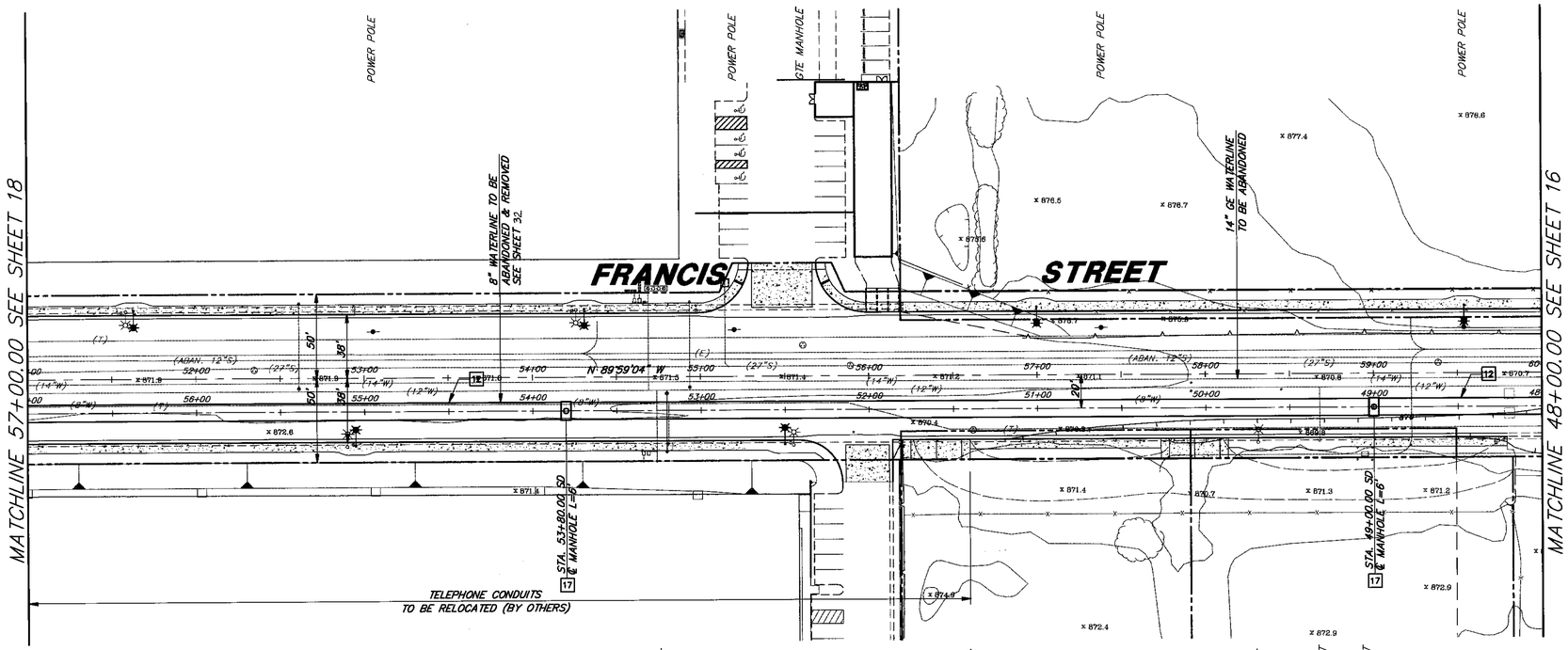


PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'



STORM DRAIN CONSTRUCTION NOTES:

12 CONSTRUCT 120" R.C.P. STORM DRAIN, D-LOAD PER PLAN
17 CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1

Underground Service Alert
Call: TOLL FREE
1-800
227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

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FAX: (909) 948-2750

Don Brooks 6-1-05
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REGISTERED PROFESSIONAL ENGINEER
DONALD R. BROOKS JR
No. 41829
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" STA. 48+00.00 TO STA. 57+00.00

SHEET 17 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13052

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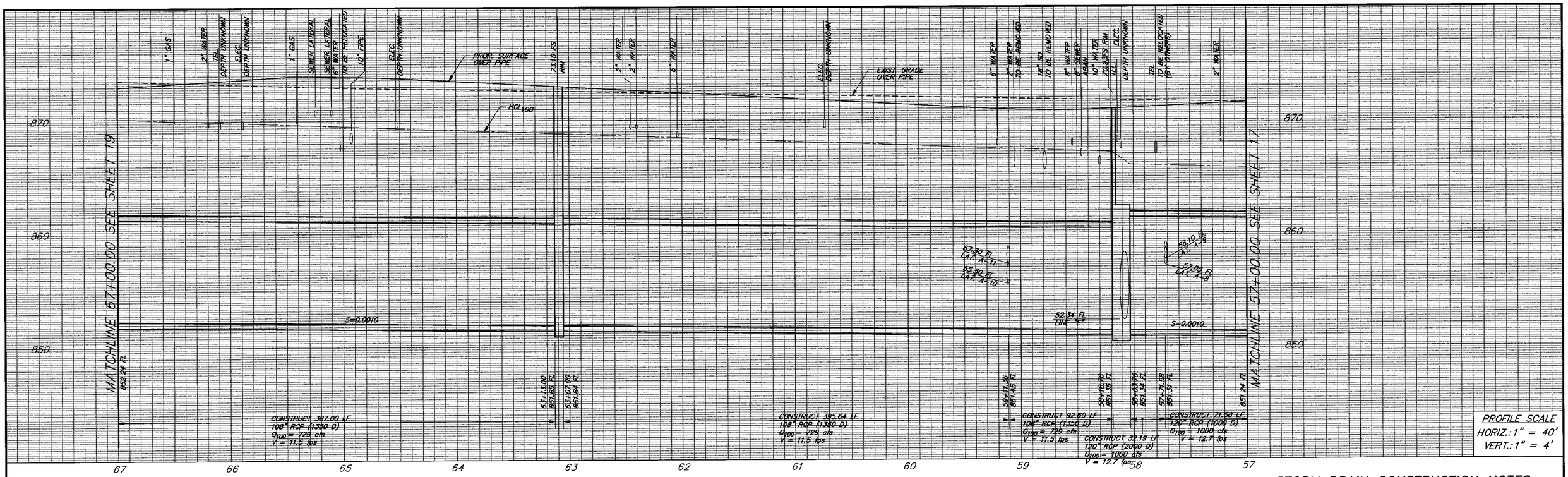

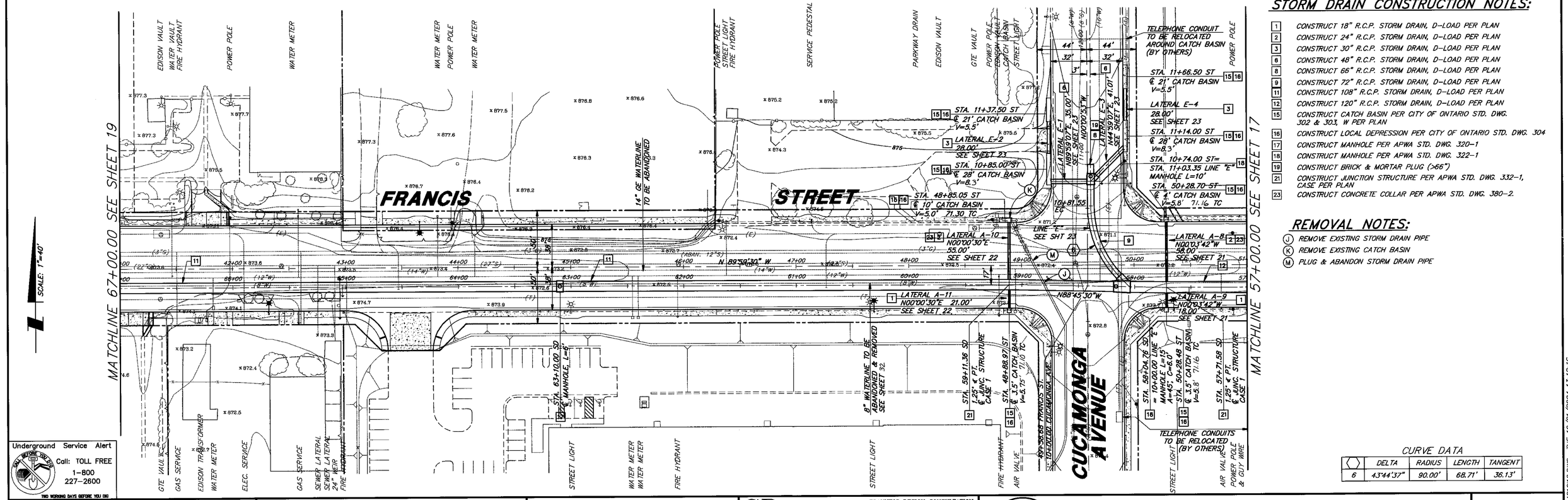

STORM DRAIN CONSTRUCTION NOTES:

1. CONSTRUCT 18" R.C.P. STORM DRAIN, D-LOAD PER PLAN
2. CONSTRUCT 24" R.C.P. STORM DRAIN, D-LOAD PER PLAN
3. CONSTRUCT 30" R.C.P. STORM DRAIN, D-LOAD PER PLAN
6. CONSTRUCT 48" R.C.P. STORM DRAIN, D-LOAD PER PLAN
8. CONSTRUCT 66" R.C.P. STORM DRAIN, D-LOAD PER PLAN
9. CONSTRUCT 72" R.C.P. STORM DRAIN, D-LOAD PER PLAN
11. CONSTRUCT 108" R.C.P. STORM DRAIN, D-LOAD PER PLAN
12. CONSTRUCT 120" R.C.P. STORM DRAIN, D-LOAD PER PLAN
15. CONSTRUCT CATCH BASIN PER CITY OF ONTARIO STD. DWG. 302 & 303, W PER PLAN
16. CONSTRUCT LOCAL DEPRESSION PER CITY OF ONTARIO STD. DWG. 304
17. CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1
18. CONSTRUCT MANHOLE PER APWA STD. DWG. 322-1
19. CONSTRUCT BRICK & MORTAR PLUG (>66")
21. CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 332-1, CASE PER PLAN
23. CONSTRUCT CONCRETE COLLAR PER APWA STD. DWG. 380-2.

REMOVAL NOTES:

(J) REMOVE EXISTING STORM DRAIN PIPE
(K) REMOVE EXISTING CATCH BASIN
(M) PLUG & ABANDON STORM DRAIN PIPE

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
6	43°44'37"	90.00'	68.71'	36.13'

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY ____ DATE ____
DRAWN BY ____ DATE ____
CHECKED BY ____ DATE ____

CITY OF ONTARIO

RECOMMENDED BY ____ ASSISTANT CITY ENGINEER ____ DATE
ACCEPTED BY ____ CITY ENGINEER ____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

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Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" STA. 57+00.00 TO STA. 67+00.00

SHEET 18 OF 32
CONTRACT ____
ACCOUNT ____
DWG. NO. D 17053

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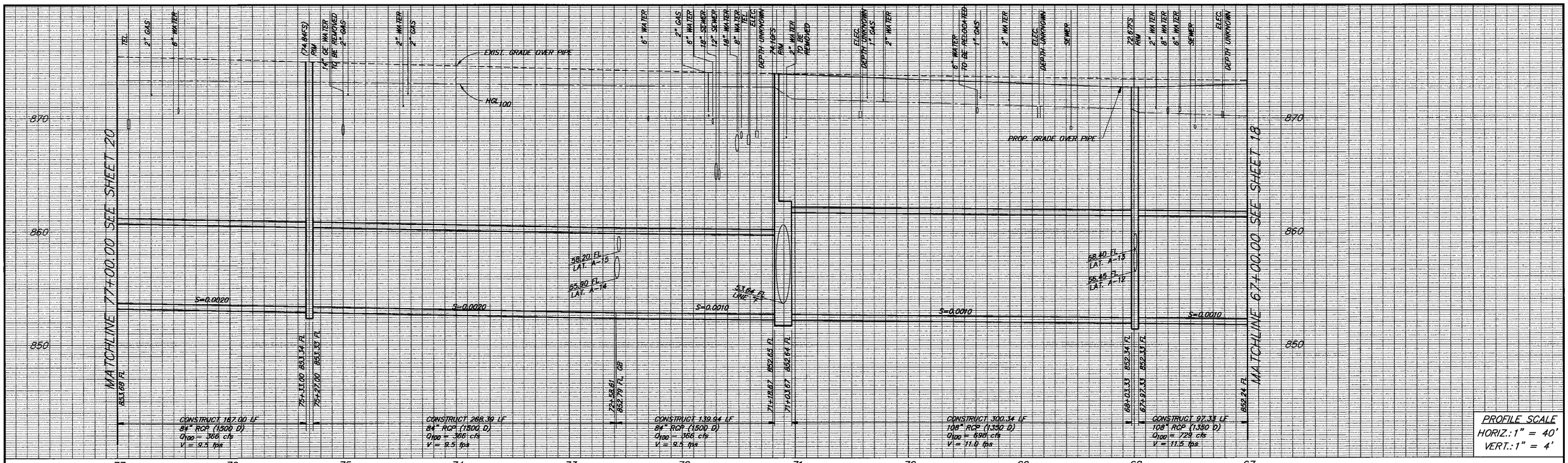
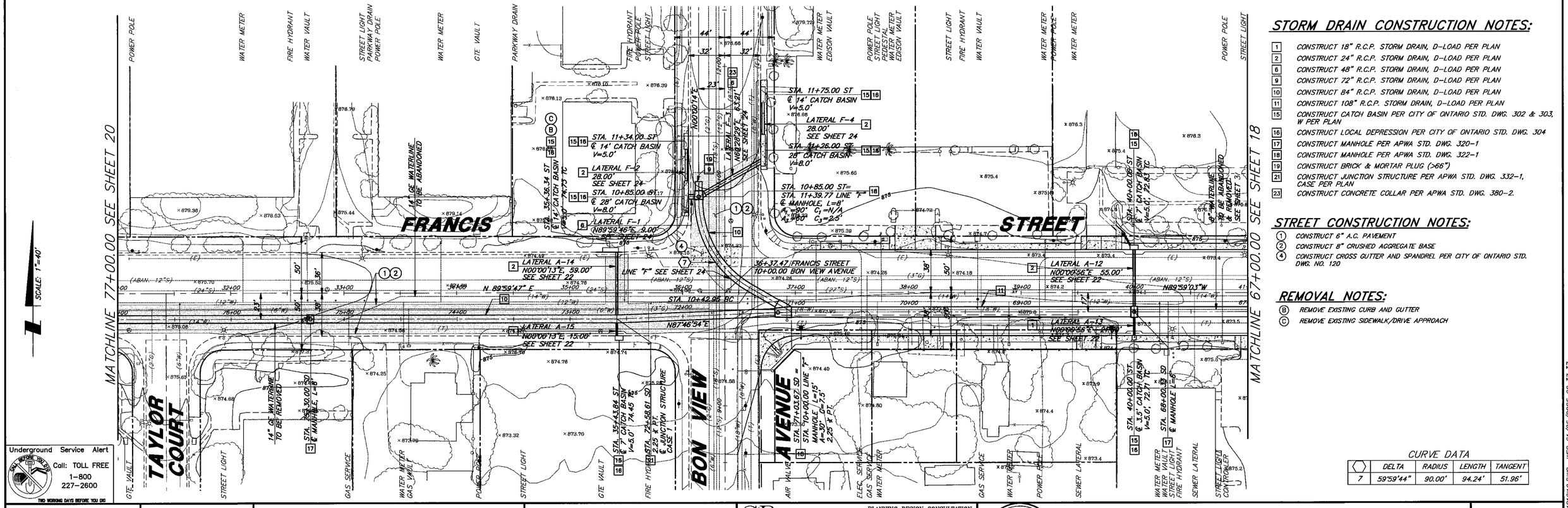


PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'



STORM DRAIN CONSTRUCTION NOTES:

1. CONSTRUCT 18" R.C.P. STORM DRAIN, D-LOAD PER PLAN
2. CONSTRUCT 24" R.C.P. STORM DRAIN, D-LOAD PER PLAN
6. CONSTRUCT 48" R.C.P. STORM DRAIN, D-LOAD PER PLAN
9. CONSTRUCT 72" R.C.P. STORM DRAIN, D-LOAD PER PLAN
10. CONSTRUCT 84" R.C.P. STORM DRAIN, D-LOAD PER PLAN
11. CONSTRUCT 108" R.C.P. STORM DRAIN, D-LOAD PER PLAN
15. CONSTRUCT CATCH BASIN PER CITY OF ONTARIO STD. DWG. 302 & 303, W PER PLAN
16. CONSTRUCT LOCAL DEPRESSION PER CITY OF ONTARIO STD. DWG. 304
17. CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1
18. CONSTRUCT MANHOLE PER APWA STD. DWG. 322-1
19. CONSTRUCT BRICK & MORTAR PLUG (>66")
21. CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 332-1, CASE PER PLAN
23. CONSTRUCT CONCRETE COLLAR PER APWA STD. DWG. 380-2.

STREET CONSTRUCTION NOTES:

1. CONSTRUCT 6" A.C. PAVEMENT
2. CONSTRUCT 8" CRUSHED AGGREGATE BASE
4. CONSTRUCT CROSS GUTTER AND SPANDREL PER CITY OF ONTARIO STD. DWG. NO. 120

REMOVAL NOTES:

- (B) REMOVE EXISTING CURB AND GUTTER
- (C) REMOVE EXISTING SIDEWALK/DRIVE APPROACH

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
7	59°59'44"	90.00'	94.24'	51.96'

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

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Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" 67+00.00 TO STA. 77+00.00

SHEET 19 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13054

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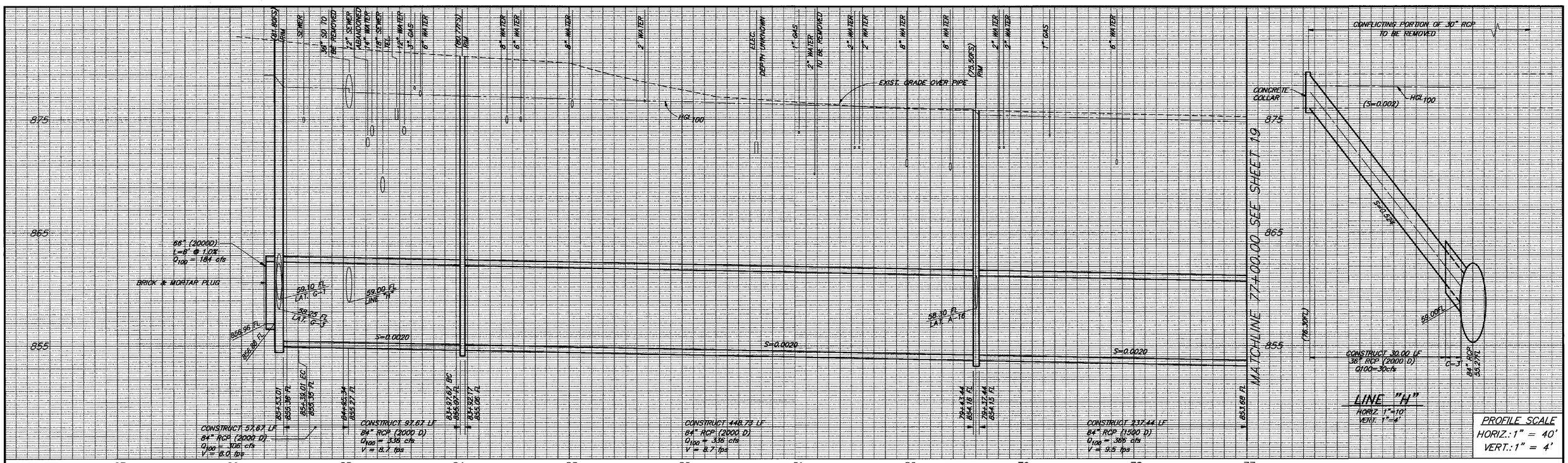

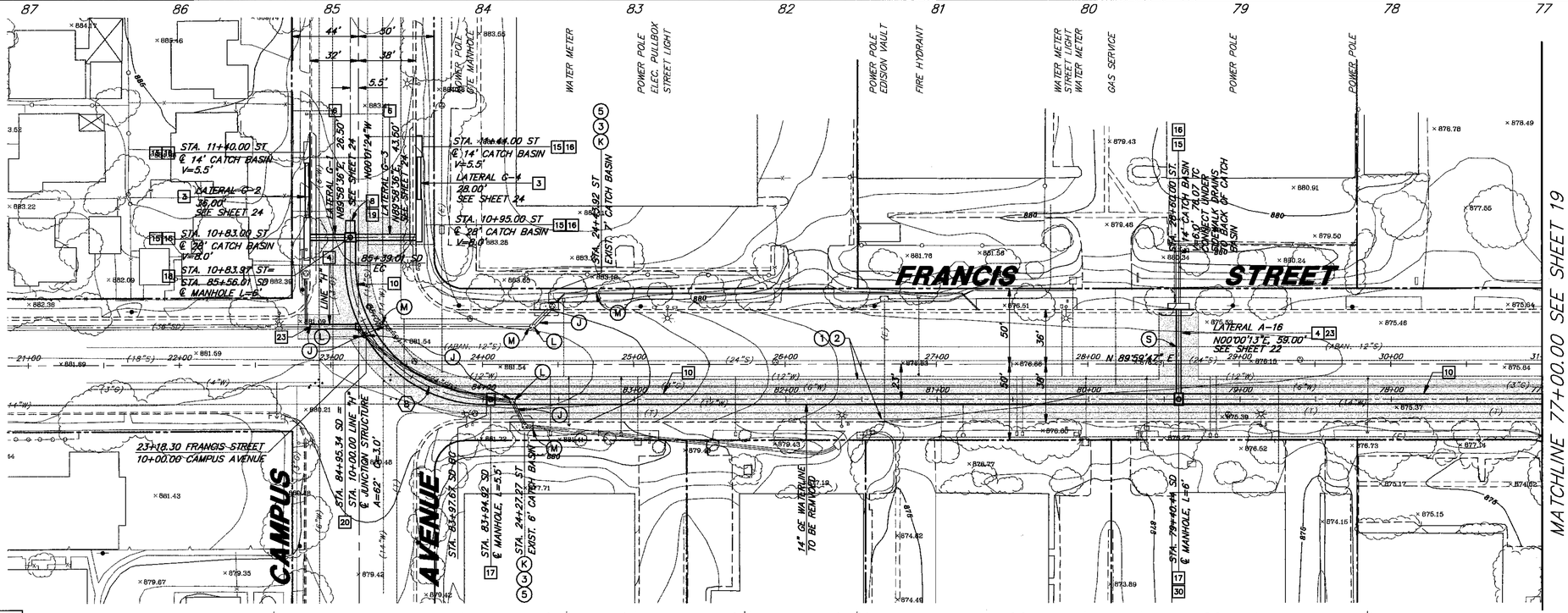

STORM DRAIN CONSTRUCTION NOTES:

- [3] CONSTRUCT 30" R.C.P. STORM DRAIN, D-LOAD PER PLAN
- [4] CONSTRUCT 36" R.C.P. STORM DRAIN, D-LOAD PER PLAN
- [6] CONSTRUCT 48" R.C.P. STORM DRAIN, D-LOAD PER PLAN
- [8] CONSTRUCT 66" R.C.P. STORM DRAIN, D-LOAD PER PLAN
- [10] CONSTRUCT 84" R.C.P. STORM DRAIN, D-LOAD PER PLAN
- [15] CONSTRUCT CATCH BASIN PER CITY OF ONTARIO STD. DWG. 302 & 303, W PER PLAN
- [16] CONSTRUCT LOCAL DEPRESSION PER CITY OF ONTARIO STD. DWG. 304
- [17] CONSTRUCT MANHOLE PER APWA STD. DWG. 320-1
- [18] CONSTRUCT MANHOLE PER APWA STD. DWG. 322-1
- [19] CONSTRUCT BRICK & MORTAR PLUG (>66")
- [20] CONSTRUCT JUNCTION STRUCTURE PER APWA STD. DWG. 331-2
- [23] CONSTRUCT CONCRETE COLLAR PER APWA STD. DWG. 380-2.
- [30] CONSTRUCT PRESSURE SHAFT AND MANHOLE COVER PER APWA STD. DWG. 211-1 AND 328-1

REMOVAL NOTES:

- (B) REMOVE EXISTING CURB AND GUTTER
- (J) REMOVE EXISTING STORM DRAIN PIPE
- (K) REMOVE EXISTING CATCH BASIN
- (L) REMOVE EXISTING MANHOLE
- (M) PLUG & ABANDON STORM DRAIN PIPE
- (S) REMOVE CONFLICTING ABANDONED UTILITY

STREET CONSTRUCTION NOTES:

- (1) CONSTRUCT 6" A.C. PAVEMENT
- (2) CONSTRUCT 8" CRUSHED AGGREGATE BASE
- (3) CONSTRUCT 8" CURB & GUTTER PER CITY OF ONTARIO STD. DWG. NO. 114, TYPE "B"
- (5) CONSTRUCT 5' P.C.C. SIDEWALK PER CITY OF ONTARIO STD. DWG. NO. 121 & 125

MATCHLINE 77+00.00 SEE SHEET 19

PROFILE SCALE
HORIZ.: 1" = 40'
VERT.: 1" = 4'

LINE "H"
HORIZ. 1"=10'
VERT. 1"=4'

CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
8	89°58'49"	90.00'	141.34'	89.97'

Underground Service Alert
DIAL BEFORE YOU DIG
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

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FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LINE "A" STA. 77+00.00 TO STA. 85+53.01

SHEET 20 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13055

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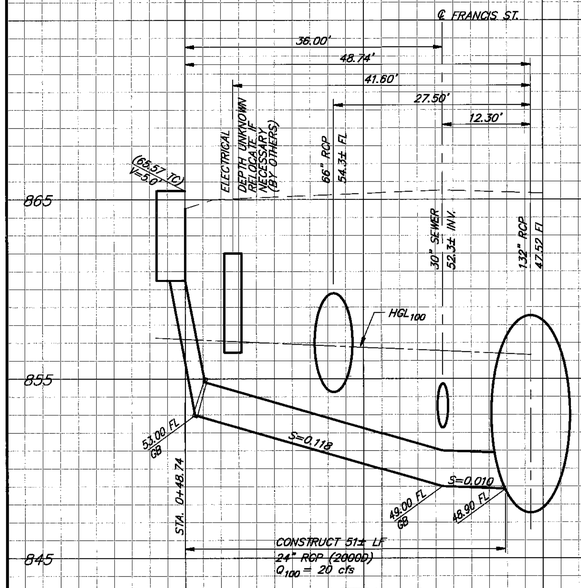
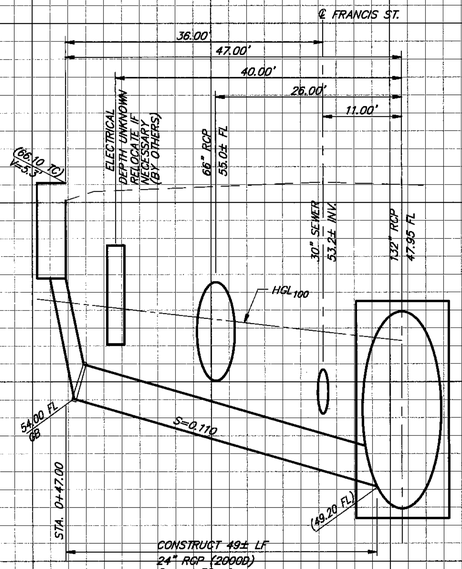
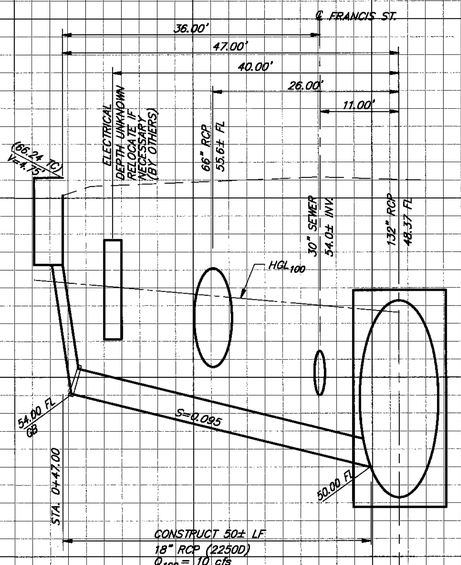


LATERAL A-1



LATERAL A-2



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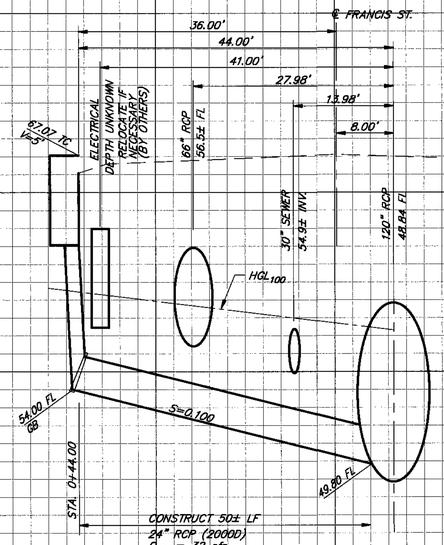

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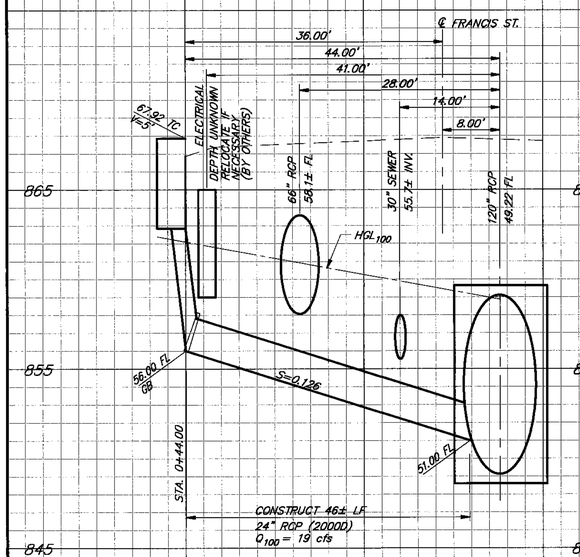
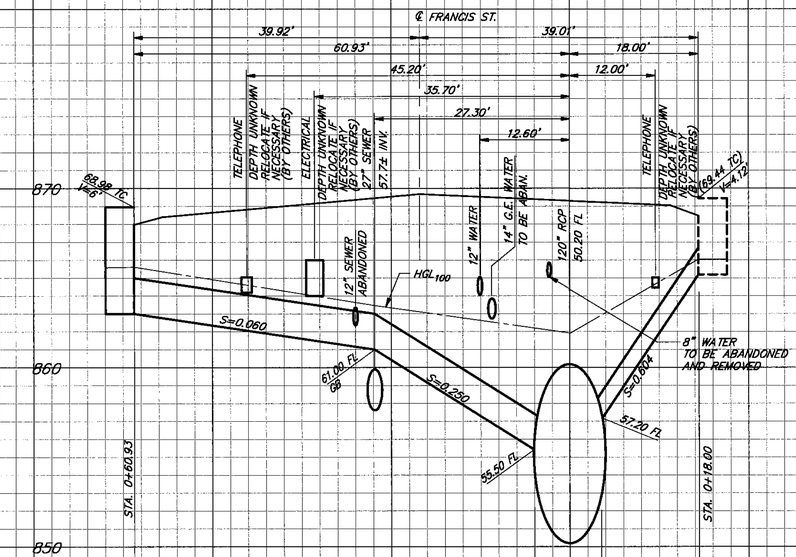
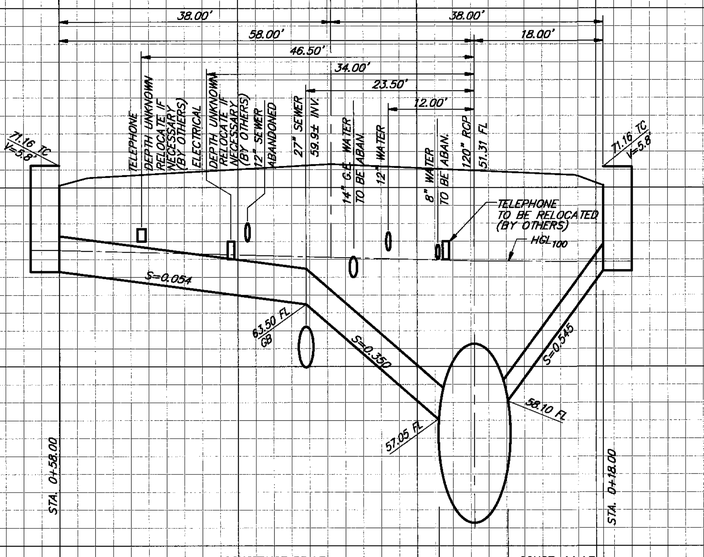


LATERAL A-5



LATERAL A-6

LATERAL A-7



LATERAL A-8

LATERAL A-9

PROFILE SCALE
HORIZ.: 1" = 10'
VERT.: 1" = 4'

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

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Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER — DONALD R. BROOKS — No. 41829 — Exp. 3/31/06 — CIVIL — STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LATERAL PROFILES

SHEET 21 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13056

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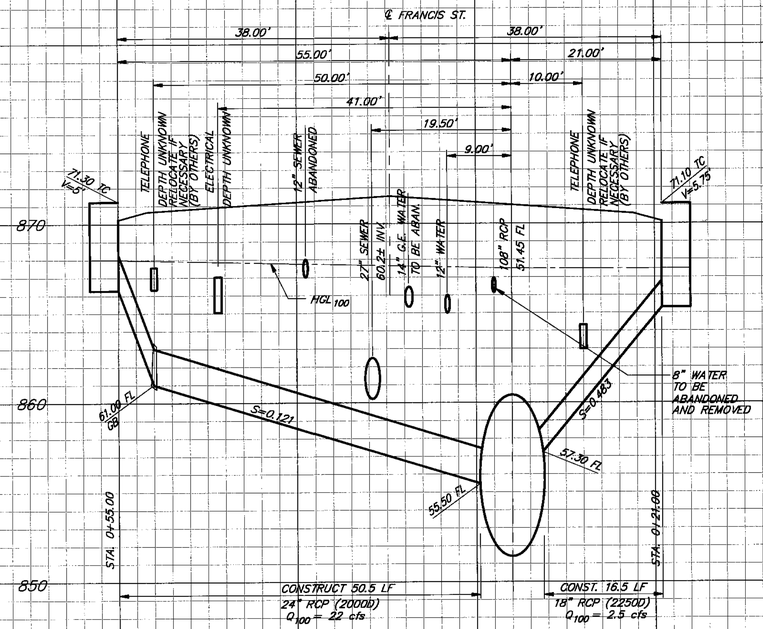

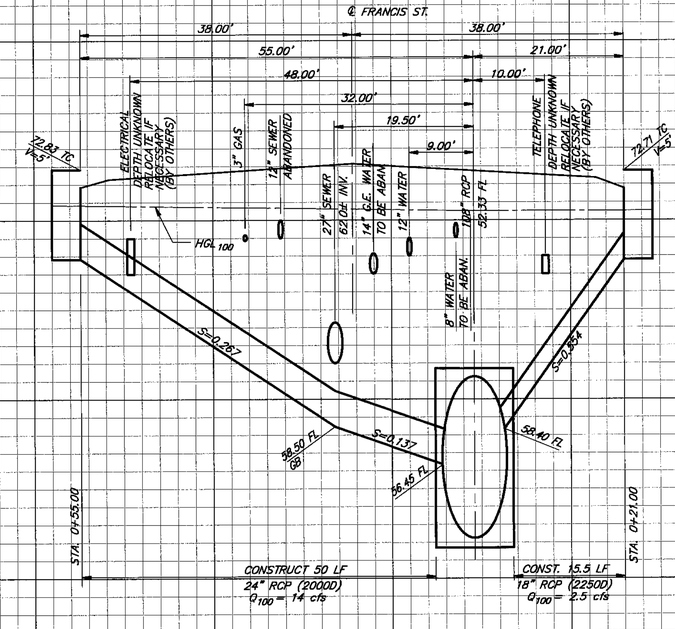

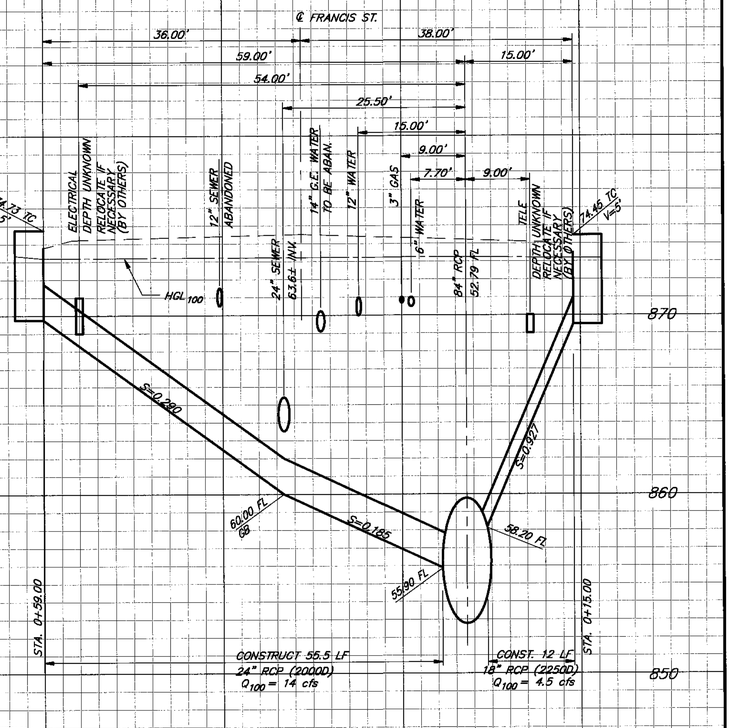

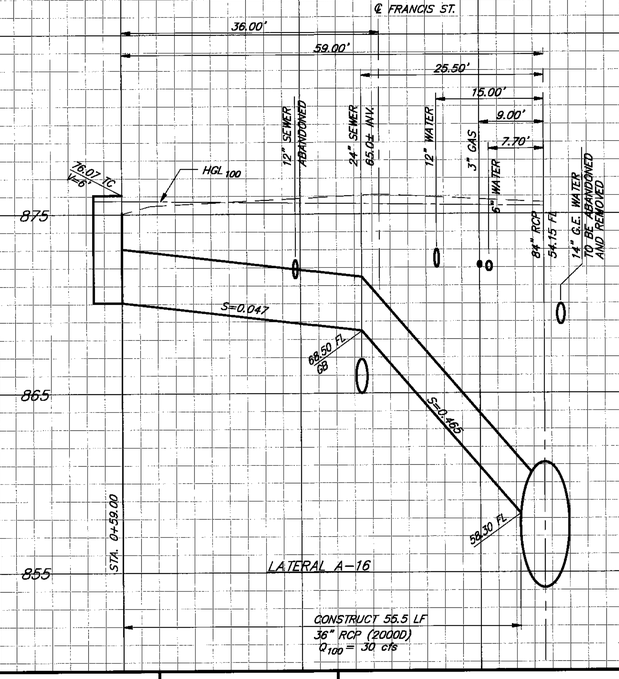

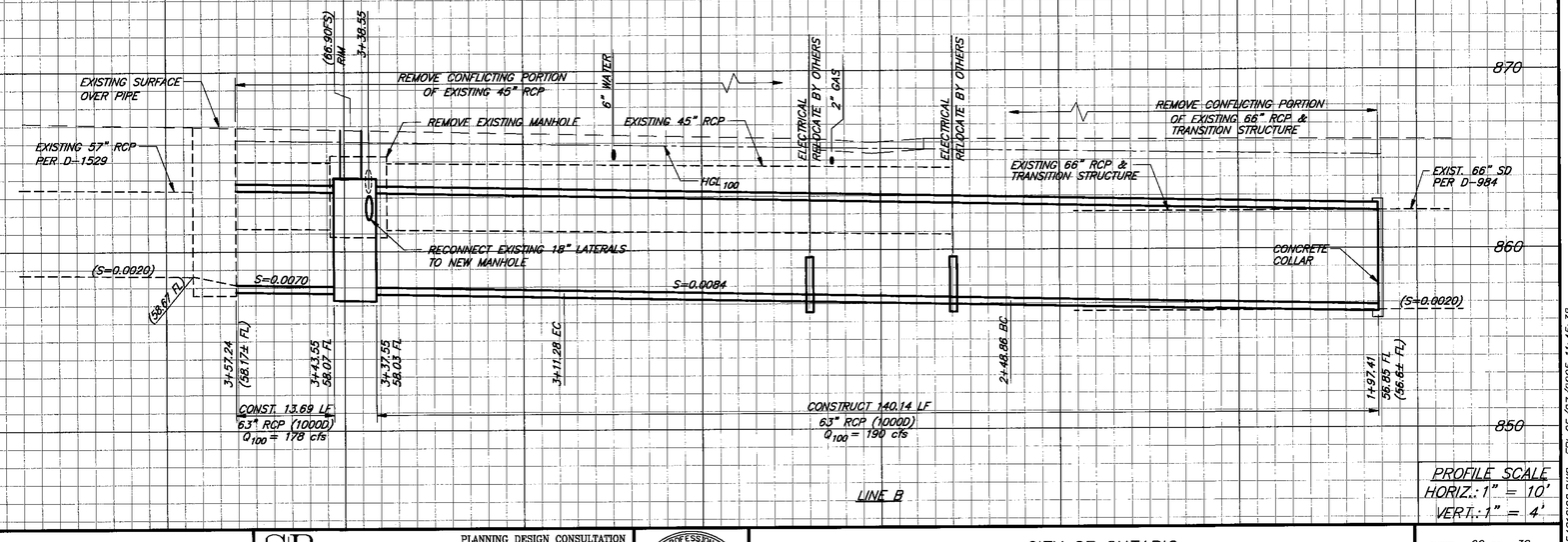

PROFILE SCALE
HORIZ.: 1" = 10'
VERT.: 1" = 4'

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

DESIGNED BY _____ DATE _____
DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O
Land Planning
Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750

Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER — DONALD R. BROOKS — No. 41829 — Exp. 3/31/06 — CIVIL — STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LATERAL PROFILES

SHEET 22 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13057

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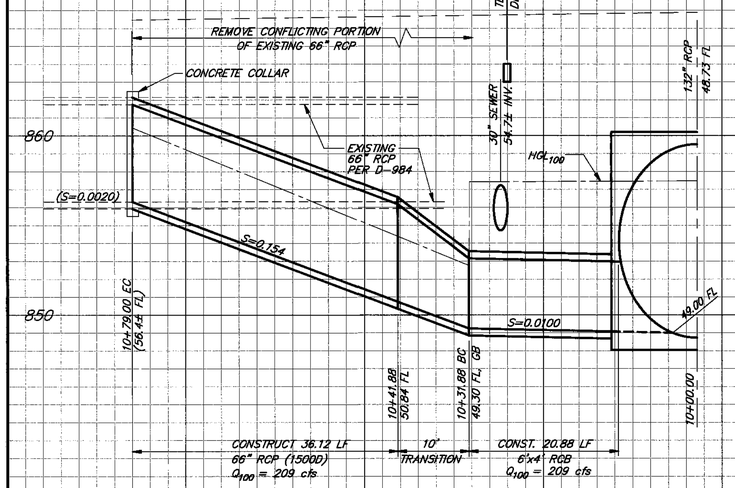

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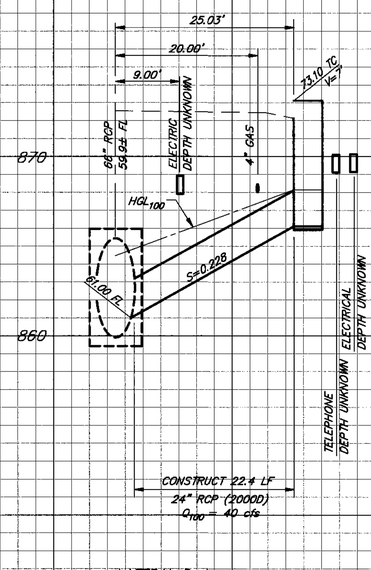

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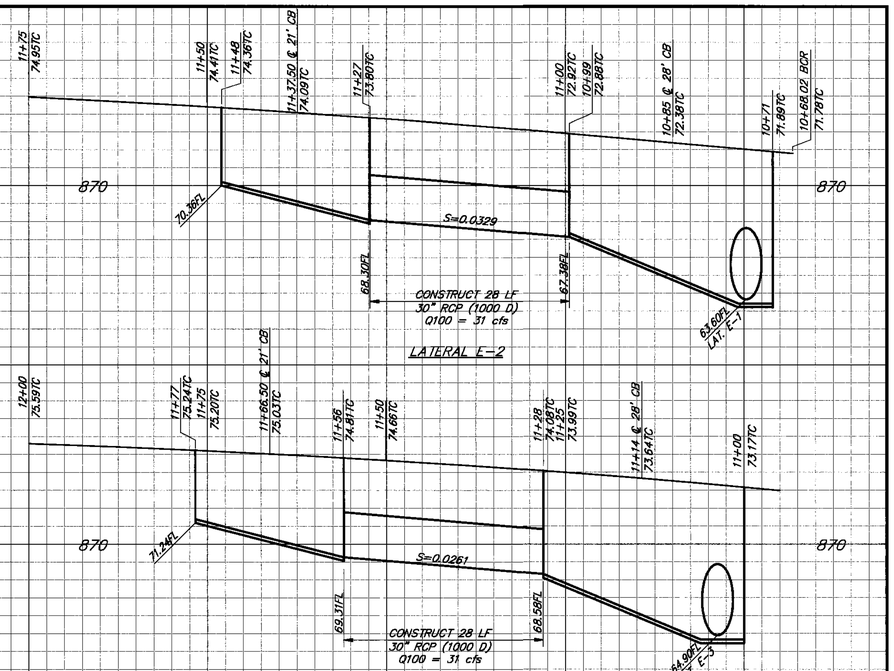

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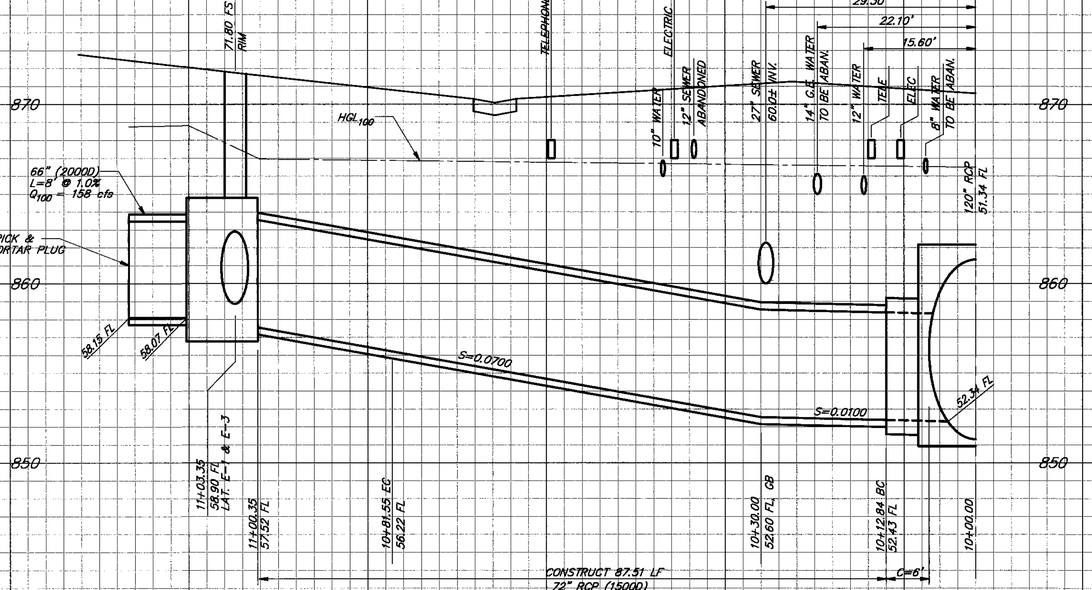

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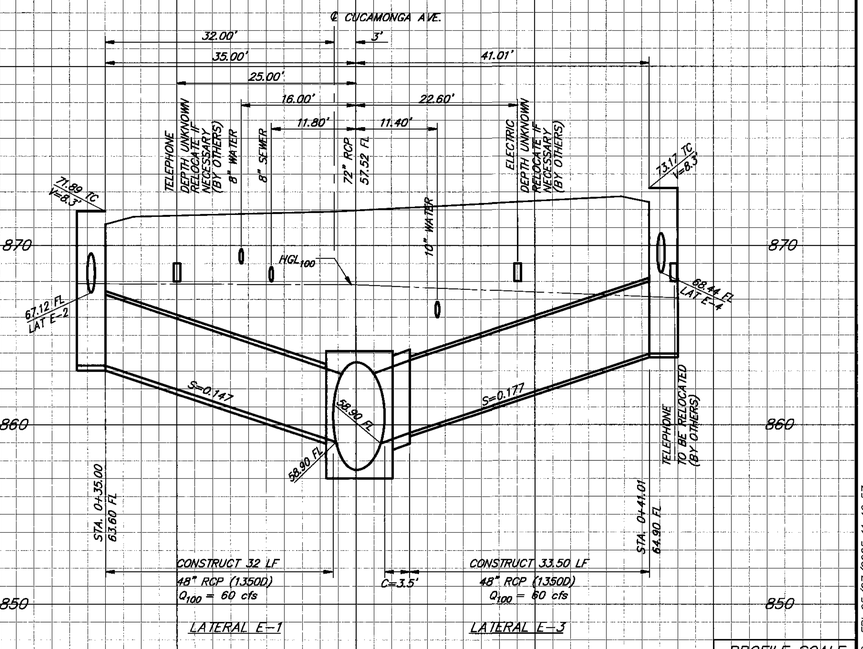

LATERAL E-1

LATERAL E-3

PROFILE SCALE
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REGISTERED PROFESSIONAL ENGINEER — DONALD R. BROOKS — No. 41829 — Exp. 3/31/06 — CIVIL — STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LATERAL PROFILES

SHEET 23 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13058

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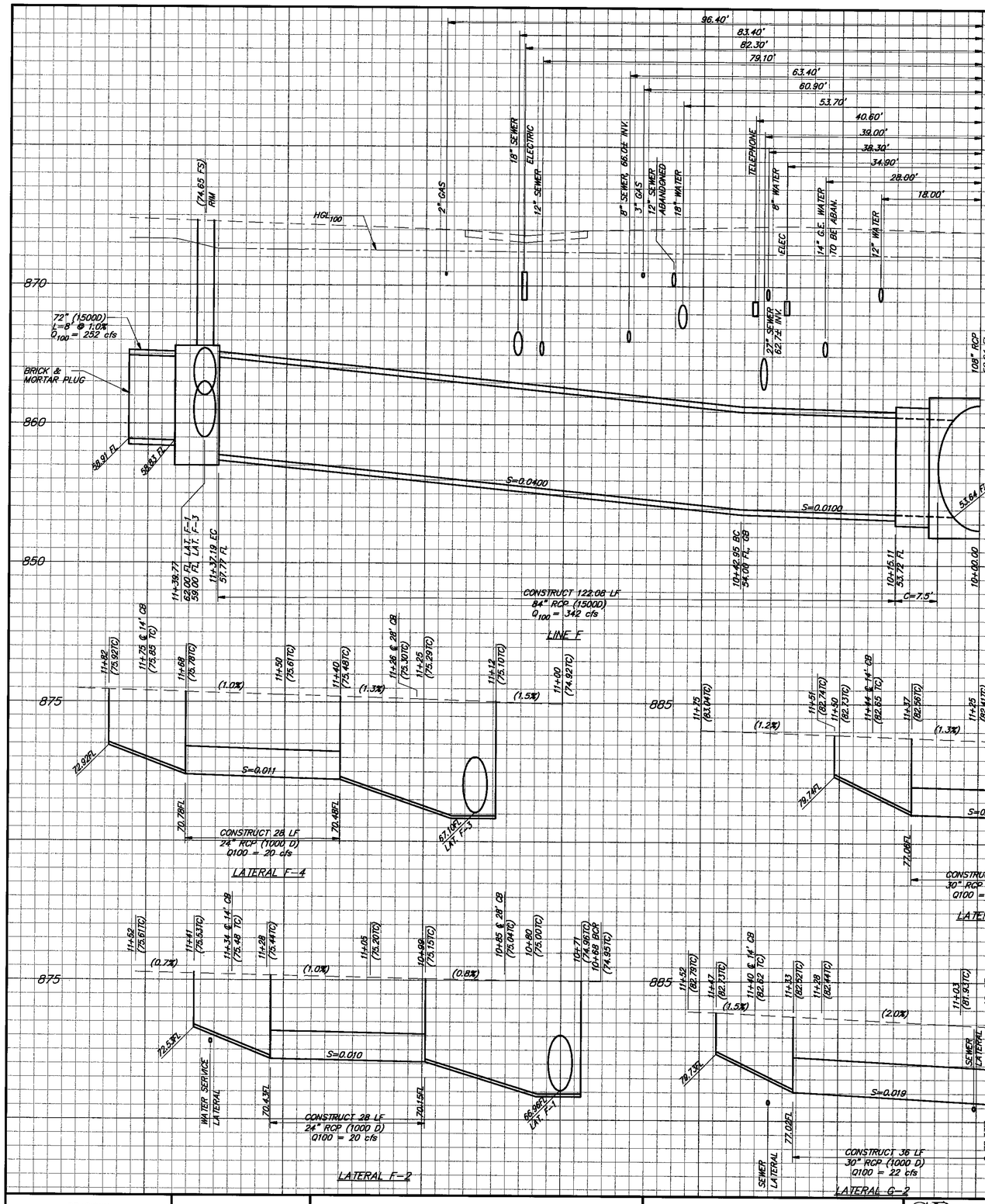

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REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS, JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
LATERAL PROFILES

SHEET 24 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D 13059

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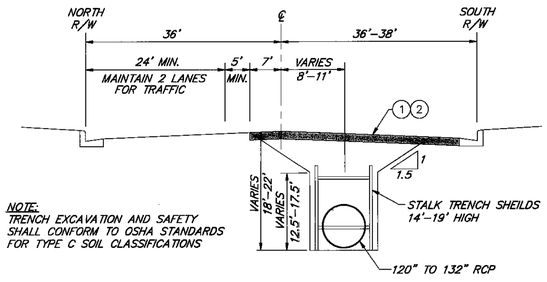
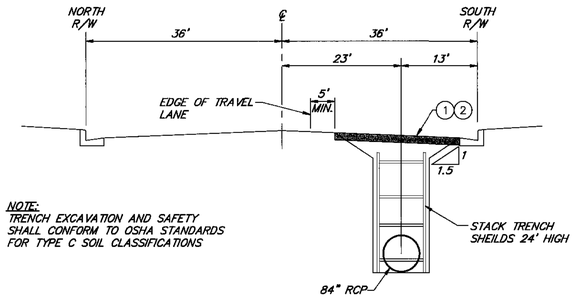


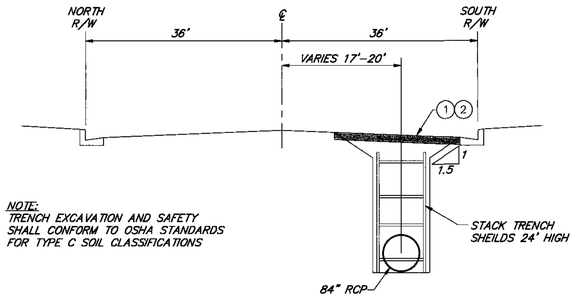
TRENCH & PAVEMENT REPAIR DETAIL

GROVE AVENUE TO WEST CUCAMONGA CHANNEL
N.T.S.



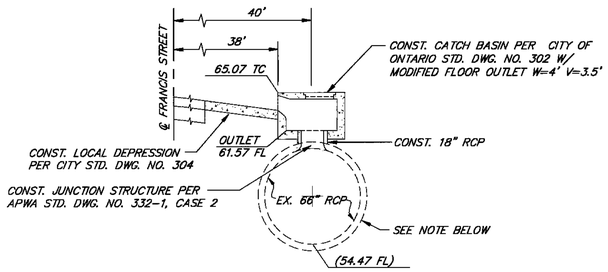
TRENCH & PAVEMENT REPAIR DETAIL

CAMPUS AVENUE TO BON VIEW AVENUE
N.T.S.



TRENCH & PAVEMENT REPAIR DETAIL

BON VIEW AVENUE TO GROVE AVENUE
N.T.S.



CATCH BASIN AND JUNCTION STRUCTURE

STA. 88+20.00

NOTE: CONTRACTOR SHALL VERIFY EXACT LOCATION AND ELEVATION OF EXISTING RCP. IF DIFFERENT THAN SHOWN, THE ENGINEER SHALL BE NOTIFIED PRIOR TO CONSTRUCTION.

DETAIL "Z"

NTS

REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

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CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
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BENCH MARK NO. _____ ELEV. _____
LOCATION:

S|B &|O
Land Planning
Civil Engineering
Land Surveying

PLANNING DESIGN CONSULTATION
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CIVIL
STATE OF CALIFORNIA

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
STORM DRAIN CONSTRUCTION DETAILS

SHEET 25 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13060

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STRUCTURAL ABBREVIATIONS

AB	ANCHOR BOLT	I.D.	INSIDE DIAMETER
ABV	ABOVE	I.E.	INVERT ELEVATION
ADD'L	ADDITIONAL	IN.(")	INCH(ES)
ADJ	ADJACENT	INT.	INTERIOR
ALUM	ALUMINUM	JST	JOIST
APA	AMERICAN PLYWOOD ASSOC.	JT	JOINT
ALT	ALTERNATE	K	KIPS(1000)
APPRX	APPROXIMATELY	KP	KING POST
ARCH'L	ARCHITECTURAL	KS	KING STUD
@	AND	LAT.	LATERAL
@	AT	LB(#)	POUND(S)
B.F.	BRACED FRAME	L.B.	LAG BOLTS
BLDG	BUILDING	L.F.	LINEAR FEET(FOOT)
BLK.	BLOCK	LGTH	LENGTH
BLKG	BLOCKING	LLH	LONG LEG HORIZ.
BLW	BELOW	LG	LONG(ITUDINAL)
BM	BEAM	LLV	LONG LEG VERT.
BN	BOUNDARY NAILING	LT.WT.	LIGHT WEIGHT
BNDRY	BOUNDARY	L.SL	LONGITUDINAL BEAM
B.O.F.	BOTTOM OF FOOTING	MAS	MASONRY
BOTT	BOTTOM	MAT'L	MATERIAL
BRDG.	BRIDGE(ING)	MAX	MAXIMUM
BRG	BEARING	M.B.	MACHINE BOLT
BTM(B)	BOTTOM	MECH	MECHANICAL
BTWN	BETWEEN	MEZZ	MEZZANINE
BS	BOTH SIDES	MFR	MANUFACTURER
CAMB (C)	CAMBER(ED)	MISC	MISCELLANEOUS
CE	CARBON EQUIVALENT	MIN	MINIMUM
CANT	CANTILEVER(ED)	ML	MICROLAN
C.F.	CUBIC FEET(FOOT)	MTL	METAL
C.I.P.	CAST IN PLACE	NO.(#)	NUMBER
C.J.	CEILING JOIST	N.S.	NEAR SIDE
CL (℄)	CENTER LINE	NTS	NOT TO SCALE
CLG	CEILING	O.C.	ON CENTER
CLR	CLEAR	O.D.	OUTSIDE DIAMETER
COL	COLUMN	O.H.	OPPOSITE HAND (REVERSE)
CONC	CONCRETE	OPT	OPTIONAL
CONN.	CONNECTION	PAR	PARALLEL
CONST	CONSTRUCTION	P/C	PRECAST
CONT	CONTINUOUS	PERP	PERPENDICULAR
CTSK	COUNTERSINK	PL	PLATE (WOOD)
CTR	CENTER(ED)	PL	PLATE (METAL)
C.Y.	CUBIC YARD	PLY	PLYWOOD
d	PENNY(NAILS)	P.S.F.	POUNDS PER SQUARE FOOT
DBL (D)	DOUBLE	P.S.I.	POUNDS PER SQUARE INCH
DEPT	DEPARTMENT	PSL	PARALLAM BEAM
DES.	DESIGN	P.T.	PRESSURE TREATED
D.F.	DOUGLAS FIR	P.T.D.F.	PRESSURE TREATED DOUGLAS FIR
DIA	DIAMETER	QTY	QUANTITY
DIAPH.	DIAPHRAGM	RAD(R)	RADIUS
DIM	DIMENSION	R.C.P.	REINFORCED CONCRETE PIPE
DN	DOWN	REF	REFERENCE
do	DITTO(REPEAT)	R.F.	RIGID FRAME
DP	DEEP	REINF	REINFORCEMENT(ING)
DWG	DRAWING(S)	REQ'D	REQUIRED
DWL	DOWEL(S)	RJ	ROOF JOIST
EA.	EACH	R.R.	ROOF RAFTER
E.F.	EACH FACE	R.O.	ROUGH OPENING
E.J.	EXPANSION JOINT	R/S	ROUGH SAWN
EL.	ELEVATION	SCH	SCHEDULE
ELEC	ELECTRICAL	SHT	SHEET
ELEV	ELEVATION	SIM	SIMILAR
EMBD	EMBED(MENT)	SKEW	SKEW(ED)
EN	EDGE NAIL	SPC	SPACE(ING)
ENG	ENGINEER	SPEC.	SPECIFICATION(S)
ENH	ENHANCED	SPL	SPLICE
EQ	EQUAL	SP.INSP.	SPECIAL INSPECTION
EQPT	EQUIPMENT	SQ	SQUARE
E.S.	EACH SIDE	STD	STANDARD
EX.	EXISTING	STGR	STAGGER(ED)
EXT.	EXTERIOR	STIF	STIFFENER(S)
EXP.	EXPANSION	STL	STEEL
(F)	FLUSH	STRUC	STRUCTURAL
FAB	FABRICATION	STIR.	STIRRUP(S)
FDN	FOUNDATION	SUSP	SUSPENDED(TION)
FIN	FINISHED	SYMM	SYMMETRICAL
F.J.	FLOOR JOIST	T.	TOP
FLG	FLANGE	T&B	TOP AND BOTTOM
FLR	FLOOR	T&G	TONGUE AND GROOVE
FN	FIELD (FACE NAIL)	TEMP	TEMPERATURE
F.O.C	FACE OF CONCRETE	THK	THICKNESS
F.O.M.	FACE OF MASONRY	THRD	THREADED
F.O.S.	FACE OF STUD	TMPRY	TEMPORARY
F.O.W.	FACE OF WALL	TN	TOE NAIL
FRM	FRAME(ING)	T.O.S.	TOP OF SHEATHING
F.S.	FAR SIDE	T.O.W.	TOP OF WALL
FT.(')	FOOT(FEET)	T.S.	TOP OF STEEL
FTG	FOOTING	T PL	TOP PLATE
GA	GAUGE	TRANSV	TRANSVERSE
GALV	GALVINIZE(D)	TYP	TYPICAL
G.E.	GABLE END	U.O.N.	UNLESS OTHERWISE NOTED
GB	GRADE BEAM	VERT (V)	VERTICAL
GLB	GLUED LAMINATED BEAM	V.I.F.	VERIFY IN FIELD
GRD	GRADE	(W)	WIDE(WIDTH)
G.T.	GRIDER TRUSS	w/	WITH
GYPBD	GYPSUM WALLBOARD	WIN	WINDOW
HD	HOLD DOWN	WDW	WINDOW
HRD	HEADER	WD	WOOD
HGR	HANGER	W.P.	WORK POINT
HORIZ (H)	HORIZONTAL	WPJ.	WEAKENED PLANE JOINT
HSB	HIGH STRENGTH BOLTS	W.S.	WELDED STUD(S)
HT	HEIGHT	WT	WEIGHT
		WWF	WELDED WIRE FABRIC
		X-STG	EXTRA STRONG
		XX-STG	DOUBLE EXTRA STRONG
		YD	YARD

FOR ADDITIONAL ABBREVIATIONS SEE SHEAR WALL SCHEDULE SHT.S3

SPECIAL INSPECTION LIST

1. CONCRETE
2. BOLTS INSTALLED IN CONCRETE
3. CONCRETE MOMENT RESISTING SPACE FRAME
4. REINFORCING STEEL AND PRESTRESSING STEEL
5A. WELD TESTING DUCTILE MOMENT RESISTING STEEL FRAMES
5B. ALL STRUCTURAL WELDING INCLUDING REINFORCING STEEL
6. HIGH-STRENGTH BOLTING
7. STRUCTURAL MASONRY
8. REINFORCING GYPSUM CONCRETE
9. INSULATING CONCRETE FILL
10. SPRAY APPLIED FIRE PROOFING
11. DEEP FOUNDATIONS (PILING, DRILLED PIERS & CAISSONS)
12. SHOTCRETE
13A. VERIFY SOIL CONDITIONS ARE SUBSTANTIALLY IN CONFORMANCE WITH THE SOIL INVESTIGATION REPORT.
13B. VERIFY THAT FOUNDATION EXCAVATIONS EXTEND TO PROPER DEPTH & BEARING STRATA.
13C. PROVIDE SOIL COMPACTION TEST RESULTS,DEPTH OF FILL,RELATIVE DENSITY,BEARING VALUES.
13D. PROVIDE SOIL EXPANSION TEST RESULTS,EXPANSION INDEX RECOMMENDATIONS FOR FOUNDATIONS, ON GRADE FLOOR SLABS DESIGN FOR EACH BUILDING SITE.
14. SPECIAL CASES (DESCRIBE)
15. OFF-SITE FABRICATION OF BLDG. COMPONENTS
16. OTHER STRUCTURAL INSPECTIONS AS REQUIRED BY DESIGNER.

NO.	DESCRIPTION OF TYPE OF INSPECTION REQUIRED,LOCATION,REMARKS,ETC.	DESIGN STRENGTH
1	CONCRETE	f'c = 4000 PSI
13A THRU 13D	PER GEOTECHNICAL REQUIREMENTS	

A. THE CONSTRUCTION INSPECTIONS LISTED ARE IN ADDITION TO THE CALLED INSPECTIONS REQUIRED BY CHAPTER 17 OF THE UNIFORM BUILDING CODE. SPECIAL INSPECTION IS NOT A SUBSTITUTE FOR INSPECTION BY A CITY INSPECTOR. SPECIALLY INSPECTED WORK WHICH IS INSTALLED OR COVERED WITHOUT THE APPROVAL OF THE CITY INSPECTOR IS SUBJECT TO REMOVAL OR EXPOSURE.

B. CONTINUOUS INSPECTION IS ALWAYS REQUIRED DURING THE PERFORMANCE OF THE WORK UNLESS OTHERWISE SPECIFIED.

C. THE SPECIAL INSPECTORS MUST BE CERTIFIED BY THE APPROVING MUNICIPALITY TO PERFORM THE TYPES OF INSPECTION SPECIFIED.

D. IT IS THE RESPONSIBILITY OF THE OWNER TO INFORM THE SPECIAL INSPECTOR OR INSPECTION AGENCY AT LEAST ONE WORKING DAY PRIOR TO PERFORMING ANY WORK THAT REQUIRES SPECIAL INSPECTION. ALL WORK PERFORMED WITHOUT REQUIRED SPECIAL INSPECTION IS SUBJECT TO REMOVAL.

E. NOTE: A CERTIFICATE OF SATISFACTORY COMPLETION OF WORK REQUIRING SPECIAL INSPECTION MUST BE COMPLETED AND SUBMITTED TO THE FIELD INSPECTION DIVISION OF THE APPROVING MUNICIPALITY.

FOUNDATION NOTES:

1. MAXIMUM DESIGN SOIL PRESSURE:
   - CONTINUOUS FOOTINGS: 1500 PSF
   - PAD FOOTINGS: 1500 PSF
2. SEE SOILS REPORT BY: CHJ, INC.
   - PROJECT NO.: 00490-3
   - DATED: AUGUST 22, 2000
3. ALL FOOTINGS TO BE A MINIMUM OF 18" BELOW NATURAL GRADE
   18" BELOW FINISH GRADE
4. SOILS COMPACTION AND SITE PREPARATION TO BE IN ACCORDANCE WITH SOILS REPORT. ALL WORK TO BE DONE UNDER THE DIRECT SUPERVISION OF THE GEOTECHNICAL ENGINEER.
5. FINISH EXCAVATION FOR FOUNDATION SHALL BE NEAT AND TRUE TO LINE WITH LOOSE MATERIAL REMOVED FROM EXCAVATION.
6. THE FOOTING EXCAVATIONS SHALL BE KEPT FREE FROM LOOSE MATERIAL AND STANDING WATER AND, BEFORE ANY FOOTING CONCRETE IS PLACED, SHALL BE CHECKED AND APPROVED BY A QUALIFIED GEOTECHNICAL ENGINEER TO INSURE COMPLIANCE WITH THE REQUIREMENTS.
7. SIDE OF FOUNDATION MAY BE POURED AGAINST STABLE EARTH (U.O.N.)
8. METHOD OF SUPPORTING REINFORCING PIPE SLEEVES MUST BE APPROVED BY THE STRUCTURAL ENGINEER.
9. CONTRACTOR SHALL PROTECT ALL UTILITY LINES, ETC., ENCOUNTERED DURING EXCAVATION AND BACKFILLING.
10. CONTRACTOR TO BRACE OR PROTECT FROM LATERAL LOADS ALL RETAINING WALLS UNTIL ATTACHING FLOORS OR SLABS ARE COMPLETELY IN PLACE AND HAVE ATTAINED FULL STRENGTH OR BHEATHED.
11. FOOTING BACKFILL AND UTILITY TRENCH BACKFILL WITHIN BUILDING AREA SHALL BE MECHANICALLY COMPACTED IN LAYERS TO THE APPROVAL OF THE GEOTECHNICAL OR STRUCTURAL ENGINEER. FLOODING WILL NOT BE PERMITTED.(U.O.N.)
12. ALL HOLDOWNS SHALL BE TIED IN PLACE PRIOR TO FOUNDATION INSPECTION.
13. ALL SILL PLATES (P.T.D.F.) WITH 5/8"ø A/B x 12" AT 48" (U.O.N. ON PLANS) W/ 3/16"x2"x2" PLATE WASHERS.
14. FOR ADDITIONAL DIMENSIONS SEE ARCHITECTURAL DRAWINGS.
15. POST TENSION SHOP DRAWINGS SHALL BE SUBMITTED TO ENGINEER OF RECORD FOR REVIEW PRIOR TO CONSTRUCTION

CONCRETE NOTES:

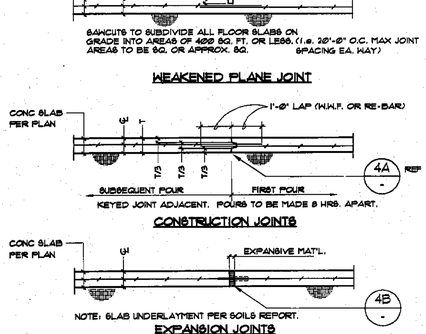
1. CONCRETE IN ALL WORK SHALL HAVE THE FOLLOWING ULTIMATE COMPRESSIVE STRENGTH AT 28 DAYS EXCEPT AS MODIFIED BY THESE NOTES:
   - A. SLAB ON GRADE (NO SP. INSP.) 4000 PSI
   - B. FOOTINGS 4000 PSI
   - C. WALLS 4000 PSI
2. LIGHT WEIGHT CONCRETE SHALL BE AIR ENTRAINED AND HAVE A DENSITY RANGE OF 115 PCF MAXIMUM AND 100 PCF MINIMUM.
3. COMPRESSIVE STRENGTH TEST REPORTS SHALL BE SUBMITTED TO THE ENGINEER WHEN CONCRETE REQUIRES SPECIAL INSPECTION.(SEC. INSP. WILL BE REQUIRED FOR ALL CONC. W/F'C GREATER THAN 2500 PSI.)
4. CEMENT SHALL CONFORM TO ASTM C-150, TYPE I OR TYPE II.
5. AGGREGATES FOR NORMAL WEIGHT CONCRETE SHALL CONFORM TO ASTM C-33. AGGREGATE FOR LIGHT WEIGHT CONCRETE SHALL CONFORM TO
6. READY MIX CONCRETE SHALL BE MIXED AND DELIVERED IN ACCORDANCE WITH ASTM C-94-81.
7. ADMIXTURES MAY BE USED WITH THE PRIOR APPROVAL OF THE ENGINEER. ADMIXTURE (COMPLYING WITH ASTM A494) USED TO INCREASE THE WORKABILITY OF THE CONCRETE SHALL NOT BE CONSIDERED TO REDUCE THE SPECIFIED MINIMUM CEMENT CONTENT. (CALCIUM CHLORIDE SHALL NOT BE USED).
8. WATER SHALL BE CLEAN, FREE FROM DELETERIOUS AMOUNT OF ACIDS, ALKALIS OR ORGANIC MATERIALS.
9. REFER TO ARCHITECTURAL DRAWINGS FOR MOLDS, GROOVES, ORNAMENTS, CLIPS OR GROUNDS REQUIRED TO BE CAST INTO CONCRETE AND FOR EXTENT OF DEPRESSIONS, CURBS, AND RAMPS.
10. DOWELS BETWEEN FOOTINGS AND WALLS SHALL BE THE SAME SIZE, GRADE AND SPACING AS VERTICAL WALL REINFORCING. (U.O.N.).
11. SLUMPS: THE MAXIMUM SLUMP SHALL NOT EXCEED 4" FOR FOOTINGS, SLABS ON EARTH AND MASS CONCRETE AND 5" FOR OTHER CONCRETE. DURING TEMPERATURES ABOVE 90 F, MAXIMUM OF 6" SLUMP IS PERMISSIBLE PROVIDED THE MIX DESIGN IS REVISED ACCORDINGLY BY THE TESTING LABORATORY. MEASURE SLUMP IN ACCORDANCE WITH "METHOD OF TEST FOR SLUMP" OF PORTLAND CEMENT CONCRETE ASTM C143.
12. NO SLEEVES OR CHASES SHALL BE PLACED IN BEAMS, SLABS OR WALLS EXCEPT AS SHOWN ON PLANS. CONTRACTOR SHALL OBTAIN PRIOR APPROVAL FOR INSTALLATION OF ANY ADDITIONAL SLEEVES OR CHASES. NO CONDUIT SHALL BE PLACED IN THE CONCRETE TOPPING OVER STEEL DECKING.
13. SLEEVE PLUMBING OPENINGS IN CONCRETE WALLS AND SLABS BEFORE PLACING CONCRETE. BEND REINFORCEMENT AROUND SLEEVES.
14. PROJECTING CORNERS OF SLABS, BEAMS, WALLS, COLUMNS, ETC. SHALL BE FORMED WITH A ¾" CHAMFER.
15. CONTRACTOR SHALL SUBMIT MIX DESIGNS FOR REVIEW BEFORE FABRICATION AND INSTALLATION.
16. IN THE EVENT OF AN UNINTENTIONAL COLD JOINT, THE CONTRACTOR SHALL REMOVE ALL LAITENCE AND DELITRIOUS MATERIAL TO PROVIDE A SOUND,CLEAN,ROUGH SURFACE AND USE A BONDING AGENT THAT PRODUCES A HIGHER STRENGTH JOINT THAN THE CONCRETE USED - F'C + 25% MINIMUM.
17. CONCRETE COVER SHALL BE IN ACCORDANCE WITH SECTION 7.7 OF ACI 318.
18. DO NOT DISPLACE REBAR FROM THEIR INTENDED POSITIONS DURING CONCRETING.

REINFORCING STEEL NOTES:

1. BAR REINFORCEMENT SHALL BE: GR 40 #4 & SMALLER ASTM A615 GR. 60 #5 & LARGER
2. THE "CARBON EQUIVALENT" OF ANY REINFORCING TO BE WELDED SHALL BE DETERMINED BY A TESTING LAB. IF THE "CARBON EQUIVALENT" (C.E.) IS LESS THAT Ø.59, THEN THE REINFORCING STEEL MAY BE WELDED WITHOUT PREHEATING. IF THE CARBON EQUIVALENT EXCEEDS Ø.59 NOTIFY THE STRUCTURAL ENGINEER FOR THE PREHEATING REQUIREMENTS. WELDING WILL NOT BE ALLOWED FOR A CARBON EQUIVALENT ABOVE Ø.75. WELDING OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH UBC STANDARD NO. 19-1. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185 AND SHALL BE LAPPED 12 INCHES MINIMUM. E"Ø XX ELECTRODES SHALL BE USED IN WELDING GRADE 40 REBAR. E90XX ELECTRODES SHALL BE USED IN WELDING GRADE 60 REBAR.
3. VERTICAL BARS IN WALLS SHALL BE ACCURATELY POSITIONED AT THE CENTER OF WALL (U.O.N.) AND SHALL BE TIED IN POSITION AT TOP AND BOTTOM AND AT INTERVALS PER CHAPTERS 19 AND 21 OF THE 1997 UBC.
4. REINFORCING DETAILING AND PLACING SHALL BE IN ACCORDANCE WITH THE CONCRETE REINFORCING STEEL INSTITUTE "MANUAL OF STANDARD PRACTICE" LATEST EDITION.
5. ALL REINFORCING STEEL, ANCHOR BOLTS, DOWELS, AND INSERTS SHALL BE WELL SECURED IN POSITION PRIOR TO PLACING CONCRETE.
6. REINFORCING STEEL SHALL BE PROVIDED WITH THE FOLLOWING AMOUNTS OF CONCRETE COVER:
   - FOOTINGS (CONC. DEPOSITED AGAINST EARTH).....3"
   - CONC. SURFACE (FORMED) EXPOSED TO EARTH OR WEATHER
     - #6 THROUGH #18 BARS:.....2"
     - #5 & SMALLER:.....1 1/2"
   - CONC. NOT EXPOSED TO EARTH OR WEATHER:
     - SLABS, WALLS & JOIST:
       - #14 & #18 BARS:.....1 1/2"
       - #11 BAR & SMALLER:.....3/4"
     - BEAMS, COLUMNS :
       - PRIMARY REINFORCEMENT TIES STIRRUPS, SPIRALS:1 1/2"
7. CONTRACTOR SHALL SUBMIT REINFORCING STEEL SHOP DRAWINGS FOR REVIEW BEFORE FABRICATION & INSTALLATION.

INSTALLATON OF ANCHOR BOLTS INTO EXIST CONCRETE OR MASONRY

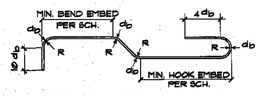
1. INSTALLATION OF ALL EPOXY ANCHOR BOLTS TO BE PER ICBO #5279 (U.O.N.)
2. FOLLOW MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION.
3. DRILLING OF HOLES, PREPARATION OF MATERIAL SURFACES, MIXING AND APPLICATION OF EPOXY ADHESIVE, AND INSTALLATION OF ALL TENSION BOLTS TO BE OBSERVED BY A REGISTERED SPECIAL INSPECTOR FOR REINFORCED CONCRETE.
4. NEW ANCHOR BOLTS TO BE INSTALLED INTO GROUTED CELLS OF EXISTING MASONRY BLOCK ONLY. IF EXISTING CELLS ARE NOT GROUTED AT AREA REQUIRING NEW BOLT, THEN GROUT MUST BE ADDED.
5. NEW ANCHOR BOLTS TO BE INSTALLED INTO GROUT BETWEEN BRICK WYTHES OF EXISTING BRICK WALLS. DO NOT DRILL INTO BRICK UNITS. CARE MUST BE TAKEN TO INSURE THAT BRICK UNITS ARE NOT DISTURBED WITHIN MORTAR BED.
6. ONE OR MORE, BUT NOT LESS THAN 20% OF THE BOLTS INSTALLED INTO EACH MATERIAL IS TO BE TESTED FOR PULL-OUT LOAD. ALL BOLTS TO WITHSTAND MINIMUM 1000 POUND PULL TEST WITHOUT MOVEMENT. THE TESTS ARE TO BE CONDUCTED BY AN APPROVED TESTING AGENCY. THE RESULTS ARE TO BE SUBMITTED TO THE STRUCTURAL ENGINEER AND THE GOVERNING BUILDING AUTHORITY FOR FINAL APPROVAL.



SLAB ON GRADE 1

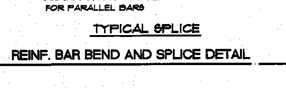
BAR DIAMETER AND MINIMUM LAP SPLICE/ANCHORAGE LENGTHS									
BAR SIZE	#3	#4	#5	#6	#7	#8	#9	#10	#11
BAR DIAM. (INCH)	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
MAS. LAP/ANCHORAGE (INCH)	18	24	30	36	42	48	54	60	66
CONC. LAP/ANHORAGE (INCH)	12	18	36	44	48	54	66	81	87

MINIMUM REINFORCING BEND/HOOK EMBEDMENT REQUIREMENTS								
BAR SIZE	#4	#5	#6	#7	#8	#9	#10	#11
EMBED. (INCH)	6	10	12	15	17	19	21	23



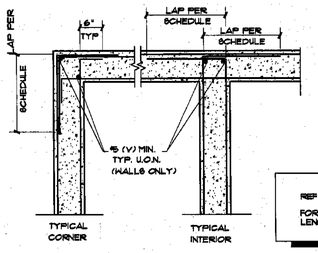
db= DIAMETER OF BAR
R = 3db FOR #3 TO #8
R = 4db FOR #9 TO #11

TYPICAL BAR BEND (CONC. AND MAS.)

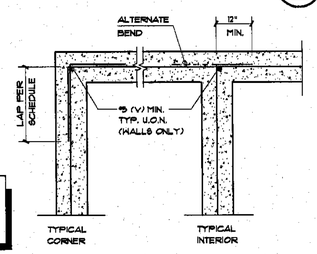


TYPICAL SPLICE

REINF. BAR BEND AND SPLICE DETAIL 2

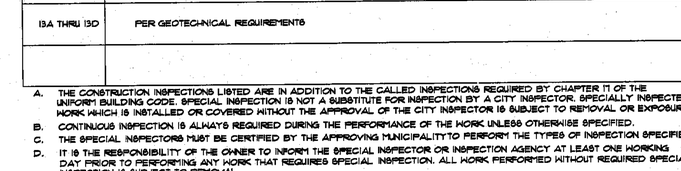


DOUBLE LAYER REINFORCING



SINGLE LAYER REINFORCING

TYP. REINF. AT INTERSECTION OF CONCRETE BEAMS, WALLS AND FOOTINGS 3

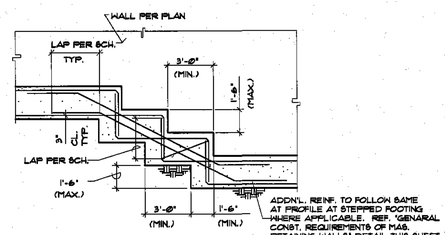


TRANSVERSE CONSTRUCTION JOINT DETAIL A -

TRANSVERSE EXPANSION JOINT DETAIL B -
APPLY @ 120 FT. MAX. APPLIES TO CONCRETE STEM

ALL TRANSVERSE CONSTRUCTION JOINTS SHALL BE IN A VERTICAL PLANE NORMAL TO THE CENTERLINE AND THE SPACING THEREOF SHALL NOT EXCEED 150 FEET OR BE LESS THAN 10 FEET. CONTINUOUS KEYWAYS SHALL BE CONSTRUCTED AS SHOWN IN DETAIL "A". A COMPLETE CURTAIN OF TRANSVERSE STEEL SHALL SHALL BE PLACED 3 INCHES FROM EACH FACE OF THE JOINTS AND LONGITUDINAL STEEL WILL NOT BE CONTINUOUS THROUGH THE JOINTS. IN ADDITION, EXPANSION JOINTS SHALL BE CONSTRUCTED BETWEEN REINFORCED CONCRETE CHANNEL AND REINFORCED CONCRETE BOX SECTIONS AS SHOWN IN DETAIL "B".

TRANSVERSE JOINT DETAILS 4



REF. TYPICAL WALL SECTION(S) FOR FOOTING SIZE & REINF.

TYP. STEPPED FOOTING 5

HTK STRUCTURAL ENGINEERS
HOROWITZ TAYLOR KUSHKAI
14288 Danielson Street - Suite 200
Poway, CA 92064-8819
(858) 679-8989 - Fax (858) 679-8959

REGISTERED PROFESSIONAL ENGINEER — RICHARD K. TAYLOR — No. 42052 — Expires 3/31/06 — CIVIL — STATE OF CALIFORNIA

STRUCTURE ONLY

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MARK	DATE	BY	APPROVED/RCE NO.

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CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. _____ ELEV. _____
LOCATION:

RICHARD K. TAYLOR, R.C.E. #42052 EXP. 3/31/06

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
STORM DRAIN CONSTRUCTION DETAILS - CHANNEL CONNECTION

S1

SHEET 26 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13061

\\SERVER01\D\WORK\05-2005 WORK\05_317.00 FRANCIS\05-317 S1.DWG FRI 05/27/2005 08:50:43

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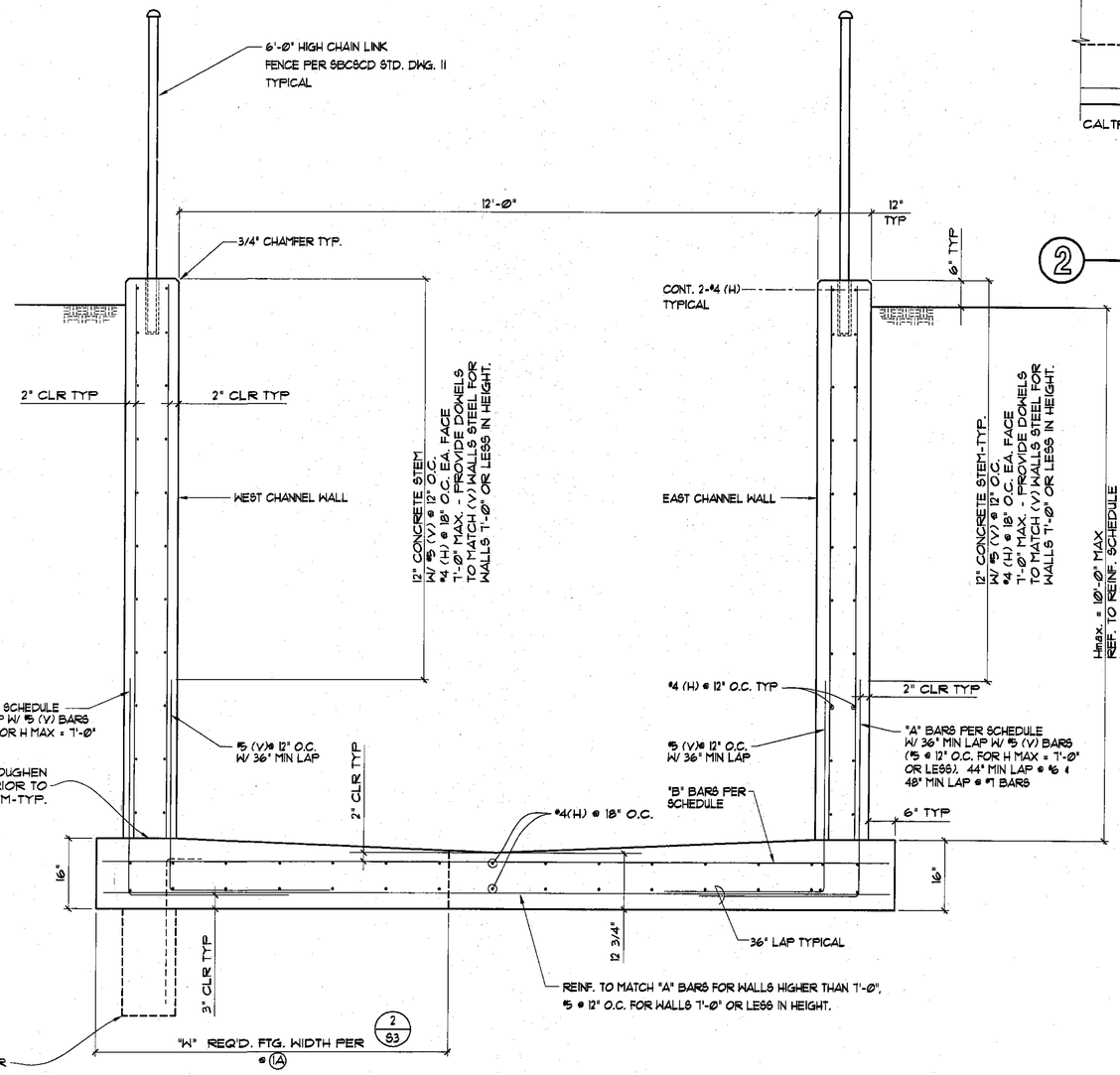


Hmax.	"A" BARS	"B" BARS
0'-0"-8'-0"	#6 @ 12"	#5 @ 12"
8'-0"-9'-0"	#6 @ 12"	#6 @ 12"
9'-0"-10'-0"	#7 @ 12"	#6 @ 12"

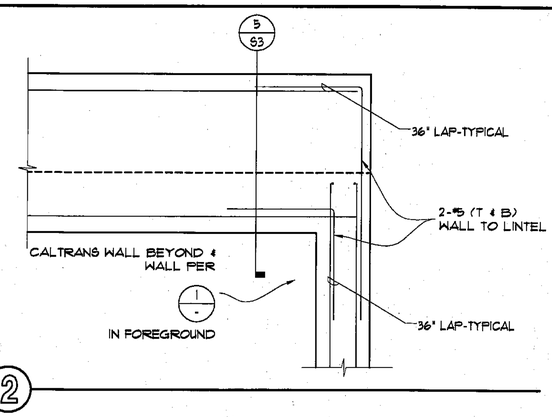
TYPICAL CHANNEL SECTION NOTES:

1. INSTALL SUB DRAINS AT BOTH WALLS PER 6/63
2. INSTALL 1/2" EXPANSION FILLER MATERIAL BETWEEN TRANSITION STRUCTURE AND CHANNEL SECTION.

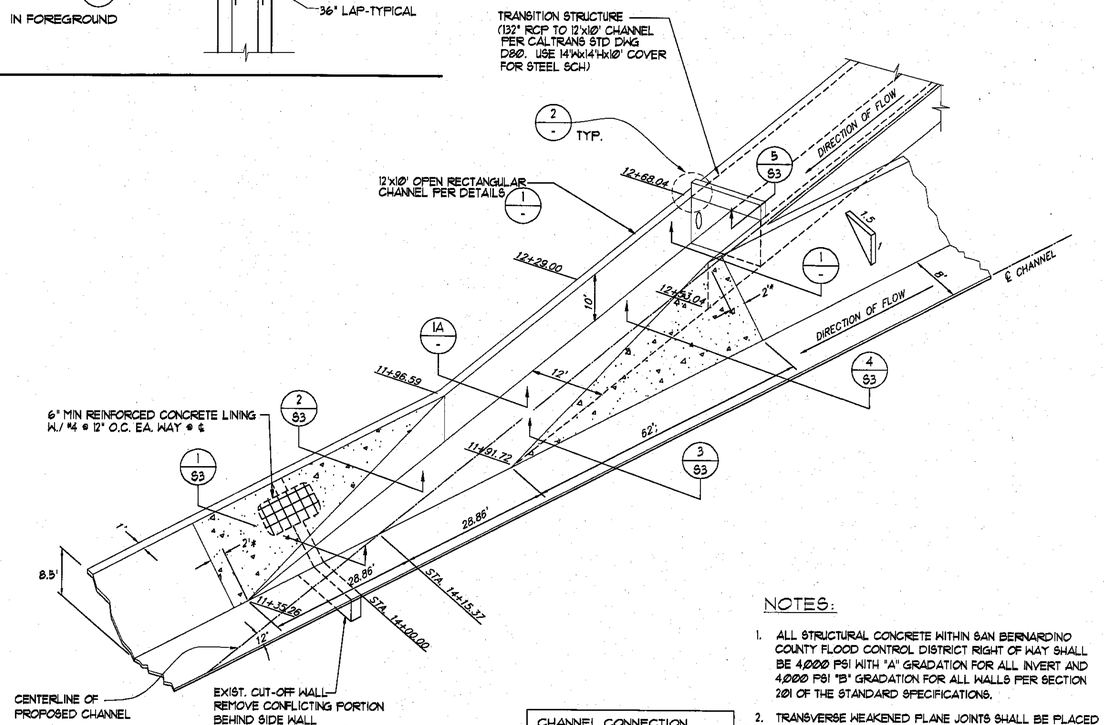
1 1A TYPICAL CHANNEL SECTION
STATION 12+53.04 TO 12+68.04

THIS TYPICAL SECTION ALSO APPLIES FOR THE PARTIAL AND FULL HEIGHT SECTIONS OF THE CHANNEL WALLS AS FOLLOWS:

EAST CHANNEL WALL: STATION 12+10.00 TO 12+68.04
WEST CHANNEL WALL: STATION 11+54.00 TO 12+68.04



2



CHANNEL CONNECTION DETAIL (BY OTHERS) IS PROVIDED FOR REFERENCE ONLY. CONTRACTOR TO VERIFY ALL STATIONS WITH CIVIL PLANS PRIOR TO CONSTRUCTION.

CHANNEL CONNECTION DETAIL
NTS

NOTES:

1. ALL STRUCTURAL CONCRETE WITHIN SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT RIGHT OF WAY SHALL BE 4,000 PSI WITH "A" GRADATION FOR ALL INVERT AND 4,000 PSI "B" GRADATION FOR ALL WALLS PER SECTION 201 OF THE STANDARD SPECIFICATIONS.
2. TRANSVERSE WEAKENED PLANE JOINTS SHALL BE PLACED TO LINE UP WITH EXISTING JOINTS IN CHANNEL FLOOR AT 15' O.C. SPACING.
3. IF AN EXISTING CONSTRUCTION JOINT IS WITHIN 5' OF REMOVAL LIMITS, REMOVAL SHALL BE EXTENDED TO THE EXISTING CONSTRUCTION JOINT.
4. WEEP HOLES SHALL BE PROVIDED PER SP 192E.

HTK HOROWITZ TAYLOR KUSHKAKI
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14285 Danielson Street • Suite 200
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REGISTERED PROFESSIONAL ENGINEER RICHARD K. TAYLOR No. 42058 Expires 3/31/06 CIVIL STATE OF CALIFORNIA

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RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
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BENCH MARK NO. _____ ELEV. _____
LOCATION:

RICHARD K. TAYLOR, R.C.E. #42058 EXP. 3/31/06

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
STORM DRAIN CONSTRUCTION DETAILS – CHANNEL CONNECTION

SHEET 27 OF 31
CONTRACT _____
ACCOUNT _____
DWG. NO. D13062

54810

\\SERVER01\D\WORK\05_317.00 FRANCIS\05-317 S2.DWG FRI 05/27/2005 08:51:03

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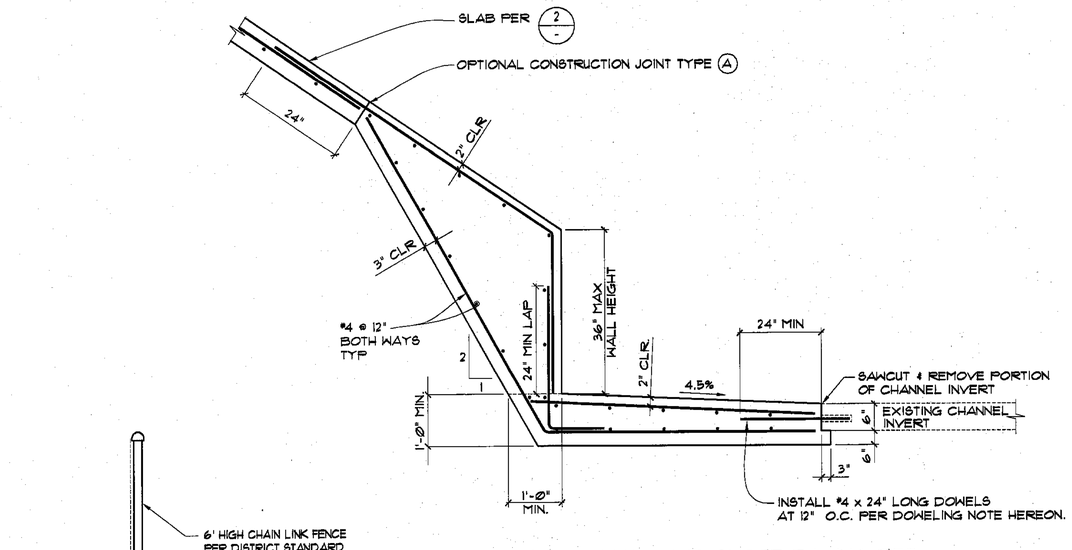
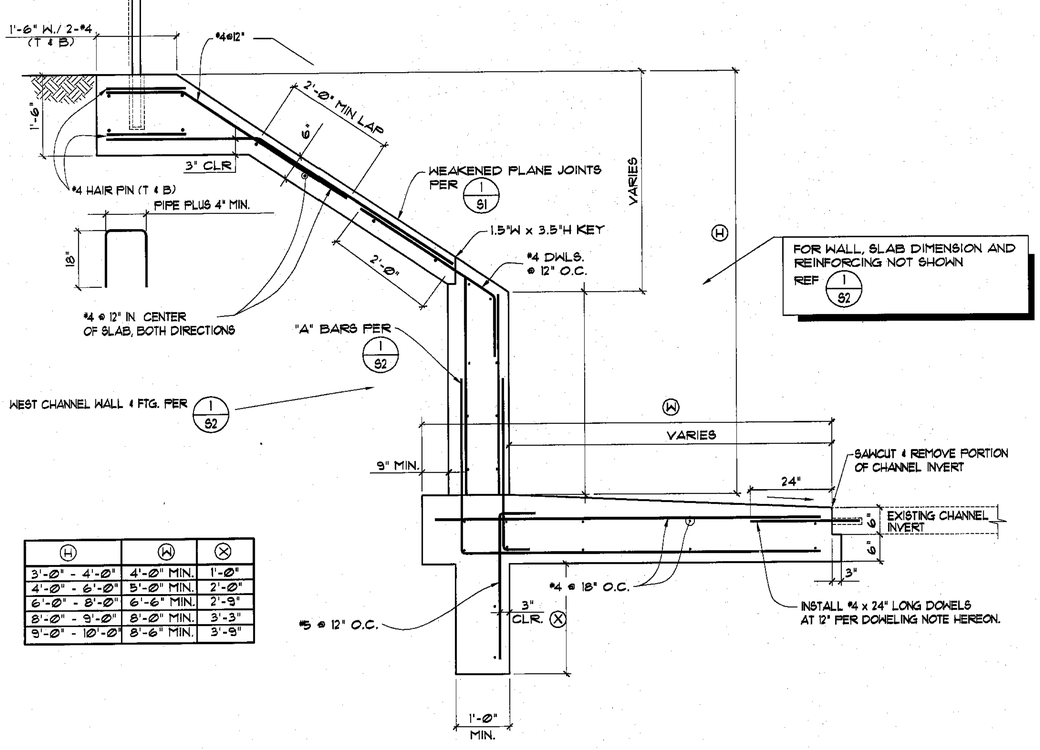
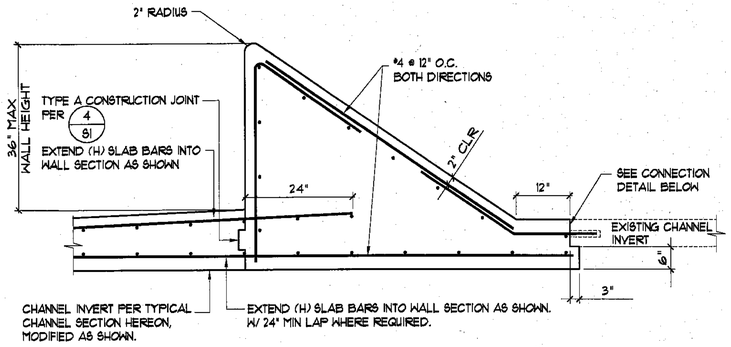


1 WEST CHANNEL WALL AND SLOPE PAVING DETAIL
STATION 11+35.26 TO 11+54.00

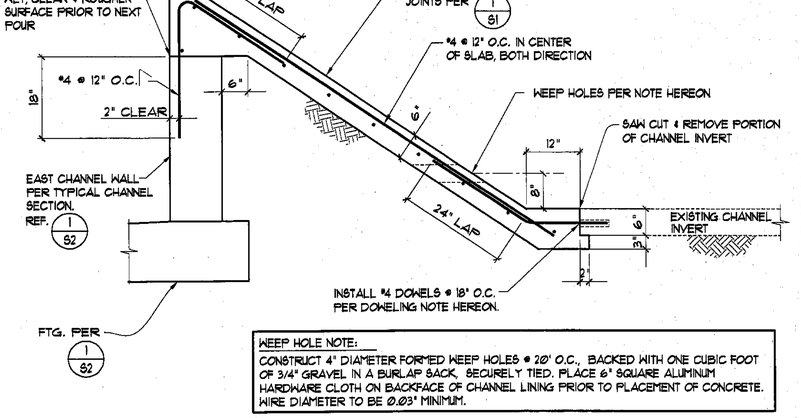


H	W	X
3'-0" - 4'-0"	4'-0" MIN.	1'-0"
4'-0" - 6'-0"	5'-0" MIN.	2'-0"
6'-0" - 8'-0"	6'-6" MIN.	2'-9"
8'-0" - 9'-0"	8'-0" MIN.	3'-3"
9'-0" - 10'-0"	8'-6" MIN.	3'-9"

2 WEST CHANNEL WALL AND SLOPE PAVING DETAILS
STATION 11+54.00 TO 11+96.59

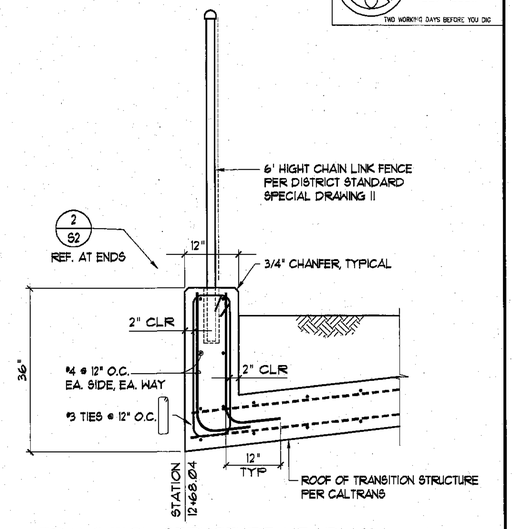


3 EAST CHANNEL WALL AND SLOPE PAVING DETAIL
STATION 11+91.72 TO 12+10.00



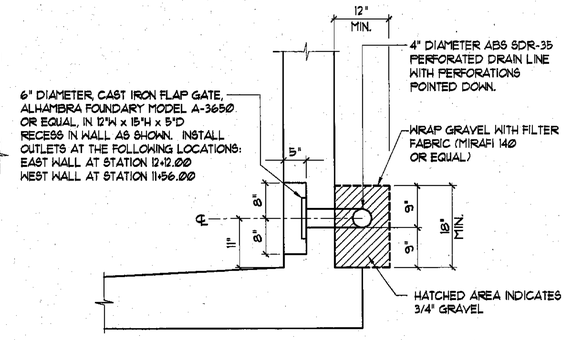
WEEP HOLE NOTE:
CONSTRUCT 4" DIAMETER FORMED WEEP HOLES @ 20' O.C., BACKED WITH ONE CUBIC FOOT OF 3/4" GRAVEL IN A BURLAP SACK, SECURELY TIED. PLACE 6" SQUARE ALUMINUM HARDWARE CLOTH ON BACKFACE OF CHANNEL LINING PRIOR TO PLACEMENT OF CONCRETE. WIRE DIAMETER TO BE 0.03" MINIMUM.

4 EAST CHANNEL WALL AND SLOPE PAVING DETAILS
STATION 12+10.00 TO 12+53.04



5 TRANSITION STRUCTURE HEADWALL

TRANSITION STRUCTURE REINFORCING NOTE:
REINFORCE TRANSITION STRUCTURE PER CALTRANS STANDARD DRAWING D80. USE 14'W x 14'H, 10' COVER STEEL SCHEDULE.



6 CHANNEL WALL SUBDRAIN DETAILS

EPOXY ANCHOR DOWELING NOTES:
ALL EPOXY ANCHORS CALLED OUT ON DETAILS PRESENTED ON THIS SHEET TO BE PER SIMPSON "SET" (ICBO 5278) WITH 4" MIN. EMBED. REF TO GUIDELINES ON SHEET S1

HTK HOROWITZ TAYLOR KUSHKAKI
STRUCTURAL ENGINEERS
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REGISTERED PROFESSIONAL ENGINEER RICHARD K. TAYLOR No. 42052 Exp. 3/31/05 CIVIL STATE OF CALIFORNIA

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CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. _____ ELEV. _____
LOCATION:

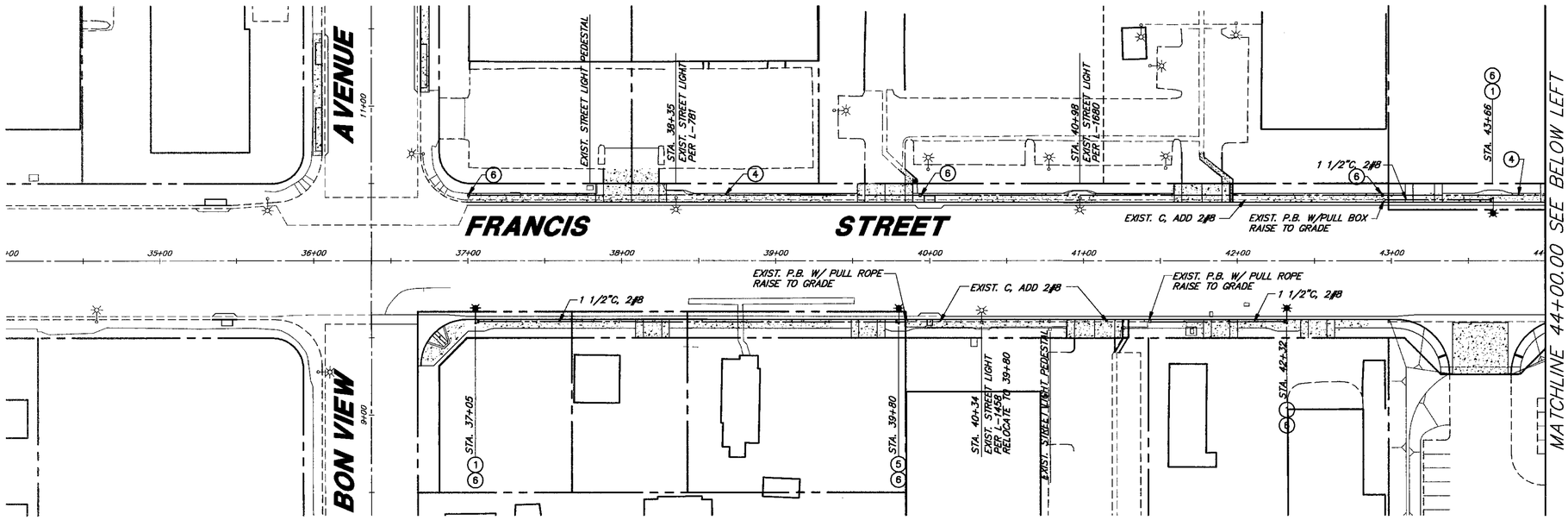
RICHARD K. TAYLOR, R.C.E. 42052 EXP. 3/31/06

CITY OF ONTARIO
STORM DRAIN IMPROVEMENT
FRANCIS STREET
STORM DRAIN CONSTRUCTION DETAILS – CHANNEL CONNECTION

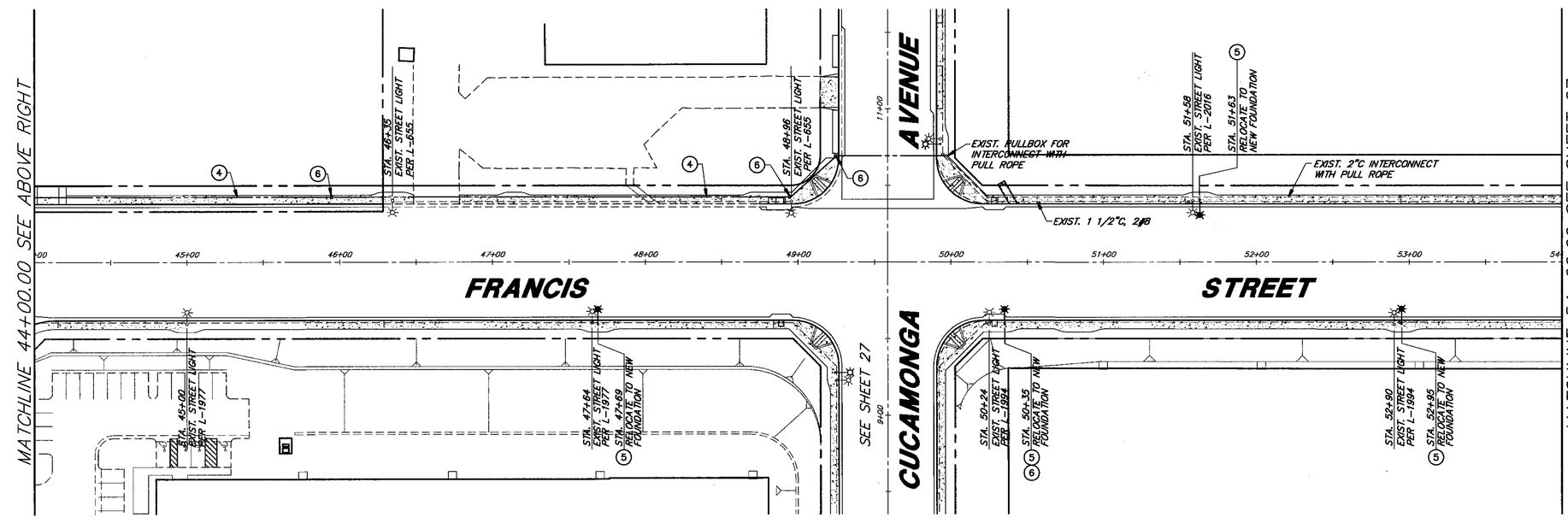
SHEET 28 OF 31
CONTRACT _____
ACCOUNT _____
DWG. NO. D13063

54810

\\SERVER01\2\WORK\10-2005 WORK\05_317.00 FRANCIS\05-317 S3.DWG FRI 05/27/2005 09:51:22



MATCHLINE 44+00.00 SEE BELOW LEFT



MATCHLINE 44+00.00 SEE ABOVE RIGHT

SEE SHEET 27

MATCHLINE 54+00.00 SEE SHEET 27

STREET LIGHT GENERAL NOTES

1. All work shall be done in strict conformance with the current City of Ontario standard specifications and standard drawings and Caltrans standard specifications sections 56, 82, 84, 85, 86 and standard drawings both dated July 1992, for traffic striping, markings, signs, traffic signals and highway lighting except as indicated hereon and the Caltrans traffic manual.
2. All cable shall be delivered new to the site and shall be pulled continuously from light standard to feed point. Spliced wires are allowed in pull boxes only, no spliced wires are allowed in conduit or street light standard.
3. As shown on the State Standard plan, ES-13, conductors shall be spliced by the use of compression connectors, and insulation shall be by "Method B". Wire nuts are not allowed.
4. Wiring shall be Poly Vinyl-Chloride Insulated (Type THW, or THNN) 600V - NO. 8 AWG Copper Cable per Standard Specifications or approved equal. NO. 12 AWG Copper Cable shall be allowed in the light standards.
5. Conductors shall conform to the following colors: Conductors for grounding and bonding shall be either bare or green, common or neutral conductors shall be white, underground-line 1 conductors shall be black, underground-line 2 conductors shall be red.
6. A number 3 1/2 pull box shall be installed 6" behind curb in line with center of standard on side nearest electrical service, sloped at 1/4" per foot to top of curb, fitted with a fused splice connector conforming to State of California Standard Specification, Section 86-2.095 and shall be Bussman - Type TRON-HEB for 120v, or TRON-HEX for 240v, with Type KTK fuses shall be rated at 20 amps (Bussman Bulletin SPF-11). Per Ontario Standard Drawing 504.
7. All conduit shall be 1 1/2" Rigid Metallic Conduit or Schedule 40 PVC. All street and commercial driveway crossings shall be 2" minimum rigid metallic conduit, and stubs shall be rigid metallic conduit.
8. Bonding of circuits shall be per applicable codes.
9. All new Luminaries circuits shall operate on 240 volts, the Contractor shall verify the voltage of the existing luminaries.
10. Poles shall be from one manufacturer.
11. Standards shall be mounted in center of foundation per Ontario Standard Drawing 503.
12. All foundations shall be adjacent to back of curb per Ontario Standard Drawing 503, or as otherwise shown.
13. All anchor bolts shall be 1" X 36" X 4", to project 4 1/2" above top of foundation. Cap with 5" of grout sloped at 1/4" per foot to top of curb. Per Ontario Standard Drawing 504.
14. Contractor shall supply and install all materials including photoelectric control circuit breakers and auxiliary relay(s). Southern California Edison will furnish and install service conductors to the landing lugs per City of Ontario Standard Drawings 505 and 506.
15. Circuit protection shall be provided as follows: 15 amp for photoelectric control, 30 amp single or double pole for each circuit as required.
16. At the direction of the engineer, the contractor shall deliver and unload any salvage to the Ontario Municipal Service Center, 1425 South Bon View Avenue, or city well site no. 9 on the west side of Columbia Avenue north of Deodar Street or well site no. 6 on Phillips Street east of Euclid Avenue
17. Install a shorting cap in the photoelectric control receptacle of all light standards.
18. A 5/8" X 8' Blackburn copper clad ground rod or equivalent with copper weld ground clamp or equivalent shall be installed in the underground electrical feed point (service pedestal). Per Ontario Standard drawing a505.
19. All work related to electric service shall be performed in conformance with the requirements of the Southern California Edison Company

CONSTRUCTION NOTES:

1. INSTALL STREET LIGHT STANDARD PER CITY OF ONTARIO STD. DWG. NO. 503, STD. C, 250 WATT, 8' ARM. INSTALL NO. 3 1/2 PULL BOX WITHIN 5' OF STANDARD.
2. INSTALL STREET LIGHT STANDARD PER CITY OF ONTARIO STD. DWG. NO. 503, STD. C, 150 WATT, 8' ARM. INSTALL NO. 3 1/2 PULL BOX WITHIN 5' OF STANDARD.
3. INSTALL UNDERGROUND ELECTRICAL FEED POINT PER CITY OF ONTARIO STD. DWG. NO. 505.
4. INSTALL 2" RIGID METALLIC CONDUIT WITH PULL ROPE FOR TRAFFIC SIGNAL INTERCONNECT AND NO. 3 1/2 PULL BOXES SPACED AT 150. INSTALL IN SAME TRENCH STREET LIGHT CONDUIT WHERE POSSIBLE.
5. RELOCATE EXIST. STREET LIGHT TO NEW FOUNDATION
6. INSTALL NO. 3 1/2 PULLBOX

LEGEND

- INDICATES INSTALL STANDARD CONCRETE ELECTROLIER USING ONE (1) OF THE FOLLOWING POLES.

  AMERON #1-C1-28-F8 (STEEL MAST ARM)
  CENTRECON #MBO-9-AP-8 (STEEL MAST ARM)
  PUMCO #G6-D8 (STEEL MAST ARM)

  AND 250 WATT, TYPE MC-III, CLEAR HIGH PRESSURE SODIUM VAPOR LAMP, MOUNTED IN A G.E. M-400A LUMINAIRE OR AN EQUAL ALTERNATE APPROVED IN WRITING BY THE CITY ENGINEER.
  (30"x30"x48" FOUNDATION) (INSTALLED ADJACENT TO BACK OF CURB) (CUTOFF TYPE LUMINAIRE) (G.E. ORDER NO. MDCL2553A22LC32F)

- INDICATES INSTALL STANDARD CONCRETE ELECTROLIER USING ONE (1) OF THE FOLLOWING POLES.

  AMERON #1-C1-28-F8 (STEEL MAST ARM)
  CENTRECON #MBO-9-AP-8 (STEEL MAST ARM)
  PUMCO #G6-D8 (STEEL MAST ARM)

  AND 150 WATT, TYPE MC-II, CLEAR HIGH PRESSURE SODIUM VAPOR LAMP, MOUNTED IN A G.E. M-250A LUMINAIRE OR AN EQUAL ALTERNATE APPROVED IN WRITING BY THE CITY ENGINEER.
  (30"x30"x48" FOUNDATION) (INSTALLED ADJACENT TO BACK OF CURB) (CUTOFF TYPE LUMINAIRE) (G.E. ORDER NO. MDCL15S7N22GM32)

- INSTALL CONDUIT PER NOTES, 18" MINIMUM DEPTH IN PARKWAY, 24" MINIMUM DEPTH AT ALL STREET CROSSING.
- INSTALL NO. 3 1/2 PULL BOX. UNLESS OTHERWISE NOTED.
- EXISTING STREET LIGHT

SCALE: 1"=40'

D:\54870\DWG\54870127.DWG TUE 12/21/2004 15:41:44

Underground Service Alert
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REVISIONS			
MARK	DATE	BY	APPROVED/RCE NO.

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DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

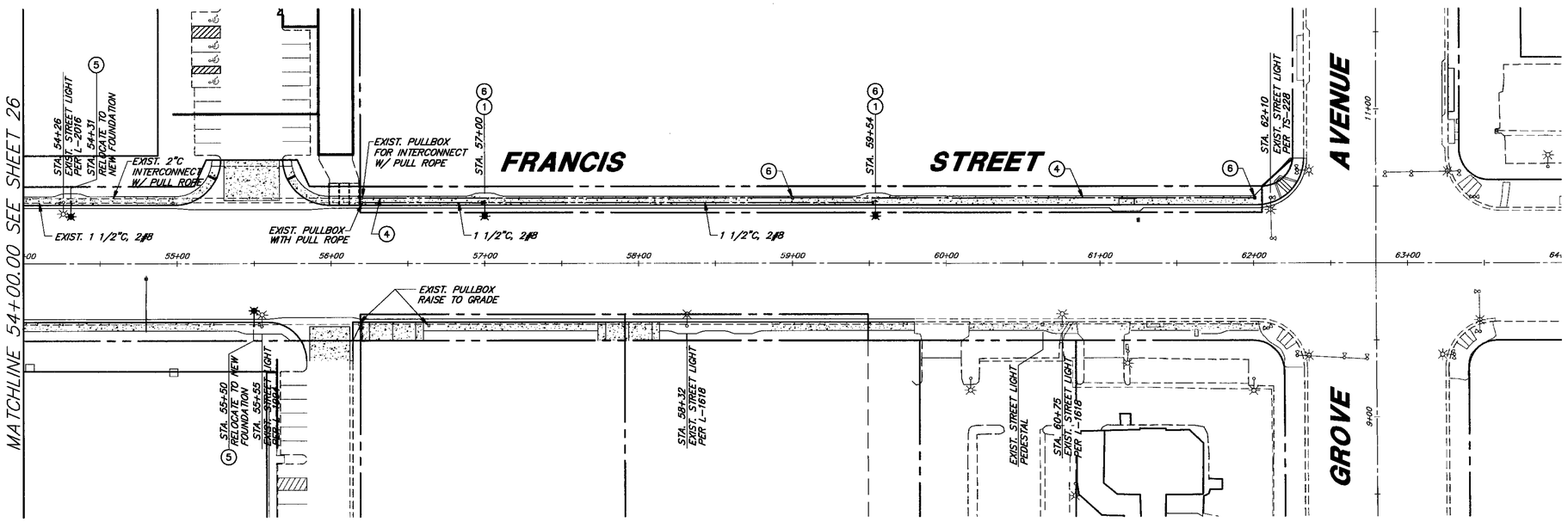
BENCH MARK NO. _____ ELEV. _____
LOCATION:

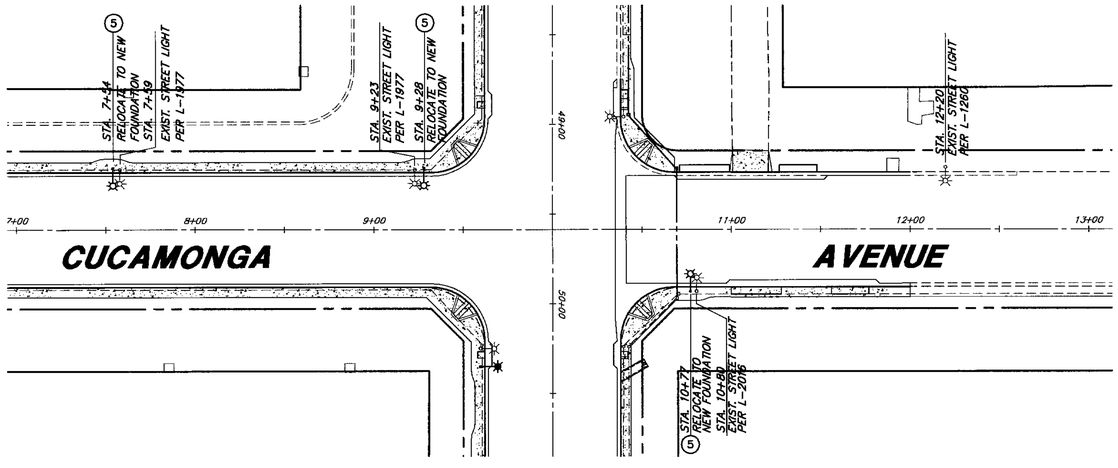
SB&O Land Planning Civil Engineering Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STREET LIGHTING IMPROVEMENT
FRANCIS STREET
BON VIEW AVENUE TO STA. 54+00.00

SHEET 29 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13064





CONSTRUCTION NOTES:

1. INSTALL STREET LIGHT STANDARD PER CITY OF ONTARIO STD. DWG. NO. 503, STD. C, 250 WATT, 8' ARM. INSTALL NO. 3 1/2 PULL BOX WITHIN 5' OF STANDARD.
2. INSTALL STREET LIGHT STANDARD PER CITY OF ONTARIO STD. DWG. NO. 503, STD. C, 150 WATT, 8' ARM. INSTALL NO. 3 1/2 PULL BOX WITHIN 5' OF STANDARD.
3. INSTALL UNDERGROUND ELECTRICAL FEED POINT PER CITY OF ONTARIO STD. DWG. NO. 505.
4. INSTALL 2" RIGID METALLIC CONDUIT WITH PULL ROPE FOR TRAFFIC SIGNAL INTERCONNECT AND NO. 3 1/2 PULL BOXES SPACED AT 150. INSTALL IN SAME TRENCH STREET LIGHT CONDUIT WHERE POSSIBLE.
5. RELOCATE EXIST. STREET LIGHT TO NEW FOUNDATION
6. INSTALL NO. 3 1/2 PULLBOX

LEGEND

- INDICATES INSTALL STANDARD CONCRETE ELECTROLIER USING ONE (1) OF THE FOLLOWING POLES.

  AMERON #1-C1-28-F8 (STEEL MAST ARM)
  CENTRECON #MBO-9-AP-8 (STEEL MAST ARM)
  PUMCO #G6-D8 (STEEL MAST ARM)

  AND 250 WATT, TYPE MC-III, CLEAR HIGH PRESSURE SODIUM VAPOR LAMP, MOUNTED IN A G.E. M-400A LUMINAIRE OR AN EQUAL ALTERNATE APPROVED IN WRITING BY THE CITY ENGINEER. (30"x30"x48" FOUNDATION) (INSTALLED ADJACENT TO BACK OF CURB) (CUTOFF TYPE LUMINAIRE) (G.E. ORDER NO. MDCL2553A22LC32F)

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MARK	DATE	BY	APPROVED/RCE NO.

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CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. _____ ELEV. _____
LOCATION:

SB&O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
STREET LIGHTING IMPROVEMENT
FRANCIS STREET
STA. 54+00.00 TO GROVE AVENUE & CUCAMONGA AVENUE

SHEET 30 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13065

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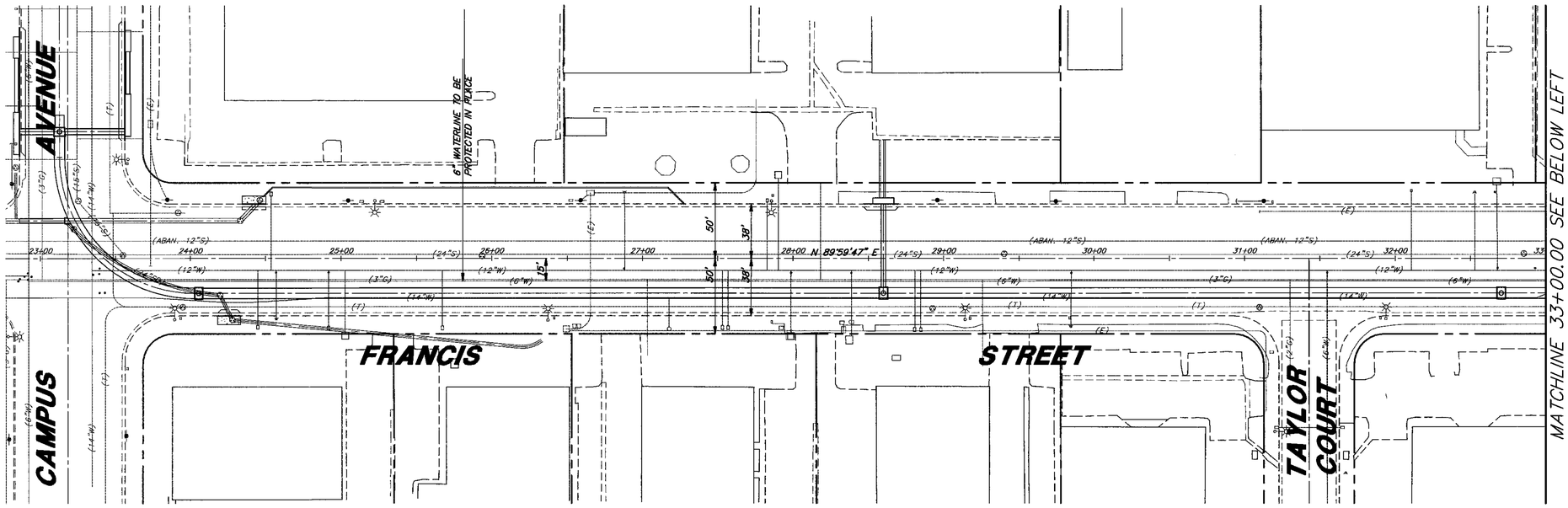
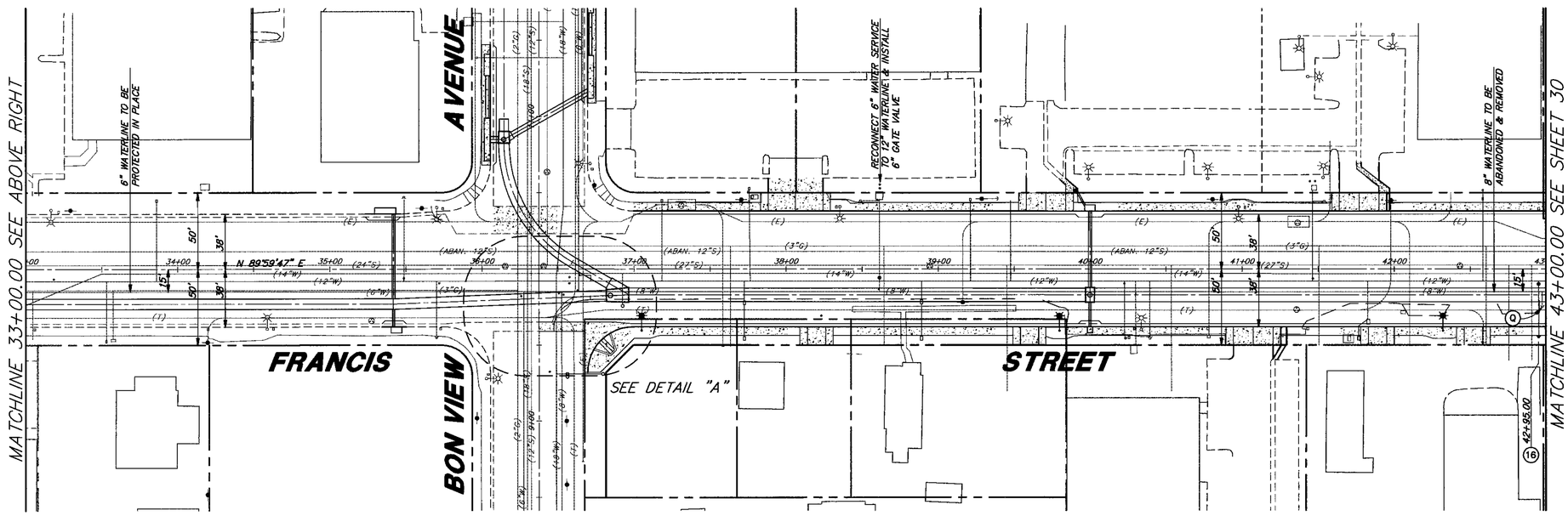
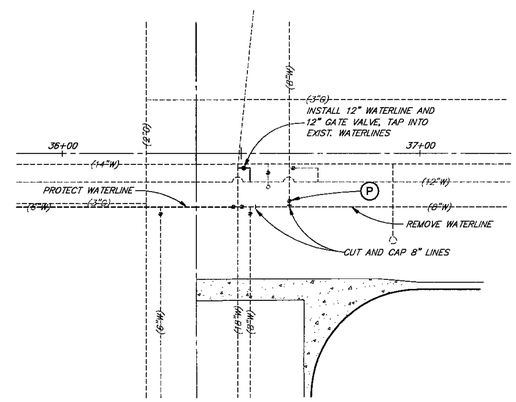




WATER GENERAL NOTES

1. THE CONTRACTOR SHALL NOTIFY THE CITY OF ONTARIO ENGINEERING DEPARTMENT 48 HOURS PRIOR TO BEGINNING OF WORK. PH. (909) 395-2025.
2. THE CONTRACTOR SHALL CONTACT ALL UTILITY COMPANIES AS REQUIRED, 48 HOURS PRIOR TO EXCAVATION.
3. WORK SITE AND EXTERIOR STREETS SHALL BE IN A NEAT, CLEAR, HAZARD FREE, ORDERLY STATE THROUGHOUT CONSTRUCTION. SITE SHALL BE CLEANED UPON REQUEST OF THE INSPECTOR.
4. THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 7-10.4.1 OF THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" IN REGARD TO SAFETY ORDERS.
5. CITY ACCEPTANCE OF PLANS DOES NOT RELIEVE THE DEVELOPER FROM RESPONSIBILITY FOR THE CORRECTION OF ERRORS AND OMISSIONS DISCOVERED DURING CONSTRUCTION UPON REQUEST OF THE CITY INSPECTOR, THE REQUIRED PLAN REVISIONS SHALL BE PROMPTLY SUBMITTED TO THE CITY ENGINEER FOR REVIEW.
6. QUANTITIES SHOWN ARE PROVIDED BY THE ENGINEER FOR REFERENCE AND FEE PURPOSED ONLY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING HIS/HER OWN QUANTITIES FOR BIDDING, CONTRACT AND CONSTRUCTION PURPOSES.
7. PRIOR TO STARTING CONSTRUCTION, THE CONTRACTOR SHALL VERIFY LOCATION AND ELEVATION OF EXISTING WATER MAIN(S) AND NOTIFY THE DESIGN ENGINEER OF ANY VARIATION FROM DESIGN.
8. PRIOR TO THE ISSUANCE OF THE REQUIRED WATER CONSTRUCTION PERMIT, THE CONTRACTOR SHALL OBTAIN A PERMIT FOR EXCAVATION AND TRENCHES FROM THE STATE OF CALIFORNIA, DIVISION OF INDUSTRIAL SAFETY AND SUBMIT COPIES OF THE PERMIT TO THE CITY OF ONTARIO.
9. ALL VALVE OPERATIONS SHALL BE BY CITY FORCES. THE CONTRACTOR SHALL CONTACT THE CITY A MINIMUM OF TWO (2) WORKING DAYS PRIOR TO TIME OF THE REQUIRED VALVE OPERATION. PH. (909) 395-2600.
10. WATER MAINS SHALL BE DUCTILE IRON (ANSI/AWWA C151/A21.51), CLASS 350, CEMENT MORTAR LINED AND ASPHALT COATED OR WELDED STEEL (ANSI/AWWA C200), 10 GAUGE, CEMENT MORTAR LINED AND ASPHALT WRAPPED OR COATED, UNLESS OTHERWISE SPECIFIED.
11. MINIMUM COVER OVER WATER MAINS SHALL BE 36 INCHES FROM FINISHED SURFACE
12. CONSTRUCTION OF WATER MAINS AND LATERALS CROSSING OVER AND/OR UNDER EXISTING AND PROPOSED SUBSTRUCTURES SHALL CONFORM TO CITY OF ONTARIO STANDARD DRAWINGS 425 AND 426 AS APPLICABLE.
13. PRESSURE TESTING AND DISINFECTION OF WATER MAINS SHALL BE PERFORMED IN ACCORDANCE WITH "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION", LATEST EDITION, INCLUDING SUPPLEMENTS.
14. PROTECTION OF WATER LINES FROM SANITARY SEWER SHALL COMPLY WITH CITY OF ONTARIO STANDARD DRAWING 401.
15. THRUST BLOCKS SHALL BE CONSTRUCTED AS REQUIRED PER CITY OF ONTARIO STANDARD DRAWING 405.
16. JOINTS FOR WELDED STEEL PIPE SHALL BE CONSTRUCTED PER CITY OF ONTARIO STANDARD DRAWING 406.
17. VALVE BOXES SHALL INITIALLY BE INSTALLED TO SUBGRADE ELEVATION. AFTER PAVING HAS BEEN COMPLETED, THE VALVE BOX SHALL BE RAISED TO FINISHED GRADE BY THE CONTRACTOR.
18. THE CONTRACTOR SHALL IDENTIFY WATER SERVICE LOCATIONS WITH A PERMANENT MARK CHISELED OR STAMPED IN THE CURB FACE OR TOP OF CURB. THIS MARK SHALL INDICATE THE SERVICE SIZE IN INCHES FOLLOWED BY THE LETTER "W".
19. ALL STATIONS ARE ALONG CENTERLINE OF STREET.
20. AT THE COMPLETION OF CONSTRUCTION, THE DEVELOPER/ENGINEER SHALL FURNISH THE CITY WITH A COMPLETE MYLAR SET OF "AS-BUILT" RECORD DRAWINGS PRIOR TO FINAL INSPECTION.



DETAIL "A"
1"=20'

CONSTRUCTION NOTE:

(16) INSTALL FIRE HYDRANT ASSEMBLY PER CITY OF ONTARIO STD. DWG. NO. 402.

REMOVAL NOTE:

(P) REMOVE EXISTING VALVE COVER AND SEAL WITH SLURRY
(Q) REMOVE EXISTING FIRE HYDRANT ASSEMBLY, SALVAGE FIRE HYDRANT HEAD

SCALE: 1"=40'

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CHECKED BY _____ DATE _____

CITY OF ONTARIO

RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

SB&O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
9007 Arrow Route, #120
Rancho Cucamonga, CA 91730
(909) 948-3450
FAX: (909) 948-2750
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER — DONALD R. BROOKS JR. — No. 41829 Exp. 3/31/06 — CIVIL — STATE OF CALIFORNIA

CITY OF ONTARIO
WATER IMPROVEMENT
FRANCIS STREET
CAMPUS AVENUE TO STA. 43+00.00

SHEET 31 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13060

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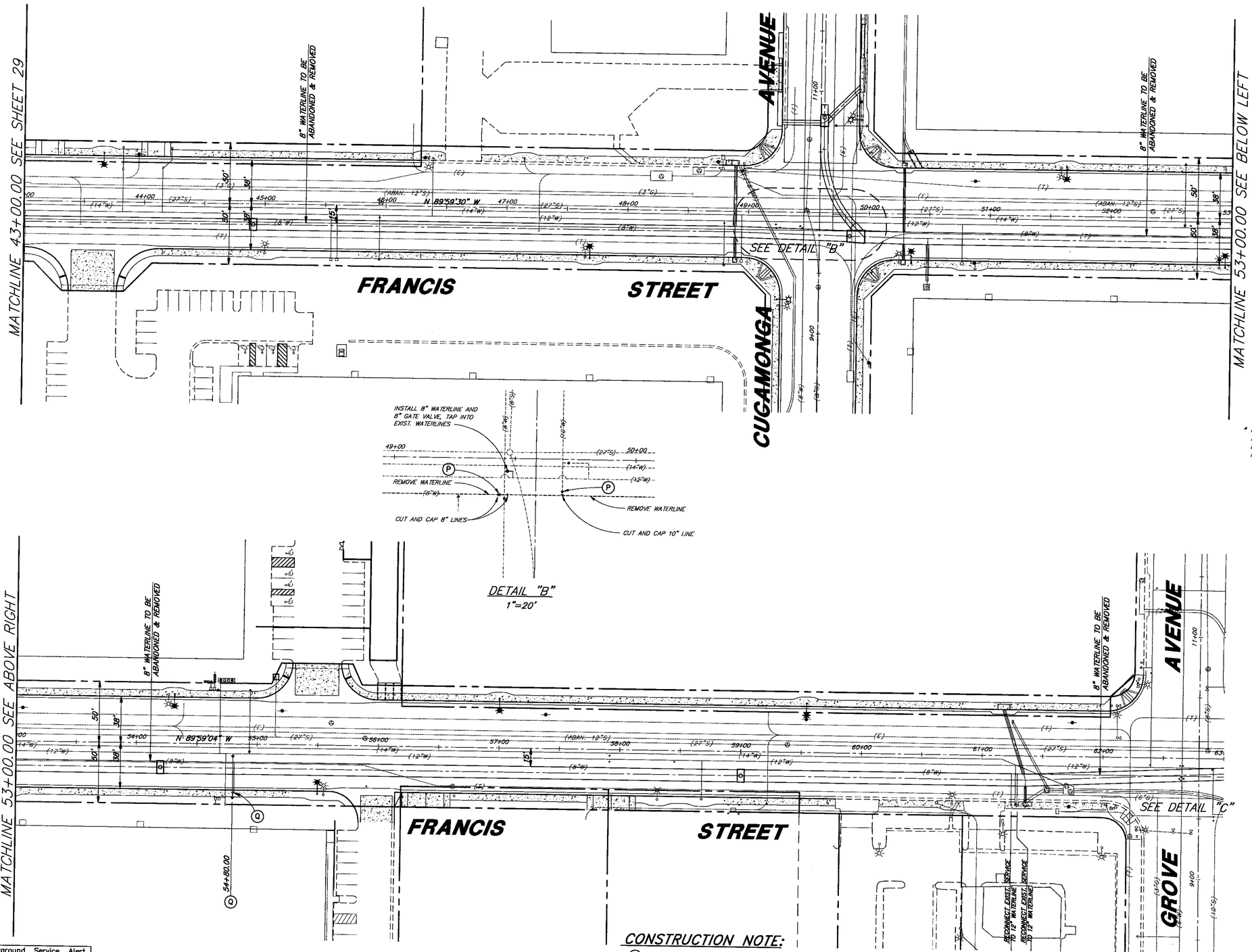
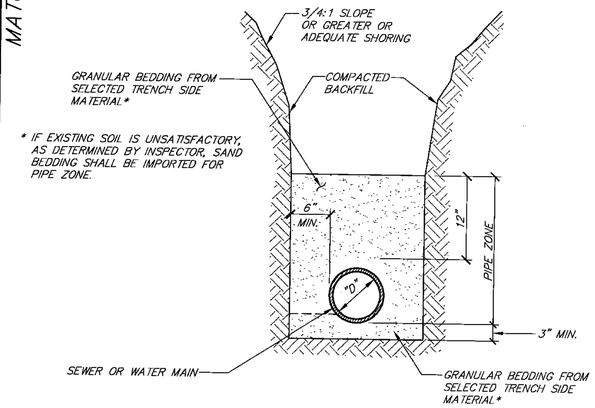
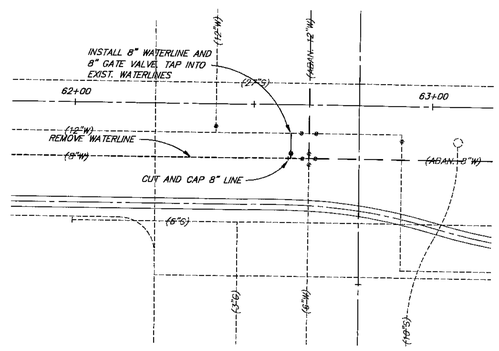


NOTES:
1. TRENCH WIDTH SHALL BE CONTROLLED TO TOP OF PIPE ZONE.
2. TRENCH DEPTHS OF GREATER THAN 5' SHALL HAVE ADEQUATE SHORING.
3. COMPACTION SHALL BE 90% IN ALL ZONES UNLESS OTHERWISE SPECIFIED.
4. TRENCH STABILITY SHALL CONFORM TO CAL-OSHA REQUIREMENTS.



* IF EXISTING SOIL IS UNSATISFACTORY, AS DETERMINED BY INSPECTOR, SAND BEDDING SHALL BE IMPORTED FOR PIPE ZONE.

TYPICAL TRENCH DETAIL
N.T.S.



DETAIL "C"
1"=20'

CONSTRUCTION NOTE:
(16) INSTALL FIRE HYDRANT ASSEMBLY PER CITY OF ONTARIO STD. DWG. NO. 402.

REMOVAL NOTE:
(P) REMOVE EXISTING VALVE COVER AND SEAL WITH SLURRY
(Q) REMOVE EXISTING FIRE HYDRANT ASSEMBLY, SALVAGE FIRE HYDRANT HEAD

SCALE: 1"=40'

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REVISIONS			
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CHECKED BY _____ DATE _____

CITY OF ONTARIO
RECOMMENDED BY _____ ASSISTANT CITY ENGINEER _____ DATE
ACCEPTED BY _____ CITY ENGINEER _____ DATE

BENCH MARK NO. 1065 ELEV. 864.631
LOCATION: FRANCIS ST. & SAN BERNARDINO CO. FLOOD CONTROL CHANNEL. NAIL & WASHER ON NORTH SIDE OF STREET IN CONCRETE RIBBON AT CENTERLINE OF CHANNEL

S&O
Land Planning
Civil Engineering
Land Surveying
PLANNING DESIGN CONSULTATION
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Don Brooks 6-1-05
DON BROOKS, R.C.E. 41829 EXP. 3/31/06

REGISTERED PROFESSIONAL ENGINEER DONALD R. BROOKS JR. No. 41829 Exp. 3/31/06 CIVIL STATE OF CALIFORNIA

CITY OF ONTARIO
WATER IMPROVEMENT
FRANCIS STREET
STA. 43+00.00 TO GROVE AVENUE

SHEET 32 OF 32
CONTRACT _____
ACCOUNT _____
DWG. NO. D13067

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Appendix C

PRELIMINARY HYDROLOGY AND HYDRAULICS REPORT

FOR

FRANCIS STREET STORM DRAIN PROJECT

IN THE
CITY OF ONTARIO

Prepared by:

SB&O, INC.
9007 Arrow Route, #120
Rancho Cucamonga, California 91730
(909) 948-3450

DONALD R. BROOKS, PE 41829

June 30, 2000

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BACKGROUND
METHODOLOGY
COMPARISON ANALYSIS

SECTION 2 - HYDROLOGY ANALYSIS

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SECTION 5 - GROVE AVENUE

SECTION 6 - PRELIMINARY DESIGN OF MASTER PLANNED FACILITIES

APPENDIX - PORTION OF COUNTY HYDROLOGY STUDY

SECTION 1

INTRODUCTION

The project site is located in the City of Ontario, California. The project entails the design and construction of a variable-sized storm drain in Francis Street from Campus Avenue to the West Cucamonga Creek Channel (formerly Walker Avenue). The length of the project is approximately 1.25 miles.

area recently incorporated into the City and now known as the New Model Colony (NMC).

The Francis Street Storm Drain is a key component in the future development of the Agricultural Preserve. Currently, most of the runoff from the 900+/- acres north of Francis Street and south of the Union Pacific Railroad between Campus Avenue and the West Cucamonga Creek Channel makes its way south to the Route 60 Freeway where undersized culverts and street undercrossings become inundated. The project once constructed, in conjunction with the Riverside Drive Storm Drain Project, ~~currently under~~ construction by SBCFCD, will collect runoff from the area north of Riverside Drive before it can enter the ~~Agricultural Preserve~~ area.

recently constructed

New Model Colony (NMC)

The proposed zoning for the study area was obtained from the City's Planning Department and is shown on the enclosed hydrology map (Exhibit "A") by color codes.

The base mapping for the hydrology map was obtained from the City's Geographic Information Systems Department and includes street right-of-way, parcel lines, and five foot contours which are from digital ortho photos, ~~less than five years old~~.

recent

BACKGROUND

The San Bernardino County Flood Control District and the City of Ontario both have studied hydrology in this area as part of their Master Storm Drain Planning. A portion of the North Ontario Hydrology Map is included as Exhibit "B". See the appendix for relevant portions of the District's study. The City has an existing 66" line in Francis Street from the West Cucamonga Creek Channel to Grove Avenue and a variable sized line continuing up Grove Avenue from Francis Street to Mission Boulevard. The County also has an existing 66" line in Francis Street from the West Cucamonga Creek Channel to Grove Avenue. These two lines were not designed to collect the 100 year storm runoff from the drainage basin.

Both existing 66" systems are being utilized to the maximum extent possible by integrating them with the new storm drain system. It is estimated that their combined capacity is approximately 350 cfs, however, because of the horizontal and vertical location of the County's 66" line, its full capacity will not be able to be utilized.

METHODOLOGY

Hydrology calculations were performed in accordance with the County of San Bernardino Hydrology Manual dated August 1986, using CIVIL CADD/CIVIL DESIGN software version 5.1. Section 2 contains the hydrology results and is divided into sub-sections with each major drainage basin being a sub-section. Node numbers, areas, and Q's shown on the hydrology map correspond to the hydrology results.

The calculations were based on ultimate build-out, not existing conditions, per the respective zoning.

Drainage boundaries for the hydrology study were established using a combination of methods. The primary method used was based on a comprehensive site reconnaissance. Each street was driven, each inlet or culvert was noted, and each industrial park was explored in order to establish flow patterns and sub-areas. This field investigation was used in combination with existing street improvement plans, the five foot contours obtained from the City, the North Ontario MPD Hydrology Map (Exhibit "B"), the Grove Avenue Grade Separation Plans, and a surface flow map furnished by the City in order to derive the most accurate drainage boundaries. As explained below, the drainage boundaries for this study differ slightly from the County's study.

The RD4412 computer program from Los Angeles County Public Works was used to analyze pipe flow and calculate water surface elevations (hydraulic grade line). Section 3 contains the hydraulic analysis for the proposed storm drain. Sections 5 contains two hydraulic analyses for the existing Grove Avenue storm drain, one for existing system and one for the proposed modified system.

Catch basin sizes and locations were determined based on the depth of flow in the street. For a Q_{100} storm, standard criteria states that the depth of flow cannot exceed the right-of-way limits. Catch basin lengths are taken from Tables D-10A thru D-10C from the Los Angeles County Flood Control District Design Manual. Catch basins were placed at major intersections and low points unless the depth of flow criteria warranted additional or different locations. Depth vs. Flow charts were developed based street sections and grades using Manning's Formula. Street grades were determined from survey data, existing street improvement plans, contours on the hydrology map, and previous hydrology studies. Section 4 contains calculations for the proposed catch basins on Francis Street. Section 6 contains preliminary calculations for catch basins for Cucamonga, Bon View, and Campus Avenues along with corresponding schematic exhibits. Section 5 contains an analysis of the existing Grove Avenue storm drain system, including existing catch basins, modified to incorporate the Grove Avenue Grade Separation design.

COMPARISON ANALYSIS

The purpose of this comparison analysis is to determine the overall increase in runoff volume to the West Cucamonga Creek Channel as a result of the addition of the Campus Avenue sub-basin and various other adjustments compared to the runoff volume calculated in the County's drainage study.

A direct comparison between the County's study and this study is difficult for a couple of reasons. First, we do not have a copy of the County's complete study for this drainage basin, therefore, we cannot verify input data such as land use and tributary areas. Second, this study is much more detailed providing a higher degree of accuracy over the County's study with respect to land use, drainage patterns, and boundary lines.

One difference worth noting between the two studies is the County's study uses condition AMC II and this study uses AMC III. AMC III is recommended by the San Bernardino County Hydrology Manual for a 100 year storm because it assumes completely saturated soil and therefore produces a higher runoff value. Since this drainage basin is mostly of the commercial / industrial land use, which is 90% impervious anyway, the difference between using AMC II and AMC III is negligible (about 2%). If the County had used AMC III, their results would have been slightly higher.

The County's study for this area encompasses 663 acres and produces a Q_{100} at Francis Street and Parco Avenue of 1,182 cfs (node 3067). According to our estimates, the same area is actually 692 acres. The reason for the discrepancy is that the County probably calculated the areas based off of a 1000-scale quad map. Obviously there is a degree of error with this method. If the County's study were to be adjusted to account for the actual total area, then the runoff would be approximately 1,234 cfs.

In order to get an accurate comparison between the County's study and this study, an adjustment needs to be calculated to account for the changes to the drainage boundary lines (see Exhibit "D"). Although changes to the interior boundary lines have a minor affect on the hydrology results, the following adjustments are needed as a result of the changes to the perimeter boundary lines, specifically the eastern perimeter boundary. Since the County's study assumed the Francis Street storm drain would turn south on Parco, the comparison will have to be done at this common point.

The County's study included a 54 acre area (area 3) east of Grove Avenue and north of Acacia Street which will now be collected by the proposed Acacia Street storm drain. The runoff generated from this area will be conveyed directly to the Channel and is not included in this study. There are other minor areas which, based on the revised boundary lines and modifications due to the Grove Avenue Grade Separation, have been either included in or excluded from this study. Overall, there are 78 acres from the County's study being excluded (areas 2, 3 and 4) from this study and 6 "other" acres being added (areas 5 and 6). Therefore, the net change from the County's study is a decrease of 72 acres for a total adjustment of 115 cfs based on 1.6 cfs/acre. This factor is directly related to the time of concentration and was estimated by calculating the cfs/acre that the Parco sub-basin contributes to the main stream peak at the confluence point (node 509). This total represents the area from the County's study which was deleted from this study due to the fact that it is no longer tributary to the Francis Street storm drain.

This study encompasses an area of 796 acres, which is a net increase of 104 acres (176 acres - 72 acres) from the County's study area (692 acres actual). Campus Avenue, which was also originally tabled to the Cypress Channel Drainage System, is now being included in the Lower Cucamonga Drainage System via the Francis Street storm drain. Calculations show the additional runoff from the addition of Campus Avenue as being 163 cfs. In addition, another 30 cfs will be collected from

the 36" Sultana storm drain, which will be reconstructed to tie into the end of the proposed Francis Street storm drain terminating at Campus Avenue.

From the hydrology results in Section 2 and as shown on the hydrology map, the Q_{100} from the proposed drainage basin including the Campus Avenue sub-basin is 1,282 cfs at the intersection of Francis Street and Parco Avenue (node 509). Thus the net increase as a result of the Campus Avenue sub-basin addition is: 1,282 cfs plus 115 cfs (area adjustments) minus 1,182 cfs (County Q) equals 215 cfs plus 30 cfs from Sultana storm drain equals 245 cfs. However, this includes the 29 acre (663 vs. 692) error in the County study. If the County's Q is increased by 52 cfs (1,182 cfs to 1,234 cfs) then the actual net increase is only 193 cfs (163 cfs from Campus plus 30 cfs from the Sultana storm drain).

One would expect that the 176 acres from the Campus Avenue sub-basin would produce an increase of more than 163 cfs. This can be mostly attributed to the difference in the time of concentration. The time of concentration for this study is longer than the County's study at the common node, 32.85 minutes versus 26.69 minutes. By having the Campus Avenue sub-basin as the upper end of the hydrology analysis, the runoff from each successive sub-basin (i.e. Bon View, Cucamonga, etc.) after confluence will result in a lower Q than when compared to the County's study. This is because as the peak Q from Campus Avenue arrives at a confluence point, the respective peaks from each of the successive sub-basins have passed, resulting in a lower Q from that sub-basin. For example, by the time the main stream peak reaches Parco Avenue, the runoff from Parco Avenue contributing to the main stream is about 67% of its peak flow, whereas in the County's study, Parco Avenue contributes about 84% of its peak because of the shorter time of concentration of the main stream. The average Q per acre for the County's study is 1.78, whereas the average Q per acre for this study is 1.61.

So far, the discussion has focused on the change in Q at a common node at the downstream end of the Francis Street drainage basin. The ultimate concern is what the change will be at the Ely Basins. Since the proposed alignment of the Francis Street storm drain is shorter than the alignment used in the County's Study, the time of concentration is less, 36.03 minutes versus 43.34 minutes. This means there will be no significant impact on the Channel and Ely Basins from extending the proposed storm drain to Campus Avenue.

According to the County's study, at the point of confluence between the Channel and the Francis Street drainage basin (node 3165), the time of concentration for the basin is 43.34 minutes and the time of concentration of the Channel is 61.41 minutes. The confluence results indicate that when the peak flow of the channel reaches this node (at the 61.41 minute mark), the runoff from the basin contributes only 53% of its peak. This is calculated by taking the post confluence Q of 3,603 cfs and subtracting the channel Q of 2,891 cfs to get 622 cfs. 622 cfs of 1,182 cfs is 53%.

Using that same formula and adjusting the channel time of concentration to account for the upstream connection point, the total Q after confluence should be less than the County's study. With a basin time of concentration of 36 minutes and an estimated channel time of concentration of 60 minutes, the basin will contribute approximately 35% of its peak at confluence. Therefore, 2,891 cfs plus 45% of 1,282 cfs equals 3,340 cfs.

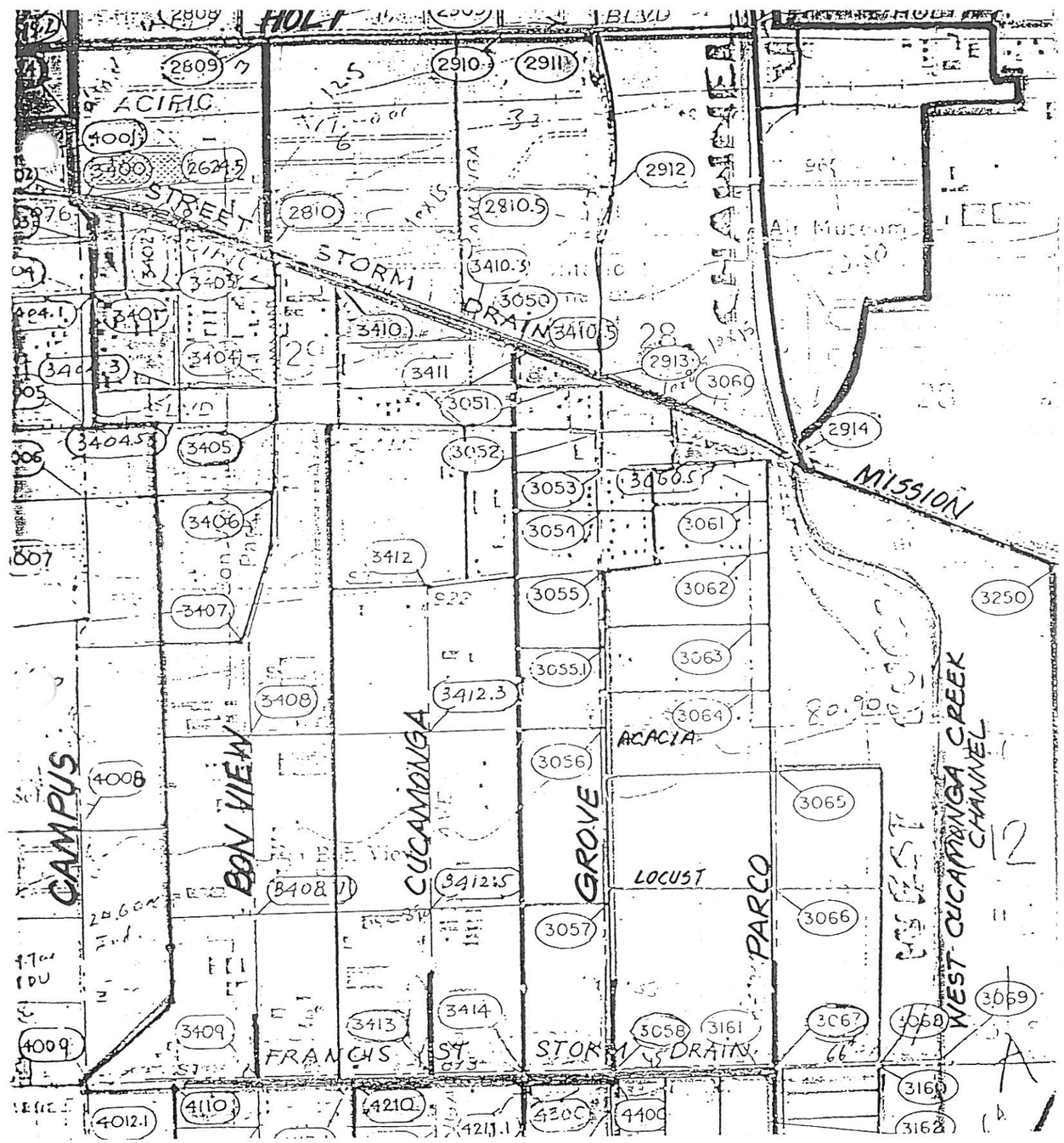

HOLT
BLVD
ACIFIC
STREET
STORM
DRAIN
MISSION
Air Museum
CAMPUS
BON VIEW
CUCAMONGA
GROVE
PARCO
ACACIA
LOCUST
WEST CUCAMONGA CREEK CHANNEL
FRANCIS ST
STORM DRAIN
2809
2910
2911
4001
3400
2624.5
2810
2810.5
2912
3410.5
3050
3410
3411
3051
2913
3060
2914
3404.5
3405
3052
3053
3054
3061
3406
3412
3055
3062
3250
3407
3055.1
3063
3408
3412.3
3064
3056
4008
3065
3408.1
3412.5
3057
3066
3409
3413
3414
3058
3161
3067
3068
3069
4009
4110
4210
4300
4400
4012.1
3160
3162

EXHIBIT "B"

EXHIBIT "C"

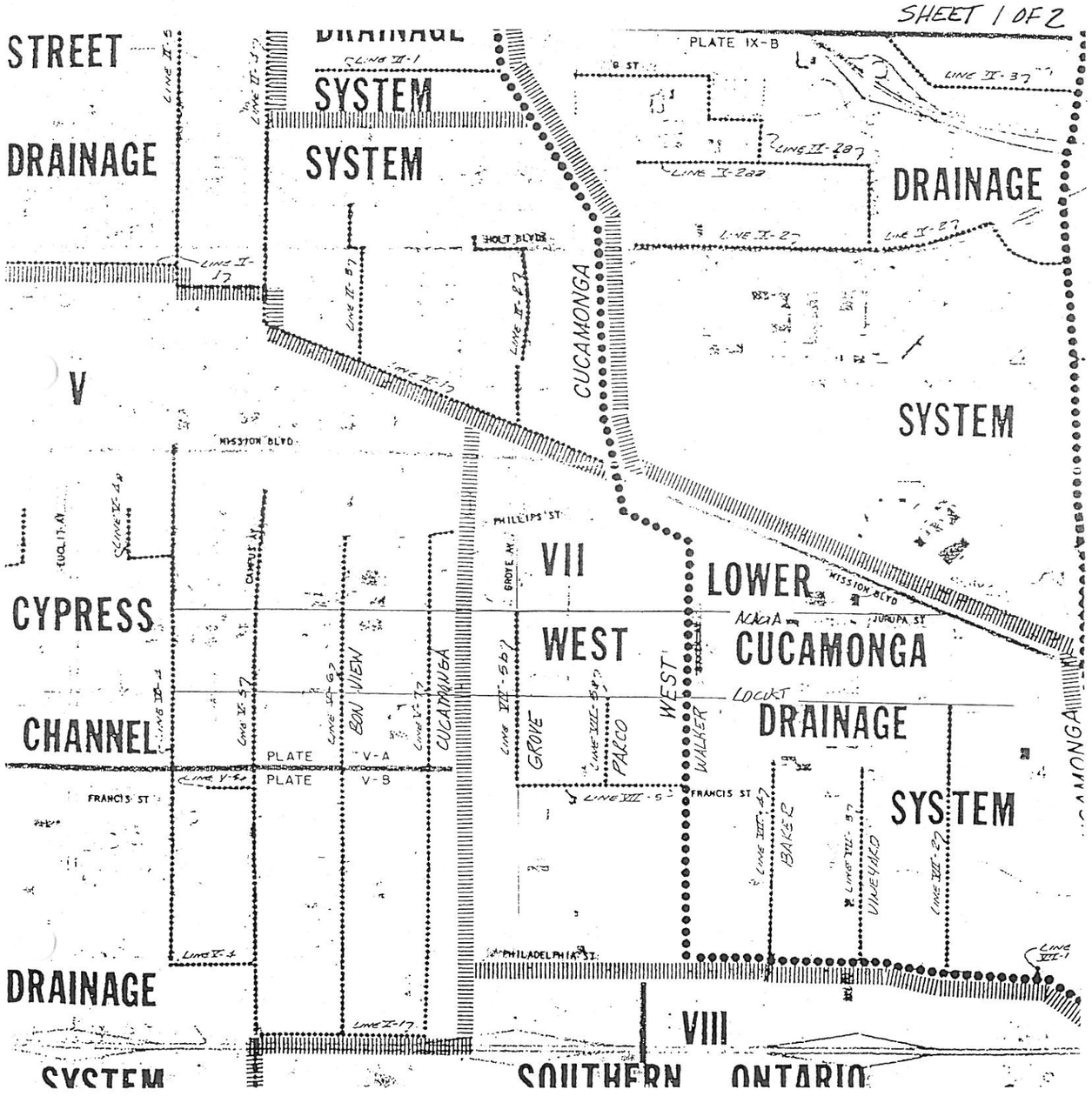

STREET
DRAINAGE
SYSTEM
DRAINAGE
SYSTEM
PLATE IX-B
DRAINAGE
SYSTEM
V
MISSION BLVD
CUCAMONGA
PHILLIPS ST
VII
LOWER
CYPRESS
WEST
CUCAMONGA
ACACIA
JURUPA ST
MISSION BLVD
LOCUST
DRAINAGE
CHANNEL
PLATE V-A
PLATE V-B
BON VIEW
CUCAMONGA
GROVE
PACO
WEST
WALKER
FRANCIS ST
FRANCIS ST
SYSTEM
BAKER
VINEYARD
PHILADELPHIA ST
DRAINAGE
VIII
SYSTEM
SOUTHERN
ONTARIO

EXHIBIT "C"

SHEET 2 OF 2

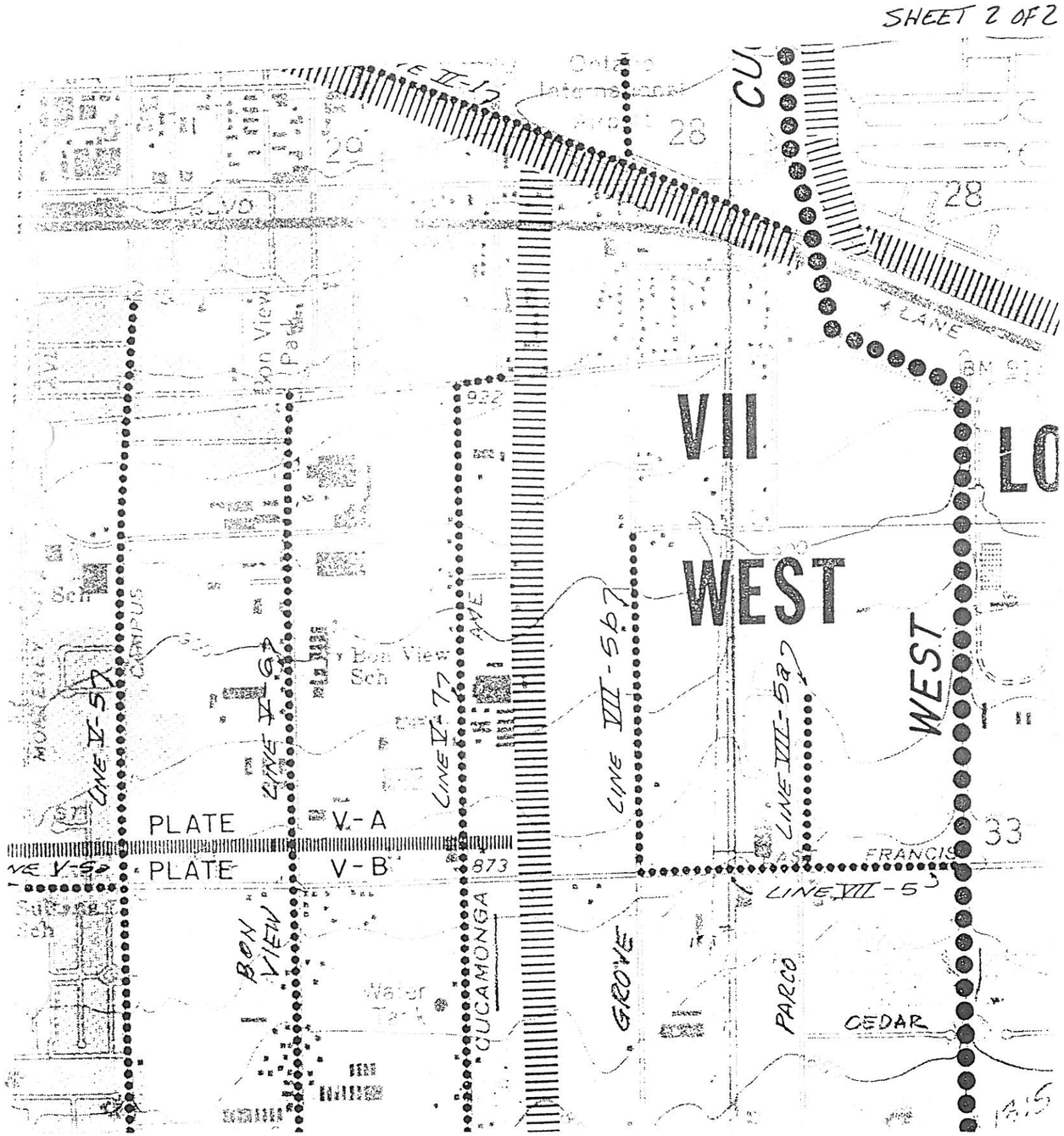
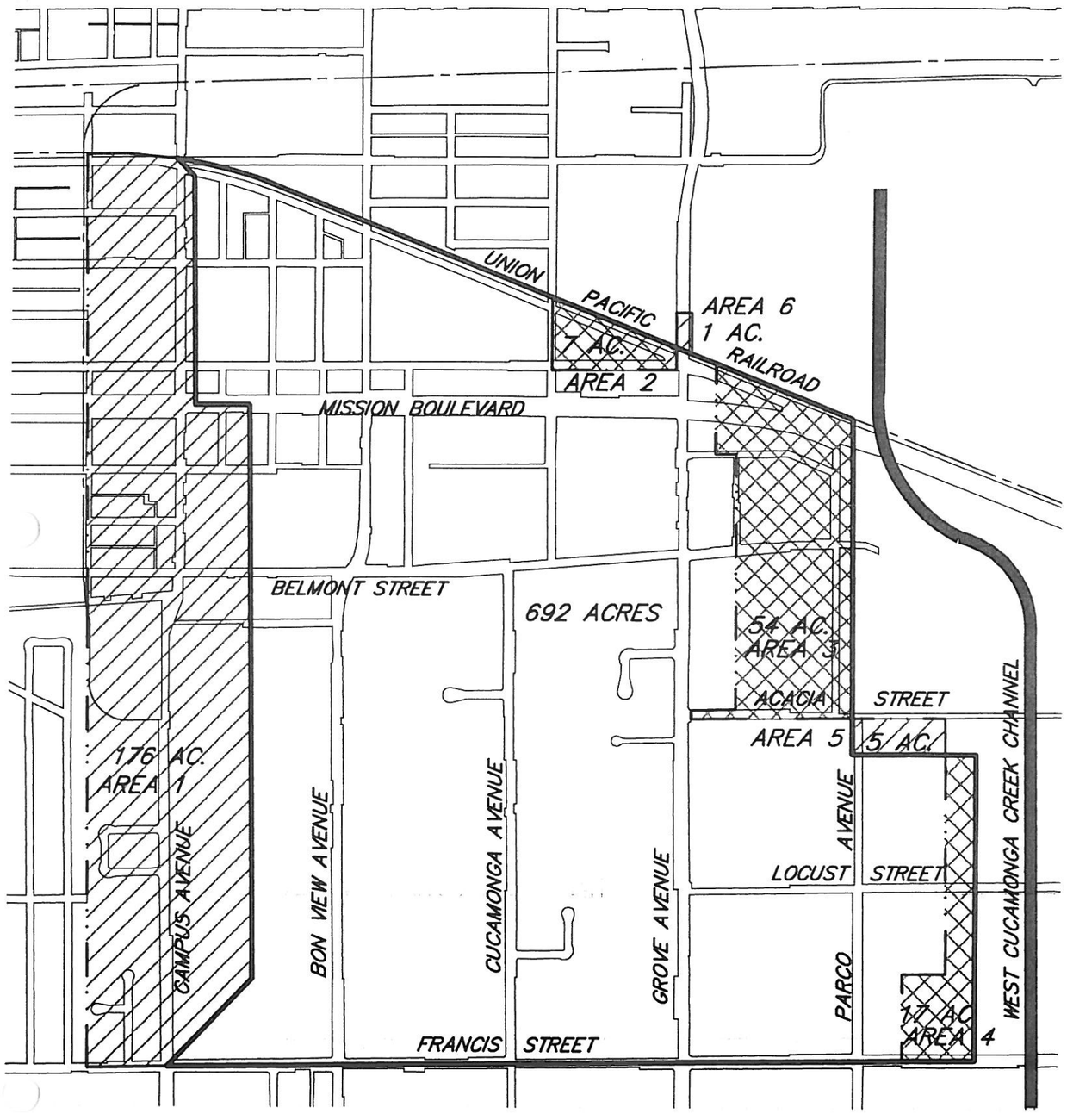
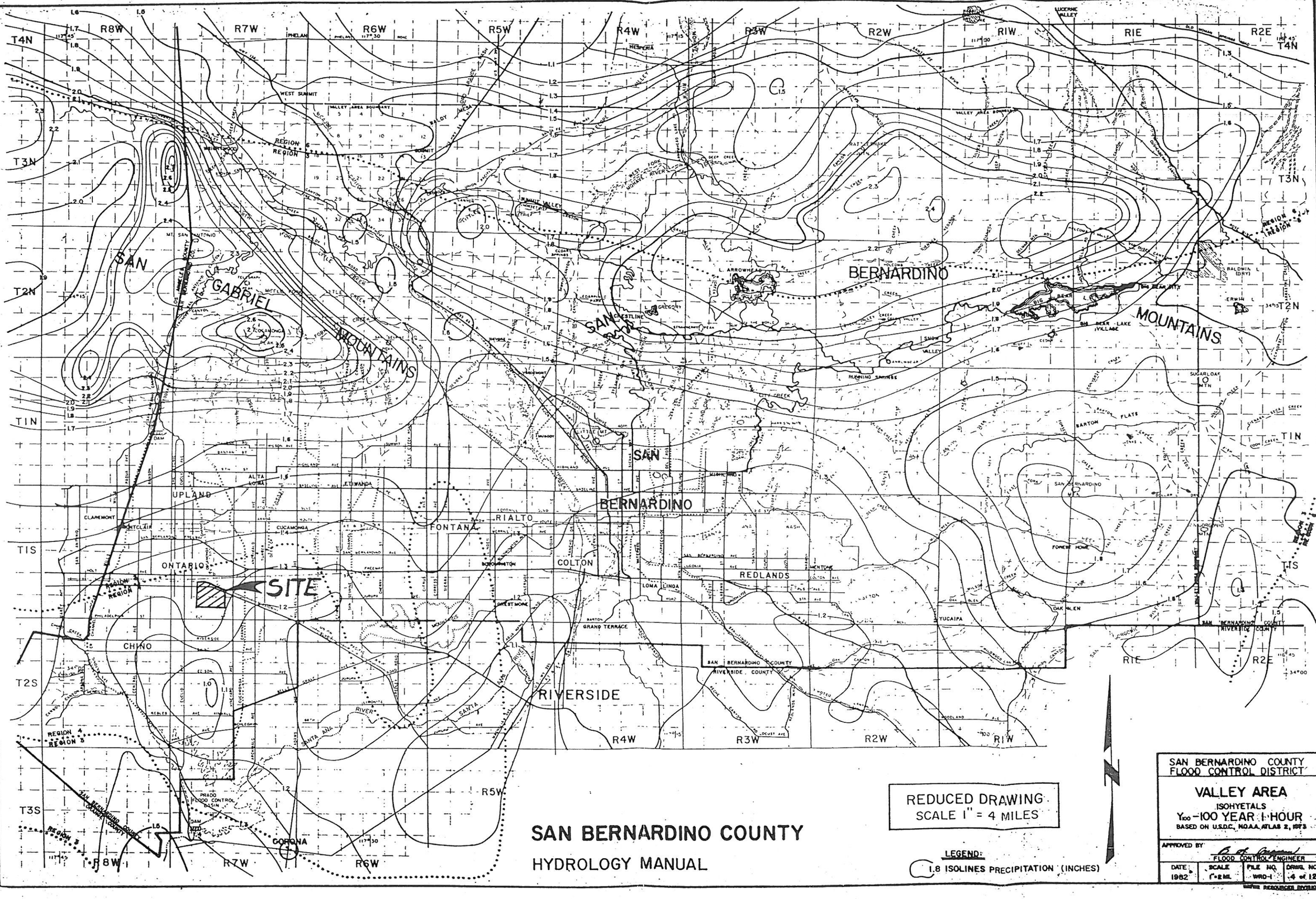


EXHIBIT "D"


UNION PACIFIC RAILROAD
AREA 6
1 AC.
AREA 2
1 AC.
MISSION BOULEVARD
BELMONT STREET
692 ACRES
54 AC.
AREA 3
ACACIA STREET
AREA 5
5 AC.
176 AC.
AREA 1
CAMPUS AVENUE
BON VIEW AVENUE
CUCAMONGA AVENUE
GROVE AVENUE
PARCO AVENUE
LOCUST STREET
WEST CUCAMONGA CREEK CHANNEL
1.7 AC.
AREA 4
FRANCIS STREET
COUNTY DRAINAGE BOUNDARY
PROPOSED BOUNDARY
AREA SUBTRACTION
AREA ADDITION

SECTION 2

HYDROLOGY RESULTS



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

REDUCED DRAWING
SCALE 1" = 4 MILES

LEGEND:
1.8 ISOLINES PRECIPITATION (INCHES)

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

VALLEY AREA
ISOHYETALS
Y_{100} – 100 YEAR 1 HOUR
BASED ON U.S.D.C., N.O.A.A. ATLAS 2, 1973

APPROVED BY _____
FLOOD CONTROL ENGINEER

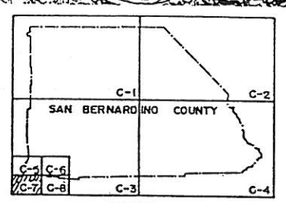
DATE	SCALE	FILE NO.	DRWG. NO.
1982	1"=2 MI.	WRD-1	4 of 12

WATER RESOURCES DIVISION

SITE

SOURCE: 1971 SCS SURVEY

SOURCE: 1971 SCS SURVEY



INDEX MAP

LEGEND

SOIL GROUP BOUNDARY

A SOIL GROUP DESIGNATION

BOUNDARY OF INDICATED SOURCE

SCALE 1:48,000

SCALE REDUCED BY 1/2

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP
FOR
SOUTHWEST-C AREA

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-1999 Version 6.1
Rational Hydrology Study Date: 06/14/00

AREA A - CAMPUS AVENUE
Q100 STORM

SB&O, Inc., Rancho Cucamonga, California - S/N 714

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.320 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 980.000(Ft.)
Bottom (of initial area) elevation = 967.000(Ft.)
Difference in elevation = 13.000(Ft.)
Slope = 0.01300 s(%)= 1.30
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.484 min.
Rainfall intensity = 3.560(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 23.059(CFS)
Total initial stream area = 7.360(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++

Process from Point/Station 101.000 to Point/Station 102.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 967.000(Ft.)
End of street segment elevation = 940.000(Ft.)
Length of street segment = 1600.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 44.176(CFS)
Depth of flow = 0.558(Ft.), Average velocity = 4.629(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 21.553(Ft.)
Flow velocity = 4.63(Ft/s)
Travel time = 5.76 min. TC = 17.24 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.789(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.875
Subarea runoff = 27.781(CFS) for 13.480(Ac.) ✓
Total runoff = 50.840(CFS) 51 cfs ✓
Effective area this stream = 20.84(Ac.)
Total Study Area (Main Stream No. 1) = 20.84(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 50.840(CFS)
Half street flow at end of street = 25.420(CFS)
Depth of flow = 0.582(Ft.), Average velocity = 4.792(Ft/s)
Flow width (from curb towards crown)= 22.756(Ft.)

++
Process from Point/Station 102.000 to Point/Station 103.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 940.000(Ft.)
End of street segment elevation = 928.000(Ft.)
Length of street segment = 750.000(Ft.)

Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 58.720(CFS)
Depth of flow = 0.613(Ft.), Average velocity = 4.867(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 24.303(Ft.)
Flow velocity = 4.87(Ft/s)
Travel time = 2.57 min. TC = 19.81 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Rainfall intensity = 2.566(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.846
Subarea runoff = 8.456(CFS) for 6.460(Ac.) ✓
Total runoff = 59.296(CFS) ✓
Effective area this stream = 27.30(Ac.)
Total Study Area (Main Stream No. 1) = 27.30(Ac.)
Area averaged Fm value = 0.153(In/Hr)
Street flow at end of street = 59.296(CFS)
Half street flow at end of street = 29.648(CFS)
Depth of flow = 0.615(Ft.), Average velocity = 4.878(Ft/s)
Flow width (from curb towards crown)= 24.394(Ft.)

++
Process from Point/Station 103.000 to Point/Station 108.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 928.000(Ft.)
End of street segment elevation = 922.000(Ft.)
Length of street segment = 1015.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)

Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 63.282(CFS)
Depth of flow = 0.746(Ft.), Average velocity = 3.205(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 3.97(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 30.966(Ft.)
Flow velocity = 3.20(Ft/s)
Travel time = 5.28 min. TC = 25.09 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 57.025(CFS)
therefore the upstream flow rate of Q = 59.296(CFS) is being used
Rainfall intensity = 2.227(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.827
Subarea runoff = 0.000(CFS) for 3.670(Ac.)
Total runoff = 59.296(CFS)
Effective area this stream = 30.97(Ac.)
Total Study Area (Main Stream No. 1) = 30.97(Ac.)
Area averaged Fm value = 0.181(In/Hr)
Street flow at end of street = 59.296(CFS)
Half street flow at end of street = 29.648(CFS)
Depth of flow = 0.727(Ft.), Average velocity = 3.210(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 3.03(Ft.)
Flow width (from curb towards crown)= 30.029(Ft.)

++
Process from Point/Station 103.000 to Point/Station 108.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 30.970(Ac.)

Runoff from this stream = 59.296(CFS)
Time of concentration = 25.09 min.
Rainfall intensity = 2.227(In/Hr)
Area averaged loss rate (Fm) = 0.1812(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2308

++
Process from Point/Station 104.000 to Point/Station 105.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 400.000(Ft.)
Top (of initial area) elevation = 978.000(Ft.)
Bottom (of initial area) elevation = 972.000(Ft.)
Difference in elevation = 6.000(Ft.)
Slope = 0.01500 s(%)= 1.50
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.735 min.
Rainfall intensity = 4.512(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.884
Subarea runoff = 25.777(CFS)
Total initial stream area = 6.460(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++
Process from Point/Station 105.000 to Point/Station 106.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 972.000(Ft.)
End of street segment elevation = 940.000(Ft.)
Length of street segment = 1950.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150

Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 80.702(CFS)
Depth of flow = 0.675(Ft.), Average velocity = 5.277(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 0.42(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 27.419(Ft.)
Flow velocity = 5.28(Ft/s)
Travel time = 6.16 min. TC = 13.89 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 3.175(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.878
Subarea runoff = 68.953(CFS) for 27.530(Ac.)
Total runoff = 94.730(CFS) 94 CFS ✓
Effective area this stream = 33.99(Ac.) ✓
Total Study Area (Main Stream No. 1) = 64.96(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 94.730(CFS)
Half street flow at end of street = 47.365(CFS)
Depth of flow = 0.717(Ft.), Average velocity = 5.329(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 2.50(Ft.)
Flow width (from curb towards crown)= 29.496(Ft.)

++
Process from Point/Station 106.000 to Point/Station 107.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 940.000(Ft.)
End of street segment elevation = 928.000(Ft.)
Length of street segment = 800.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)

Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 117.304(CFS)
Depth of flow = 0.783(Ft.), Average velocity = 5.229(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 5.80(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 5.23(Ft/s)
Travel time = 2.55 min. TC = 16.44 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Rainfall intensity = 2.870(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.844
Subarea runoff = 26.779(CFS) for 16.200(Ac.)
Total runoff = 121.509(CFS)
Effective area this stream = 50.19(Ac.)
Total Study Area (Main Stream No. 1) = 81.16(Ac.)
Area averaged Fm value = 0.180(In/Hr)
Street flow at end of street = 121.509(CFS)
Half street flow at end of street = 60.755(CFS)
Depth of flow = 0.790(Ft.), Average velocity = 5.284(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 6.17(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 107.000 to Point/Station 108.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 928.000(Ft.)
End of street segment elevation = 922.000(Ft.)
Length of street segment = 425.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)

Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 128.167(CFS)
Depth of flow = 0.808(Ft.), Average velocity = 5.253(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 7.08(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 5.25(Ft/s)
Travel time = 1.35 min. TC = 17.79 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Rainfall intensity = 2.737(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.834
Subarea runoff = 5.619(CFS) for 5.500(Ac.)
Total runoff = 127.128(CFS)
Effective area this stream = 55.69(Ac.)
Total Study Area (Main Stream No. 1) = 86.66(Ac.)
Area averaged Fm value = 0.201(In/Hr)
Street flow at end of street = 127.128(CFS)
Half street flow at end of street = 63.564(CFS)
Depth of flow = 0.806(Ft.), Average velocity = 5.240(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 6.99(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

Looks on Map w/ confluence
OK

++
Process from Point/Station 107.000 to Point/Station 108.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 55.690(Ac.)
Runoff from this stream = 127.128(CFS)
Time of concentration = 17.79 min.
Rainfall intensity = 2.737(In/Hr)
Area averaged loss rate (Fm) = 0.2009(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2559

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	59.296	25.09	2.227
2	127.128	17.79	2.737

Qmax(1) =
1.000 * 1.000 * 59.296) +
0.799 * 1.000 * 127.128) + = 160.853
Qmax(2) =
1.249 * 0.709 * 59.296) +
1.000 * 1.000 * 127.128) + = 179.659

Total of 2 streams to confluence:
Flow rates before confluence point:
59.296 ✓ 127.128
Maximum flow rates at confluence using above data:
160.853 179.659
Area of streams before confluence:
30.970 55.690
Effective area values after confluence:
86.660 77.650
Results of confluence:
Total flow rate = 179.659(CFS) 180cfs ✓
Time of concentration = 17.792 min.
Effective stream area after confluence = 77.650(Ac.)
Stream Area average Pervious fraction(Ap) = 0.247
Stream Area average soil loss rate(Fm) = 0.194(In/Hr)
Study area (this main stream) = 86.66(Ac.)

++
Process from Point/Station 108.000 to Point/Station 109.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 922.000(Ft.)
End of street segment elevation = 905.000(Ft.)
Length of street segment = 1375.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150

Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 228.386(CFS)
Depth of flow = 0.964(Ft.), Average velocity = 6.078(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 14.84(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.08(Ft/s)
Travel time = 3.77 min. TC = 21.56 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.439(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.854
Subarea runoff = 66.740(CFS) for 42.120(Ac.)
Total runoff = 246.400(CFS)
Effective area this stream = 119.77(Ac.)
Total Study Area (Main Stream No. 1) = 128.78(Ac.)
Area averaged Fm value = 0.153(In/Hr)
Street flow at end of street = 246.400(CFS)
Half street flow at end of street = 123.200(CFS)
Depth of flow = 0.983(Ft.), Average velocity = 6.265(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 15.84(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 109.000 to Point/Station 110.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 905.000(Ft.)
End of street segment elevation = 897.000(Ft.)
Length of street segment = 660.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)

Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 256.748(CFS)
Depth of flow = 0.997(Ft.), Average velocity = 6.331(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.53(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.33(Ft/s)
Travel time = 1.74 min. TC = 23.30 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.328(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.853
Subarea runoff = 8.425(CFS) for 10.060(Ac.)
Total runoff = 254.825(CFS)
Effective area this stream = 129.83(Ac.)
Total Study Area (Main Stream No. 1) = 138.84(Ac.)
Area averaged Fm value = 0.148(In/Hr)
Street flow at end of street = 254.825(CFS)
Half street flow at end of street = 127.413(CFS)
Depth of flow = 0.995(Ft.), Average velocity = 6.312(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.43(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++

Process from Point/Station 109.000 to Point/Station 110.000
**** SUBAREA FLOW ADDITION ****

RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Time of concentration = 23.30 min.

Rainfall intensity = 2.328(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.847
Subarea runoff = 15.941(CFS) for 9.150(Ac.)
Total runoff = 270.766(CFS) 271 CFS
Effective area this stream = 138.98(Ac.)
Total Study Area (Main Stream No. 1) = 147.99(Ac.)
Area averaged Fm value = 0.164(In/Hr)

++
Process from Point/Station 110.000 to Point/Station 111.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 897.000(Ft.)
End of street segment elevation = 889.000(Ft.)
Length of street segment = 655.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 280.478(CFS)
Depth of flow = 1.021(Ft.), Average velocity = 6.574(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 17.73(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.57(Ft/s)
Travel time = 1.66 min. TC = 24.96 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.234(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.846
Subarea runoff = 7.558(CFS) for 9.970(Ac.)

Total runoff = 278.324(CFS)
Effective area this stream = 148.95(Ac.)
Total Study Area (Main Stream No. 1) = 157.96(Ac.)
Area averaged Fm value = 0.158(In/Hr)
Street flow at end of street = 278.324(CFS)
Half street flow at end of street = 139.162(CFS)
Depth of flow = 1.019(Ft.), Average velocity = 6.554(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 17.62(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 110.000 to Point/Station 111.000
**** SUBAREA FLOW ADDITION ****

APARTMENT subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.2000 Max loss rate(Fm)= 0.157(In/Hr)
Time of concentration = 24.96 min.
Rainfall intensity = 2.234(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.845
Subarea runoff = 16.582(CFS) for 8.870(Ac.) ✓
Total runoff = 294.906(CFS) 295 cfs ✓
Effective area this stream = 157.82(Ac.)
Total Study Area (Main Stream No. 1) = 166.83(Ac.)
Area averaged Fm value = 0.158(In/Hr)

++
Process from Point/Station 111.000 to Point/Station 112.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 889.000(Ft.)
End of street segment elevation = 883.000(Ft.)
Length of street segment = 600.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)

Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 296.905(CFS)
Depth of flow = 1.069(Ft.), Average velocity = 6.334(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 20.13(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.33(Ft/s)
Travel time = 1.58 min. TC = 26.54 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 286.832(CFS) 295 CFS ✓
therefore the upstream flow rate of Q = 294.906(CFS) is being used
Rainfall intensity = 2.153(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.842
Subarea runoff = 0.000(CFS) for 2.140(Ac.) ✓
Total runoff = 294.906(CFS)
Effective area this stream = 159.96(Ac.)
Total Study Area (Main Stream No. 1) = 168.97(Ac.)
Area averaged Fm value = 0.161(In/Hr)
Street flow at end of street = 294.906(CFS)
Half street flow at end of street = 147.453(CFS)
Depth of flow = 1.067(Ft.), Average velocity = 6.317(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 20.02(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)
End of computations, total study area = 168.970 (Ac.)

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-1997 Version 5.1
Rational Hydrology Study Date: 08/19/99

AREA B - BON VIEW AVENUE
Q100 STORM

SB&O, Inc., San Diego, California - S/N 714

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.320 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 200.000 to Point/Station 201.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 900.000(Ft.)
Top (of initial area) elevation = 975.000(Ft.)
Bottom (of initial area) elevation = 964.000(Ft.)
Difference in elevation = 11.000(Ft.)
Slope = 0.01222 s(%)= 1.22
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.147 min.
Rainfall intensity = 3.624(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.881
Subarea runoff = 31.909(CFS) 32 CFS ✓
Total initial stream area = 10.000(Ac.) ✓
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++

Process from Point/Station 201.000 to Point/Station 202.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 964.000(Ft.)
End of street segment elevation = 947.000(Ft.)

Length of street segment = 1080.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 68.700(CFS)
Depth of flow = 0.645(Ft.), Average velocity = 5.028(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 25.894(Ft.)
Flow velocity = 5.03(Ft/s)
Travel time = 3.58 min. TC = 14.73 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 3.066(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.877
Subarea runoff = 56.988(CFS) for 23.060(Ac.)
Total runoff = 88.897(CFS) Total area = 33.06(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 88.897(CFS)
Half street flow at end of street = 44.448(CFS)
Depth of flow = 0.706(Ft.), Average velocity = 5.200(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 1.95(Ft.)
Flow width (from curb towards crown)= 28.953(Ft.)

++

Process from Point/Station 202.000 to Point/Station 203.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 947.000(Ft.)
End of street segment elevation = 928.000(Ft.)
Length of street segment = 1275.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street

Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 111.323(CFS)
Depth of flow = 0.773(Ft.), Average velocity = 5.137(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 5.29(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 5.14(Ft/s)
Travel time = 4.14 min. TC = 18.86 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Rainfall intensity = 2.643(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.837
Subarea runoff = 21.191(CFS) for 16.680(Ac.)
Total runoff = 110.088(CFS) Total area = 49.74(Ac.)
Area averaged Fm value = 0.184(In/Hr)
Street flow at end of street = 110.088(CFS)
Half street flow at end of street = 55.044(CFS)
Depth of flow = 0.770(Ft.), Average velocity = 5.120(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 5.18(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 203.000 to Point/Station 207.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 928.000(Ft.)
End of street segment elevation = 925.000(Ft.)
Length of street segment = 570.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)

Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 123.544(CFS)
Depth of flow = 0.918(Ft.), Average velocity = 3.679(Ft/s)
~~Warning: depth of flow exceeds top of curb~~
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 12.57(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 3.68(Ft/s)
Travel time = 2.58 min. TC = 21.45 min.
Adding area flow to street
PARK subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.8500 Max loss rate(Fm)= 0.667(In/Hr)
Rainfall intensity = 2.447(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.797
Subarea runoff = 10.712(CFS) for 12.160(Ac.) Park ✓
Total runoff = 120.800(CFS) Total area = 61.90(Ac.)
Area averaged Fm value = 0.279(In/Hr)
Street flow at end of street = 120.800(CFS)
Half street flow at end of street = 60.400(CFS)
Depth of flow = 0.913(Ft.), Average velocity = 3.646(Ft/s)
~~Warning: depth of flow exceeds top of curb~~
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 12.32(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++

Process from Point/Station 203.000 to Point/Station 207.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 61.900(Ac.)
Runoff from this stream = 120.800(CFS)
Time of concentration = 21.45 min.
Rainfall intensity = 2.447(In/Hr)
Area averaged loss rate (Fm) = 0.2788(In/Hr)
Area averaged Pervious ratio (Ap) = 0.3551
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	120.800	21.45	2.447

Qmax(1) =

1.000 * 1.000 * 120.800) + = 120.800

Total of 1 streams to confluence:
Flow rates before confluence point:
120.800
Maximum flow rates at confluence using above data:
120.800
Area of streams before confluence:
61.900
Effective area values after confluence:
61.900
Results of confluence:
Total flow rate = 120.800(CFS)
Time of concentration = 21.445 min.
Effective stream area after confluence = 61.900(Ac.)
Study area average Pervious fraction(Ap) = 0.355
Study area average soil loss rate(Fm) = 0.279(In/Hr)
Study area total (this main stream) = 61.90(Ac.)

++
Process from Point/Station 204.000 to Point/Station 205.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 665.000(Ft.)
Top (of initial area) elevation = 970.000(Ft.)
Bottom (of initial area) elevation = 962.000(Ft.)
Difference in elevation = 8.000(Ft.)
Slope = 0.01203 s(%)= 1.20
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.907 min.
Rainfall intensity = 3.890(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff = 19.756(CFS) 20CFS
Total initial stream area = 5.760(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++
Process from Point/Station 205.000 to Point/Station 206.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 962.000(Ft.)
End of street segment elevation = 947.000(Ft.)
Length of street segment = 1075.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)

Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 48.945(CFS)
Depth of flow = 0.592(Ft.), Average velocity = 4.419(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 23.262(Ft.)
Flow velocity = 4.42(Ft/s)
Travel time = 4.05 min. TC = 13.96 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 3.166(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.878
Subarea runoff = 43.542(CFS) for 17.020(Ac.)
Total runoff = 63.299(CFS) Total area = 22.78(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 63.299(CFS)
Half street flow at end of street = 31.649(CFS)
Depth of flow = 0.640(Ft.), Average velocity = 4.709(Ft/s)
Flow width (from curb towards crown)= 25.680(Ft.)

++
Process from Point/Station 206.000 to Point/Station 207.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 947.000(Ft.)
End of street segment elevation = 925.000(Ft.)
Length of street segment = 1275.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)

Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 87.501(CFS)
Depth of flow = 0.690(Ft.), Average velocity = 5.423(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 1.16(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 28.156(Ft.)
Flow velocity = 5.42(Ft/s)
Travel time = 3.92 min. TC = 17.88 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Rainfall intensity = 2.729(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.829
Subarea runoff = 27.681(CFS) for 17.420(Ac.)
Total runoff = 90.979(CFS) Total area = 40.20(Ac.)
Area averaged Fm value = 0.215(In/Hr)
Street flow at end of street = 90.979(CFS)
Half street flow at end of street = 45.490(CFS)
Depth of flow = 0.700(Ft.), Average velocity = 5.435(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 1.66(Ft.)
Flow width (from curb towards crown)= 28.661(Ft.)

++

Process from Point/Station 206.000 to Point/Station 207.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 40.200(Ac.)
Runoff from this stream = 90.979(CFS)
Time of concentration = 17.88 min.
Rainfall intensity = 2.729(In/Hr)
Area averaged loss rate (Fm) = 0.2146(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2733
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	120.800	21.45	2.447
2	90.979	17.88	2.729

Qmax(1) =
1.000 * 1.000 * 120.800) +
0.888 * 1.000 * 90.979) + = 201.575

Qmax(2) =
1.130 * 0.834 * 120.800) +
1.000 * 1.000 * 90.979) + = 204.799

Total of 2 streams to confluence:
Flow rates before confluence point:
120.800 90.979
Maximum flow rates at confluence using above data:
201.575 204.799
Area of streams before confluence:
61.900 40.200
Effective area values after confluence:
102.100 91.810
Results of confluence:
Total flow rate = 204.799(CFS) 205 cfs ✓
Time of concentration = 17.880 min.
Effective stream area after confluence = 91.810(Ac.)
Study area average Pervious fraction(Ap) = 0.323
Study area average soil loss rate(Fm) = 0.254(In/Hr)
Study area total (this main stream) = 102.10(Ac.)

++

Process from Point/Station 207.000 to Point/Station 208.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 925.000(Ft.)
End of street segment elevation = 917.000(Ft.)
Length of street segment = 645.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 215.417(CFS)
Depth of flow = 0.948(Ft.), Average velocity = 5.943(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 14.09(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 5.94(Ft/s)
Travel time = 1.81 min. TC = 19.69 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Rainfall intensity = 2.576(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.854
Subarea runoff = 5.803(CFS) for 9.520(Ac.)
Total runoff = 210.602(CFS) Total area = 101.33(Ac.)
Area averaged Fm value = 0.267(In/Hr)
Street flow at end of street = 210.602(CFS)
Half street flow at end of street = 105.301(CFS)
Depth of flow = 0.943(Ft.), Average velocity = 5.889(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 13.81(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 207.000 to Point/Station 208.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In Hr)
Time of concentration = 19.69 min.
Rainfall intensity = 2.576(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.853
Subarea runoff = 21.870(CFS) for 9.730(Ac.)
Total runoff = 232.471(CFS) Total area = 111.06(Ac.)
Area averaged Fm value = 0.250(In/Hr)

++
Process from Point/Station 208.000 to Point/Station 209.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 917.000(Ft.)
End of street segment elevation = 903.000(Ft.)
Length of street segment = 1130.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)

Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 267.679(CFS)
Depth of flow = 1.006(Ft.), Average velocity = 6.480(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.96(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.48(Ft/s)
Travel time = 2.91 min. TC = 22.60 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.372(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.849
Subarea runoff = 49.013(CFS) for 33.640(Ac.)
Total runoff = 281.484(CFS) Total area = 144.70(Ac.)
Area averaged Fm value = 0.210(In/Hr)
Street flow at end of street = 281.484(CFS)
Half street flow at end of street = 140.742(CFS)
Depth of flow = 1.020(Ft.), Average velocity = 6.612(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 17.68(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 209.000 to Point/Station 210.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 903.000(Ft.)
End of street segment elevation = 893.000(Ft.)
Length of street segment = 660.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150

Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 292.028(CFS)
Depth of flow = 1.002(Ft.), Average velocity = 7.128(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.77(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 7.13(Ft/s)
Travel time = 1.54 min. TC = 24.14 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.279(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.847
Subarea runoff = 9.468(CFS) for 10.840(Ac.)
Total runoff = 290.952(CFS) Total area = 155.54(Ac.)
Area averaged Fm value = 0.201(In/Hr)
Street flow at end of street = 290.952(CFS)
Half street flow at end of street = 145.476(CFS)
Depth of flow = 1.001(Ft.), Average velocity = 7.117(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.72(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++

Process from Point/Station 209.000 to Point/Station 210.000
**** SUBAREA FLOW ADDITION ****

SCHOOL subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.6000 Max loss rate(Fm)= 0.471(In/Hr)
Time of concentration = 24.14 min.
Rainfall intensity = 2.279(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.841
Subarea runoff = 16.276(CFS) for 10.000(Ac.)
Total runoff = 307.228(CFS) Total area = 165.54(Ac.)
Area averaged Fm value = 0.217(In/Hr)

++

Process from Point/Station 210.000 to Point/Station 211.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 893.000(Ft.)
End of street segment elevation = 884.000(Ft.)
Length of street segment = 660.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 325.787(CFS)
Depth of flow = 1.050(Ft.), Average velocity = 7.215(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 19.15(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 7.21(Ft/s)
Travel time = 1.52 min. TC = 25.66 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.197(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.840
Subarea runoff = 25.883(CFS) for 20.000(Ac.)
Total runoff = 333.111(CFS) Total area = 185.54(Ac.)
Area averaged Fm value = 0.202(In/Hr)
Street flow at end of street = 333.111(CFS)
Half street flow at end of street = 166.556(CFS)
Depth of flow = 1.057(Ft.), Average velocity = 7.279(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 19.49(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++

Process from Point/Station 211.000 to Point/Station 212.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 884.000(Ft.)
End of street segment elevation = 875.000(Ft.)
Length of street segment = 595.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 342.680(CFS)
Depth of flow = 1.049(Ft.), Average velocity = 7.595(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 19.13(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 7.59(Ft/s)
Travel time = 1.31 min. TC = 26.97 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.133(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.839
Subarea runoff = 8.944(CFS) for 10.660(Ac.)
Total runoff = 342.055(CFS) Total area = 196.20(Ac.)
Area averaged Fm value = 0.196(In/Hr)
Street flow at end of street = 342.055(CFS)
Half street flow at end of street = 171.028(CFS)
Depth of flow = 1.049(Ft.), Average velocity = 7.589(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 19.10(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)
End of computations, total study area = 206.49 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.253
Area averaged SCS curve number = 32.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-1997 Version 5.1
Rational Hydrology Study Date: 09/23/99

AREA C - CUCAMONGA AVENUE
Q100 STORM

SB&O, Inc., San Diego, California - S/N 714

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.320 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 300.000 to Point/Station 301.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 960.000(Ft.)
Bottom (of initial area) elevation = 950.000(Ft.)
Difference in elevation = 10.000(Ft.)
Slope = 0.01000 s(%)= 1.00
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.102 min.
Rainfall intensity = 3.449(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 19.538(CFS)
Total initial stream area = 6.440(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++

Process from Point/Station 301.000 to Point/Station 302.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 950.000(Ft.)
End of street segment elevation = 941.000(Ft.)

Length of street segment = 710.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 45.598(CFS)
Depth of flow = 0.588(Ft.), Average velocity = 4.188(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 23.058(Ft.)
Flow velocity = 4.19(Ft/s)
Travel time = 2.83 min. TC = 14.93 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 3.041(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.877
Subarea runoff = 43.446(CFS) for 17.180(Ac.)
Total runoff = 62.984(CFS) Total area = 23.62(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 62.984(CFS)
Half street flow at end of street = 31.492(CFS)
Depth of flow = 0.649(Ft.), Average velocity = 4.536(Ft/s)
Flow width (from curb towards crown)= 26.107(Ft.)

++

Process from Point/Station 302.000 to Point/Station 303.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 941.000(Ft.)
End of street segment elevation = 922.000(Ft.)
Length of street segment = 1200.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020

Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 88.863(CFS)
Depth of flow = 0.705(Ft.), Average velocity = 5.214(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 1.91(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 28.911(Ft.)
Flow velocity = 5.21(Ft/s)
Travel time = 3.84 min. TC = 18.76 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.651(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.873
Subarea runoff = 36.656(CFS) for 19.410(Ac.)
Total runoff = 99.640(CFS) Total area = 43.03(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 99.640(CFS)
Half street flow at end of street = 49.820(CFS)
Depth of flow = 0.735(Ft.), Average velocity = 5.248(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 3.41(Ft.)
Flow width (from curb towards crown)= 30.412(Ft.)

++
Process from Point/Station 303.000 to Point/Station 304.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 922.000(Ft.)
End of street segment elevation = 920.000(Ft.)
Length of street segment = 330.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200

Estimated mean flow rate at midpoint of street = 118.744(CFS)
Depth of flow = 0.891(Ft.), Average velocity = 3.804(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 11.22(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 3.80(Ft/s)
Travel time = 1.45 min. TC = 20.21 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.536(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.872
Subarea runoff = 32.019(CFS) for 16.500(Ac.)
Total runoff = 131.659(CFS) Total area = 59.53(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 131.659(CFS)
Half street flow at end of street = 65.829(CFS)
Depth of flow = 0.917(Ft.), Average velocity = 3.937(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 12.49(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++

Process from Point/Station 304.000 to Point/Station 305.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 920.000(Ft.)
End of street segment elevation = 909.000(Ft.)
Length of street segment = 1140.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 169.666(CFS)
Depth of flow = 0.921(Ft.), Average velocity = 5.010(Ft/s)
Warning: depth of flow exceeds top of curb

Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 12.73(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 5.01(Ft/s)
Travel time = 3.79 min. TC = 24.00 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.287(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.869
Subarea runoff = 55.002(CFS) for 34.370(Ac.)
Total runoff = 186.660(CFS) Total area = 93.90(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 186.660(CFS)
Half street flow at end of street = 93.330(CFS)
Depth of flow = 0.944(Ft.), Average velocity = 5.205(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 13.87(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 305.000 to Point/Station 306.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 909.000(Ft.)
End of street segment elevation = 891.000(Ft.)
Length of street segment = 1320.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 226.587(CFS)
Depth of flow = 0.949(Ft.), Average velocity = 6.239(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 14.13(Ft.)
Streetflow hydraulics at midpoint of street travel:

Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.24(Ft/s)
Travel time = 3.53 min. TC = 27.53 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.107(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.866
Subarea runoff = 58.063(CFS) for 40.170(Ac.)
Total runoff = 244.724(CFS) Total area = 134.07(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 244.724(CFS)
Half street flow at end of street = 122.362(CFS)
Depth of flow = 0.969(Ft.), Average velocity = 6.434(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 15.10(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++

Process from Point/Station 306.000 to Point/Station 307.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 891.000(Ft.)
End of street segment elevation = 882.000(Ft.)
Length of street segment = 660.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 263.005(CFS)
Depth of flow = 0.988(Ft.), Average velocity = 6.623(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.06(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.62(Ft/s)
Travel time = 1.66 min. TC = 29.19 min.

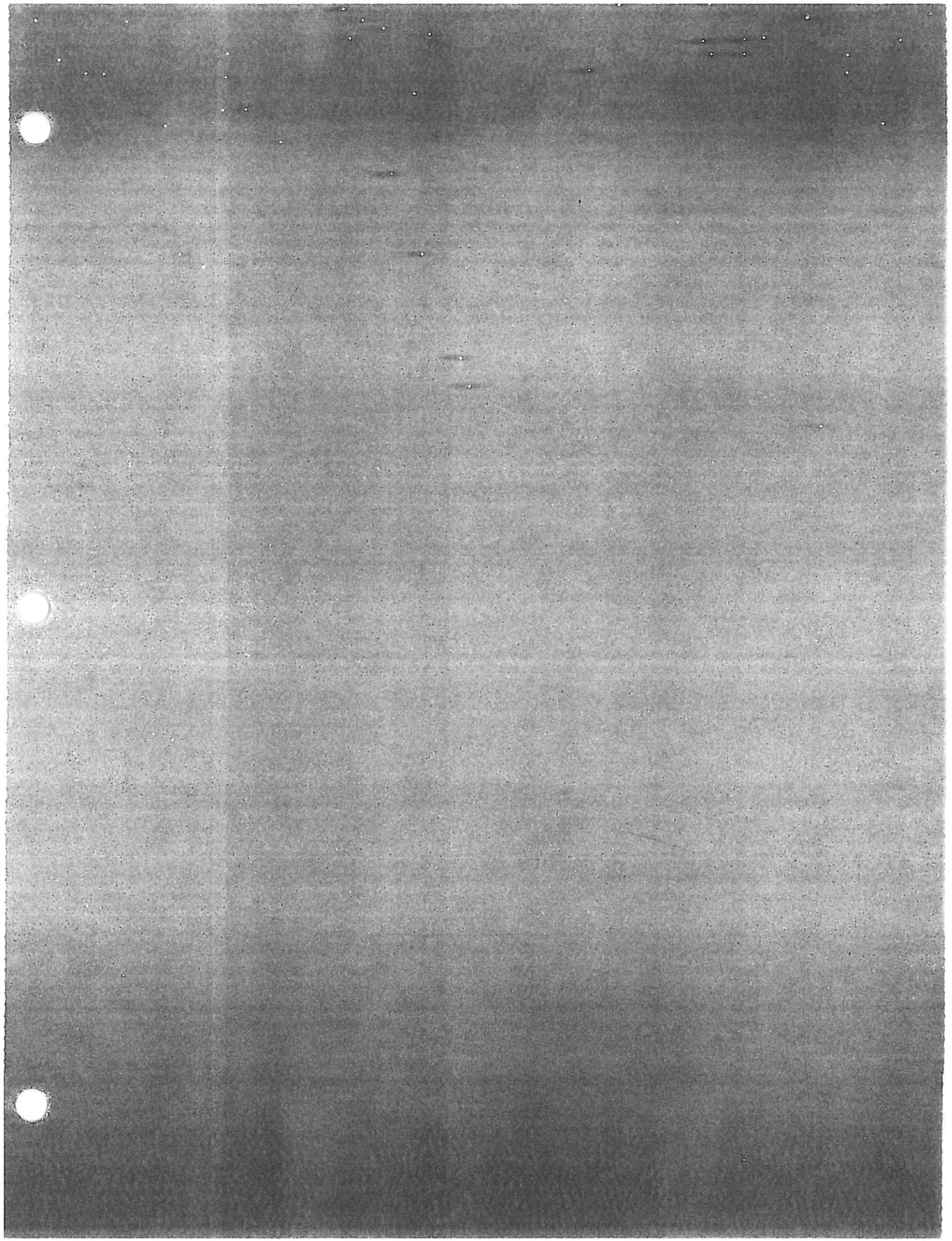
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.034(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.865
Subarea runoff = 26.469(CFS) for 20.030(Ac.)
Total runoff = 271.193(CFS) Total area = 154.10(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 271.193(CFS)
Half street flow at end of street = 135.597(CFS)
Depth of flow = 0.996(Ft.), Average velocity = 6.704(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.48(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 307.000 to Point/Station 308.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 882.000(Ft.)
End of street segment elevation = 874.000(Ft.)
Length of street segment = 580.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 278.215(CFS)
Depth of flow = 1.002(Ft.), Average velocity = 6.796(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.75(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 6.80(Ft/s)
Travel time = 1.42 min. TC = 30.61 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000

Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 1.977(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.864
Subarea runoff = 5.694(CFS) for 7.980(Ac.)
Total runoff = 276.887(CFS) Total area = 162.08(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 276.887(CFS)
Half street flow at end of street = 138.444(CFS)
Depth of flow = 1.000(Ft.), Average velocity = 6.783(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 16.68(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)
End of computations, total study area = 162.08 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number = 32.0



San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-1997 Version 5.1
Rational Hydrology Study Date: 09/23/99

GROVE AVENUE

SB&O, Inc., San Diego, California - S/N 714

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.320 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

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Process from Point/Station 400.000 to Point/Station 401.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 700.000(Ft.)
Top (of initial area) elevation = 944.000(Ft.)
Bottom (of initial area) elevation = 936.000(Ft.)
Difference in elevation = 8.000(Ft.)
Slope = 0.01143 s(%)= 1.14
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.217 min.
Rainfall intensity = 3.818(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.881
Subarea runoff = 26.052(CFS)
Total initial stream area = 7.740(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

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Process from Point/Station 401.000 to Point/Station 402.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 936.000(Ft.)
End of street segment elevation = 919.000(Ft.)
Length of street segment = 1050.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 47.000(Ft.)

Distance from crown to crossfall grade break = 45.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 13.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 51.228(CFS)
Depth of flow = 0.636(Ft.), Average velocity = 3.871(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 25.475(Ft.)
Flow velocity = 3.87(Ft/s)
Travel time = 4.52 min. TC = 14.74 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 3.065(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.877
Subarea runoff = 34.960(CFS) for 14.960(Ac.)
Total runoff = 61.012(CFS) Total area = 22.70(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 61.012(CFS)
Half street flow at end of street = 30.506(CFS)
Depth of flow = 0.673(Ft.), Average velocity = 4.024(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 0.30(Ft.)
Flow width (from curb towards crown)= 27.300(Ft.)

++
Process from Point/Station 402.000 to Point/Station 403.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 919.000(Ft.)
End of street segment elevation = 917.000(Ft.)
Length of street segment = 80.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 47.000(Ft.)
Distance from crown to crossfall grade break = 45.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 13.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)

Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 78.052(CFS)
Depth of flow = 0.680(Ft.), Average velocity = 5.015(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 0.66(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 27.659(Ft.)
Flow velocity = 5.02(Ft/s)
Travel time = 0.27 min. TC = 15.00 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 3.032(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.877
Subarea runoff = 33.039(CFS) for 12.680(Ac.)
Total runoff = 94.051(CFS) Total area = 35.38(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 94.051(CFS)
Half street flow at end of street = 47.025(CFS)
Depth of flow = 0.725(Ft.), Average velocity = 5.139(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 2.90(Ft.)
Flow width (from curb towards crown)= 29.901(Ft.)

++

Process from Point/Station 403.000 to Point/Station 404.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 917.000(Ft.)
End of street segment elevation = 905.000(Ft.)
Length of street segment = 1160.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 47.000(Ft.)
Distance from crown to crossfall grade break = 45.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 13.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 123.757(CFS)
Depth of flow = 0.898(Ft.), Average velocity = 3.787(Ft/s)
Warning: depth of flow exceeds top of curb

Distance that curb overflow reaches into property = 11.57(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 38.570(Ft.)
Flow velocity = 3.79(Ft/s)
Travel time = 5.11 min. TC = 20.11 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.544(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.872
Subarea runoff = 34.023(CFS) for 22.350(Ac.)
Total runoff = 128.073(CFS) Total area = 57.73(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 128.073(CFS)
Half street flow at end of street = 64.037(CFS)
Depth of flow = 0.907(Ft.), Average velocity = 3.815(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 12.01(Ft.)
Flow width (from curb towards crown)= 39.010(Ft.)

++
Process from Point/Station 404.000 to Point/Station 405.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 905.000(Ft.)
End of street segment elevation = 897.000(Ft.)
Length of street segment = 660.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 47.000(Ft.)
Distance from crown to crossfall grade break = 45.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 13.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 146.797(CFS)
Depth of flow = 0.922(Ft.), Average velocity = 4.181(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 12.75(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 39.752(Ft.)
Flow velocity = 4.18(Ft/s)
Travel time = 2.63 min. TC = 22.74 min.
Adding area flow to street

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.363(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.870
Subarea runoff = 25.302(CFS) for 16.880(Ac.)
Total runoff = 153.375(CFS) Total area = 74.61(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 153.375(CFS)
Half street flow at end of street = 76.688(CFS)
Depth of flow = 0.933(Ft.), Average velocity = 4.230(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 13.29(Ft.)
Flow width (from curb towards crown)= 40.293(Ft.)

++

Process from Point/Station 405.000 to Point/Station 406.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 897.000(Ft.)
End of street segment elevation = 888.000(Ft.)
Length of street segment = 660.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 47.000(Ft.)
Distance from crown to crossfall grade break = 45.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 13.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 176.389(CFS)
Depth of flow = 0.952(Ft.), Average velocity = 4.598(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 14.27(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 41.273(Ft.)
Flow velocity = 4.60(Ft/s)
Travel time = 2.39 min. TC = 25.13 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00

Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.225(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.868
Subarea runoff = 34.011(CFS) for 22.390(Ac.)
Total runoff = 187.386(CFS) Total area = 97.00(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 187.386(CFS)
Half street flow at end of street = 93.693(CFS)
Depth of flow = 0.967(Ft.), Average velocity = 4.682(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 15.03(Ft.)
Flow width (from curb towards crown)= 42.033(Ft.)

++
Process from Point/Station 406.000 to Point/Station 407.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 888.000(Ft.)
End of street segment elevation = 882.000(Ft.)
Length of street segment = 660.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 47.000(Ft.)
Distance from crown to crossfall grade break = 45.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 13.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 197.065(CFS)
Depth of flow = 1.036(Ft.), Average velocity = 4.120(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 18.47(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 45.473(Ft.)
Flow velocity = 4.12(Ft/s)
Travel time = 2.67 min. TC = 27.80 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.094(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.866
Subarea runoff = 6.759(CFS) for 10.020(Ac.)

Total runoff = 194.145(CFS) Total area = 107.02(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 194.145(CFS)
Half street flow at end of street = 97.073(CFS)
Depth of flow = 1.032(Ft.), Average velocity = 4.102(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 18.26(Ft.)
Flow width (from curb towards crown)= 45.258(Ft.)

++
Process from Point/Station 407.000 to Point/Station 408.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 882.000(Ft.)
End of street segment elevation = 873.000(Ft.)
Length of street segment = 595.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 47.000(Ft.)
Distance from crown to crossfall grade break = 45.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 13.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 207.488(CFS)
Depth of flow = 0.980(Ft.), Average velocity = 5.005(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 15.68(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 42.679(Ft.)
Flow velocity = 5.00(Ft/s)
Travel time = 1.98 min. TC = 29.78 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.009(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.865
Subarea runoff = 17.402(CFS) for 14.710(Ac.)
Total runoff = 211.547(CFS) Total area = 121.73(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 211.547(CFS)
Half street flow at end of street = 105.774(CFS)
Depth of flow = 0.985(Ft.), Average velocity = 5.034(Ft/s)
Warning: depth of flow exceeds top of curb

Distance that curb overflow reaches into property = 15.93(Ft.)
Flow width (from curb towards crown)= 42.934(Ft.)
End of computations, total study area = 121.73 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number = 32.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-1997 Version 5.1
Rational Hydrology Study Date: 08/19/99

AREA E - PARCO AVENUE
Q100 STORM

SB&O, Inc., San Diego, California - S/N 714

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.320 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 600.000 to Point/Station 601.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 750.000(Ft.)
Top (of initial area) elevation = 903.000(Ft.)
Bottom (of initial area) elevation = 893.000(Ft.)
Difference in elevation = 10.000(Ft.)
Slope = 0.01333 s(%)= 1.33
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.184 min.
Rainfall intensity = 3.826(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff = 20.303(CFS)
Total initial stream area = 6.020(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++

Process from Point/Station 601.000 to Point/Station 602.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 893.000(Ft.)
End of street segment elevation = 884.000(Ft.)
Length of street segment = 1180.000(Ft.)

Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 90.266(CFS)
Depth of flow = 0.799(Ft.), Average velocity = 3.813(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 6.61(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 3.81(Ft/s)
Travel time = 5.16 min. TC = 15.34 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.992(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.876
Subarea runoff = 104.270(CFS) for 41.490(Ac.)
Total runoff = 124.572(CFS) Total area = 47.51(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 124.572(CFS)
Half street flow at end of street = 62.286(CFS)
Depth of flow = 0.874(Ft.), Average velocity = 4.186(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 10.37(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)

++
Process from Point/Station 602.000 to Point/Station 603.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 884.000(Ft.)
End of street segment elevation = 867.000(Ft.)
Length of street segment = 1255.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 32.000(Ft.)
Distance from crown to crossfall grade break = 2.000(Ft.)

Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0200
Estimated mean flow rate at midpoint of street = 146.807(CFS)
Depth of flow = 0.844(Ft.), Average velocity = 5.385(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 8.87(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 5.38(Ft/s)
Travel time = 3.88 min. TC = 19.23 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.613(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.873
Subarea runoff = 22.483(CFS) for 16.960(Ac.)
Total runoff = 147.055(CFS) Total area = 64.47(Ac.)
Area averaged Fm value = 0.079(In/Hr)
Street flow at end of street = 147.055(CFS)
Half street flow at end of street = 73.528(CFS)
Depth of flow = 0.845(Ft.), Average velocity = 5.387(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 8.89(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)
End of computations, total study area = 64.47 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number = 32.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-1999 Version 6.1
Rational Hydrology Study Date: 06/14/00

AREA F - FRANCIS STREET
Q100 STORM

SB&O, Inc., Rancho Cucamonga, California - S/N 714

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.320 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 500.000 to Point/Station 501.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.393(In/Hr)
Initial subarea data:
Initial area flow distance = 965.000(Ft.)
Top (of initial area) elevation = 890.000(Ft.)
Bottom (of initial area) elevation = 883.000(Ft.)
Difference in elevation = 7.000(Ft.)
Slope = 0.00725 s(%)= 0.73
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 16.280 min.
Rainfall intensity = 2.887(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.778
Subarea runoff = 15.918(CFS)
Total initial stream area = 7.090(Ac.)
Pervious area fraction = 0.500
Initial area Fm value = 0.393(In/Hr)

++

Process from Point/Station 500.000 to Point/Station 501.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.090(Ac.)
Runoff from this stream = 15.918(CFS)
Time of concentration = 16.28 min.
Rainfall intensity = 2.887(In/Hr)
Area averaged loss rate (Fm) = 0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000

++
Process from Point/Station 112.000 to Point/Station 501.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.153(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 26.54 min. Rain intensity = 2.15(In/Hr)
Total area this stream = 169.00(Ac.)
Total Study Area (Main Stream No. 1) = 176.09(Ac.)
Total runoff = 294.90(CFS)

++
Process from Point/Station 112.000 to Point/Station 501.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 169.000(Ac.)
Runoff from this stream = 294.900(CFS)
Time of concentration = 26.54 min.
Rainfall intensity = 2.153(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	15.918	16.28	2.887
2	294.900	26.54	2.153

Qmax(1) =
1.000 * 1.000 * 15.918) +
1.354 * 0.613 * 294.900) + = 260.785
Qmax(2) =

0.706 * 1.000 * 15.918) +
1.000 * 1.000 * 294.900) + = 306.136

Total of 2 streams to confluence:
Flow rates before confluence point:
15.918 294.900
Maximum flow rates at confluence using above data:
260.785 306.136
Area of streams before confluence:
7.090 169.000
Effective area values after confluence:
110.755 176.090
Results of confluence:
Total flow rate = 306.136(CFS)
Time of concentration = 26.540 min.
Effective stream area after confluence = 176.090(Ac.)
Stream Area average Pervious fraction(Ap) = 0.116
Stream Area average soil loss rate(Fm) = 0.091(In/Hr)
Study area (this main stream) = 176.09(Ac.)

++
Process from Point/Station 501.000 to Point/Station 502.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 960.500(Ft.)
Downstream point/station elevation = 959.200(Ft.)
Pipe length = 660.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 306.136(CFS)
Nearest computed pipe diameter = 87.00(In.)
Calculated individual pipe flow = 306.136(CFS)
Normal flow depth in pipe = 70.03(In.)
Flow top width inside pipe = 68.94(In.)
Critical Depth = 54.71(In.)
Pipe flow velocity = 8.60(Ft/s)
Travel time through pipe = 1.28 min.
Time of concentration (TC) = 27.82 min.

++
Process from Point/Station 501.000 to Point/Station 502.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Time of concentration = 27.82 min.
Rainfall intensity = 2.093(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff = 29.462(CFS) for 10.080(Ac.)
Total runoff = 335.598(CFS)
Effective area this stream = 186.17(Ac.)
Total Study Area (Main Stream No. 1) = 186.17(Ac.)
Area averaged Fm value = 0.090(In/Hr)

++
Process from Point/Station 502.000 to Point/Station 503.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 959.200(Ft.)
Downstream point/station elevation = 957.900(Ft.)
Pipe length = 660.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 335.598(CFS)
Nearest computed pipe diameter = 90.00(In.)
Calculated individual pipe flow = 335.598(CFS)
Normal flow depth in pipe = 72.56(In.)
Flow top width inside pipe = 71.14(In.)
Critical Depth = 56.74(In.)
Pipe flow velocity = 8.79(Ft/s)
Travel time through pipe = 1.25 min.
Time of concentration (TC) = 29.07 min.

++
Process from Point/Station 502.000 to Point/Station 503.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 334.878(CFS)
therefore the upstream flow rate of Q = 335.598(CFS) is being used
Time of concentration = 29.07 min.
Rainfall intensity = 2.039(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff = 0.000(CFS) for 4.770(Ac.)
Total runoff = 335.598(CFS)
Effective area this stream = 190.94(Ac.)
Total Study Area (Main Stream No. 1) = 190.94(Ac.)
Area averaged Fm value = 0.090(In/Hr)

++
Process from Point/Station 502.000 to Point/Station 503.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 190.940(Ac.)
Runoff from this stream = 335.598(CFS)
Time of concentration = 29.07 min.
Rainfall intensity = 2.039(In/Hr)
Area averaged loss rate (Fm) = 0.0902(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1149

++
Process from Point/Station 212.000 to Point/Station 503.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.133(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 26.97 min. Rain intensity = 2.13(In/Hr)
Total area this stream = 206.50(Ac.)
Total Study Area (Main Stream No. 1) = 397.44(Ac.)
Total runoff = 342.10(CFS)

++
Process from Point/Station 212.000 to Point/Station 503.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 206.500(Ac.)
Runoff from this stream = 342.100(CFS)
Time of concentration = 26.97 min.
Rainfall intensity = 2.133(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	335.598	29.07	2.039
2	342.100	26.97	2.133

Qmax(1) =

1.000 * 1.000 * 335.598) +
0.954 * 1.000 * 342.100) + = 662.070
Qmax(2) =
1.048 * 0.928 * 335.598) +
1.000 * 1.000 * 342.100) + = 668.443

Total of 2 streams to confluence:
Flow rates before confluence point:
335.598 342.100
Maximum flow rates at confluence using above data:
662.070 668.443
Area of streams before confluence:
190.940 206.500
Effective area values after confluence:
397.440 383.644
Results of confluence:
Total flow rate = 668.443(CFS)
Time of concentration = 26.970 min.
Effective stream area after confluence = 383.644(Ac.)
Stream Area average Pervious fraction(Ap) = 0.107
Stream Area average soil loss rate(Fm) = 0.084(In/Hr)
Study area (this main stream) = 397.44(Ac.)

++
Process from Point/Station 503.000 to Point/Station 504.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 957.900(Ft.)
Downstream point/station elevation = 956.600(Ft.)
Pipe length = 660.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 668.443(CFS)
Nearest computed pipe diameter = 114.00(In.)
Calculated individual pipe flow = 668.443(CFS)
Normal flow depth in pipe = 98.63(In.)
Flow top width inside pipe = 77.88(In.)
Critical Depth = 75.61(In.)
Pipe flow velocity = 10.25(Ft/s)
Travel time through pipe = 1.07 min.
Time of concentration (TC) = 28.04 min.

++
Process from Point/Station 503.000 to Point/Station 504.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00

Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Time of concentration = 28.04 min.
Rainfall intensity = 2.083(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.898
Subarea runoff = 30.139(CFS) for 4.590(Ac.)
Total runoff = 698.582(CFS)
Effective area this stream = 388.23(Ac.)
Total Study Area (Main Stream No. 1) = 402.03(Ac.)
Area averaged Fm value = 0.084(In/Hr)

++
Process from Point/Station 504.000 to Point/Station 505.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 956.600(Ft.)
Downstream point/station elevation = 955.300(Ft.)
Pipe length = 660.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 698.582(CFS)
Nearest computed pipe diameter = 117.00(In.)
Calculated individual pipe flow = 698.582(CFS)
Normal flow depth in pipe = 97.88(In.)
Flow top width inside pipe = 86.53(In.)
Critical Depth = 76.87(In.)
Pipe flow velocity = 10.47(Ft/s)
Travel time through pipe = 1.05 min.
Time of concentration (TC) = 29.09 min.

++
Process from Point/Station 504.000 to Point/Station 505.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 695.349(CFS)
therefore the upstream flow rate of Q = 698.582(CFS) is being used
Time of concentration = 29.09 min.
Rainfall intensity = 2.038(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff = 0.000(CFS) for 7.180(Ac.)
Total runoff = 698.582(CFS)
Effective area this stream = 395.41(Ac.)
Total Study Area (Main Stream No. 1) = 409.21(Ac.)

Area averaged Fm value = 0.084(In/Hr)

++
Process from Point/Station 504.000 to Point/Station 505.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 395.414(Ac.)
Runoff from this stream = 698.582(CFS)
Time of concentration = 29.09 min.
Rainfall intensity = 2.038(In/Hr)
Area averaged loss rate (Fm) = 0.0840(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1069

++
Process from Point/Station 308.000 to Point/Station 505.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 1.977(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 30.61 min. Rain intensity = 1.98(In/Hr)
Total area this stream = 162.08(Ac.)
Total Study Area (Main Stream No. 1) = 571.29(Ac.)
Total runoff = 276.90(CFS)

++
Process from Point/Station 308.000 to Point/Station 505.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 162.080(Ac.)
Runoff from this stream = 276.900(CFS)
Time of concentration = 30.61 min.
Rainfall intensity = 1.977(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	698.582	29.09	2.038

2 276.900 30.61 1.977
Qmax(1) =
1.000 * 1.000 * 698.582) +
1.032 * 0.950 * 276.900) + = 970.251
Qmax(2) =
0.969 * 1.000 * 698.582) +
1.000 * 1.000 * 276.900) + = 953.619

Total of 2 streams to confluence:
Flow rates before confluence point:
698.582 276.900
Maximum flow rates at confluence using above data:
970.251 953.619
Area of streams before confluence:
395.414 162.080
Effective area values after confluence:
549.469 557.494
Results of confluence:
Total flow rate = 970.251(CFS)
Time of concentration = 29.095 min.
Effective stream area after confluence = 549.469(Ac.)
Stream Area average Pervious fraction(Ap) = 0.105
Stream Area average soil loss rate(Fm) = 0.082(In/Hr)
Study area (this main stream) = 557.49(Ac.)

++
Process from Point/Station 505.000 to Point/Station 506.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 955.300(Ft.)
Downstream point/station elevation = 954.000(Ft.)
Pipe length = 660.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 970.251(CFS)
Nearest computed pipe diameter = 132.00(In.)
Calculated individual pipe flow = 970.251(CFS)
Normal flow depth in pipe = 111.38(In.)
Flow top width inside pipe = 95.86(In.)
Critical Depth = 87.86(In.)
Pipe flow velocity = 11.33(Ft/s)
Travel time through pipe = 0.97 min.
Time of concentration (TC) = 30.07 min.

++
Process from Point/Station 505.000 to Point/Station 506.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000

SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 955.516(CFS)
therefore the upstream flow rate of Q = 970.251(CFS) is being used
Time of concentration = 30.07 min.
Rainfall intensity = 1.998(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff = 0.000(CFS) for 4.700(Ac.)
Total runoff = 970.251(CFS)
Effective area this stream = 554.17(Ac.)
Total Study Area (Main Stream No. 1) = 575.99(Ac.)
Area averaged Fm value = 0.082(In/Hr)

++
Process from Point/Station 506.000 to Point/Station 507.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 954.000(Ft.)
Downstream point/station elevation = 952.700(Ft.)
Pipe length = 660.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 970.251(CFS)
Nearest computed pipe diameter = 132.00(In.)
Calculated individual pipe flow = 970.251(CFS)
Normal flow depth in pipe = 111.38(In.)
Flow top width inside pipe = 95.86(In.)
Critical Depth = 87.86(In.)
Pipe flow velocity = 11.33(Ft/s)
Travel time through pipe = 0.97 min.
Time of concentration (TC) = 31.04 min.

++
Process from Point/Station 506.000 to Point/Station 507.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 944.761(CFS)
therefore the upstream flow rate of Q = 970.251(CFS) is being used
Time of concentration = 31.04 min.
Rainfall intensity = 1.960(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified

rational method)(Q=KCIA) is C = 0.897
Subarea runoff = 0.000(CFS) for 4.760(Ac.)
Total runoff = 970.251(CFS)
Effective area this stream = 558.93(Ac.)
Total Study Area (Main Stream No. 1) = 580.75(Ac.)
Area averaged Fm value = 0.082(In/Hr)

++
Process from Point/Station 506.000 to Point/Station 507.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 558.929(Ac.)
Runoff from this stream = 970.251(CFS)
Time of concentration = 31.04 min.
Rainfall intensity = 1.960(In/Hr)
Area averaged loss rate (Fm) = 0.0823(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1048

++
Process from Point/Station 408.000 to Point/Station 507.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.010(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 29.78 min. Rain intensity = 2.01(In/Hr)
Total area this stream = 121.73(Ac.)
Total Study Area (Main Stream No. 1) = 702.48(Ac.)
Total runoff = 211.50(CFS)

++
Process from Point/Station 408.000 to Point/Station 507.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 121.730(Ac.)
Runoff from this stream = 211.500(CFS)
Time of concentration = 29.78 min.
Rainfall intensity = 2.010(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	970.251	31.04	1.960
2	211.500	29.78	2.010

Qmax(1) =
1.000 * 1.000 * 970.251) +
0.975 * 1.000 * 211.500) + = 1176.365
Qmax(2) =
1.026 * 0.960 * 970.251) +
1.000 * 1.000 * 211.500) + = 1166.880

Total of 2 streams to confluence:
Flow rates before confluence point:
970.251 211.500
Maximum flow rates at confluence using above data:
1176.365 1166.880
Area of streams before confluence:
558.929 121.730
Effective area values after confluence:
680.659 658.048
Results of confluence:
Total flow rate = 1176.365(CFS)
Time of concentration = 31.036 min.
Effective stream area after confluence = 680.659(Ac.)
Stream Area average Pervious fraction(Ap) = 0.104
Stream Area average soil loss rate(Fm) = 0.082(In/Hr)
Study area (this main stream) = 680.66(Ac.)

++
Process from Point/Station 507.000 to Point/Station 508.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 952.700(Ft.)
Downstream point/station elevation = 951.100(Ft.)
Pipe length = 800.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1176.365(CFS)
Nearest computed pipe diameter = 141.00(In.)
Calculated individual pipe flow = 1176.365(CFS)
Normal flow depth in pipe = 120.38(In.)
Flow top width inside pipe = 99.65(In.)
Critical Depth = 95.29(In.)
Pipe flow velocity = 11.92(Ft/s)
Travel time through pipe = 1.12 min.
Time of concentration (TC) = 32.15 min.

++
Process from Point/Station 507.000 to Point/Station 508.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 1151.156(CFS)
therefore the upstream flow rate of Q = 1176.365(CFS) is being used
Time of concentration = 32.15 min.
Rainfall intensity = 1.919(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff = 0.000(CFS) for 15.370(Ac.)
Total runoff = 1176.365(CFS)
Effective area this stream = 696.03(Ac.)
Total Study Area (Main Stream No. 1) = 717.85(Ac.)
Area averaged Fm value = 0.082(In/Hr)

++
Process from Point/Station 508.000 to Point/Station 509.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 951.100(Ft.)
Downstream point/station elevation = 950.100(Ft.)
Pipe length = 500.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1176.365(CFS)
Nearest computed pipe diameter = 141.00(In.)
Calculated individual pipe flow = 1176.365(CFS)
Normal flow depth in pipe = 120.38(In.)
Flow top width inside pipe = 99.65(In.)
Critical Depth = 95.29(In.)
Pipe flow velocity = 11.92(Ft/s)
Travel time through pipe = 0.70 min.
Time of concentration (TC) = 32.85 min.

++
Process from Point/Station 508.000 to Point/Station 509.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a

a lower flow rate of Q = 1153.327(CFS)
therefore the upstream flow rate of Q = 1176.365(CFS) is being used
Time of concentration = 32.85 min.
Rainfall intensity = 1.895(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff = 0.000(CFS) for 10.760(Ac.)
Total runoff = 1176.365(CFS)
Effective area this stream = 706.79(Ac.)
Total Study Area (Main Stream No. 1) = 728.61(Ac.)
Area averaged Fm value = 0.082(In/Hr)

++
Process from Point/Station 508.000 to Point/Station 509.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 706.789(Ac.)
Runoff from this stream = 1176.365(CFS)
Time of concentration = 32.85 min.
Rainfall intensity = 1.895(In/Hr)
Area averaged loss rate (Fm) = 0.0815(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1038

++
Process from Point/Station 603.000 to Point/Station 509.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Rainfall intensity = 2.613(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 19.23 min. Rain intensity = 2.61(In/Hr)
Total area this stream = 64.50(Ac.)
Total Study Area (Main Stream No. 1) = 793.11(Ac.)
Total runoff = 147.10(CFS)

++
Process from Point/Station 603.000 to Point/Station 509.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 64.500(Ac.)
Runoff from this stream = 147.100(CFS)
Time of concentration = 19.23 min.

Rainfall intensity = 2.613(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	1176.365	32.85	1.895
2	147.100	19.23	2.613

Qmax(1) =
1.000 * 1.000 * 1176.365) +
0.717 * 1.000 * 147.100) + = 1281.785
Qmax(2) =
1.396 * 0.585 * 1176.365) +
1.000 * 1.000 * 147.100) + = 1108.349

Total of 2 streams to confluence:
Flow rates before confluence point:
1176.365 147.100
Maximum flow rates at confluence using above data:
1281.785 1108.349
Area of streams before confluence:
706.789 64.500
Effective area values after confluence:
771.289 478.206
Results of confluence:
Total flow rate = 1281.785(CFS)
Time of concentration = 32.853 min.
Effective stream area after confluence = 771.289(Ac.)
Stream Area average Pervious fraction(Ap) = 0.103
Stream Area average soil loss rate(Fm) = 0.081(In/Hr)
Study area (this main stream) = 771.29(Ac.)

++
Process from Point/Station 509.000 to Point/Station 510.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 950.100(Ft.)
Downstream point/station elevation = 949.300(Ft.)
Pipe length = 350.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1281.785(CFS)
Nearest computed pipe diameter = 141.00(In.)
Calculated individual pipe flow = 1281.785(CFS)
Normal flow depth in pipe = 124.13(In.)
Flow top width inside pipe = 91.53(In.)
Critical Depth = 99.47(In.)
Pipe flow velocity = 12.68(Ft/s)
Travel time through pipe = 0.46 min.
Time of concentration (TC) = 33.31 min.

++
Process from Point/Station 509.000 to Point/Station 510.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 1253.039(CFS)
therefore the upstream flow rate of Q = 1281.785(CFS) is being used
Time of concentration = 33.31 min.
Rainfall intensity = 1.879(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff = 0.000(CFS) for 3.220(Ac.)
Total runoff = 1281.785(CFS)
Effective area this stream = 774.51(Ac.)
Total Study Area (Main Stream No. 1) = 796.33(Ac.)
Area averaged Fm value = 0.081(In/Hr)

++
Process from Point/Station 510.000 to Point/Station 511.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 949.300(Ft.)
Downstream point/station elevation = 947.400(Ft.)
Pipe length = 950.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1281.785(CFS)
Nearest computed pipe diameter = 144.00(In.)
Calculated individual pipe flow = 1281.785(CFS)
Normal flow depth in pipe = 129.60(In.)
Flow top width inside pipe = 86.40(In.)
Critical Depth = 98.89(In.)
Pipe flow velocity = 11.96(Ft/s)
Travel time through pipe = 1.32 min.
Time of concentration (TC) = 34.64 min.

++
Process from Point/Station 510.000 to Point/Station 511.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000

SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q = 1262.100(CFS)
therefore the upstream flow rate of Q = 1281.785(CFS) is being used
Time of concentration = 34.64 min.
Rainfall intensity = 1.835(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff = 0.000(CFS) for 24.880(Ac.)
Total runoff = 1281.785(CFS)
Effective area this stream = 799.39(Ac.)
Total Study Area (Main Stream No. 1) = 821.21(Ac.)
Area averaged Fm value = 0.081(In/Hr)

++
Process from Point/Station 511.000 to Point/Station 512.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 947.500(Ft.)
Downstream point/station elevation = 945.500(Ft.)
Pipe length = 1000.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1281.785(CFS)
Nearest computed pipe diameter = 144.00(In.)
Calculated individual pipe flow = 1281.785(CFS)
Normal flow depth in pipe = 129.60(In.)
Flow top width inside pipe = 86.40(In.)
Critical Depth = 98.89(In.)
Pipe flow velocity = 11.96(Ft/s)
Travel time through pipe = 1.39 min.
Time of concentration (TC) = 36.03 min.
End of computations, total study area = 821.210 (Ac.)

SECTION 3

HYDRAULIC ANALYSIS

LA COUNTY PUBLIC WORKS

STORM DRAIN ANALYSIS
(INPUT)

REPT: PC/RD4412.1
DATE: 06/28/00
PAGE 1

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
8	1						854.70															
2	2	1209.0	1209.0	95.84	846.71	846.90	0.00	96.	144.	3	0.00	0.00	0.00	1	0	0	0	0.	0.	0.	40.00	0.013
2	3	1209.0	1209.0	587.32	846.98	847.45	0.00	132.	0.	3	0.00	0.00	0.15	0	0	0	0	0.	0.	0.	15.00	0.013
2	4	1209.0	1209.0	48.79	847.47	847.57	0.00	132.	0.	3	0.00	0.00	0.06	0	0	33	0	0.	77.	0.	0.00	0.013
2	5	1209.0	1209.0	434.63	847.57	847.95	0.00	132.	0.	3	0.00	0.00	0.00	0	0	34	0	0.	90.	0.	0.00	0.013
2	6	1209.0	1209.0	418.64	847.95	848.37	0.00	132.	0.	3	0.00	0.00	0.00	0	0	35	0	0.	90.	0.	6.00	0.013
2	7	1209.0	1209.0	227.70	848.38	848.60	0.00	132.	0.	3	0.00	0.00	0.00	0	8	0	0	2.	0.	0.	30.00	0.013
2	8	1209.0	1209.0	20.00	848.63	848.65	0.00	96.	144.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	30.00	0.013
2	9	1209.0	1209.0	44.20	848.68	848.73	0.00	132.	0.	3	0.00	0.00	0.00	0	10	50	0	2.	30.	0.	20.00	0.013
2	10	1040.0	1040.0	86.00	848.75	848.84	0.00	132.	0.	3	0.00	0.00	0.00	0	0	36	0	0.	90.	0.	0.00	0.013
2	11	1040.0	1040.0	360.00	848.84	849.22	0.00	132.	0.	3	0.00	0.00	0.00	0	0	37	0	0.	90.	0.	0.00	0.013
2	12	1040.0	1040.0	167.00	849.22	849.38	0.00	132.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	6.00	0.013
2	13	1040.0	1040.0	627.69	849.39	850.01	0.00	132.	0.	3	0.00	0.00	0.00	0	14	60	0	3.	62.	0.	10.00	0.013
2	14	1000.0	1000.0	173.52	850.03	850.20	0.00	120.	0.	3	0.00	0.00	0.00	0	15	38	39	3.	72.	90.	0.00	0.013
2	15	1000.0	1000.0	483.06	850.20	850.68	0.00	120.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	6.00	0.013
2	16	1000.0	1000.0	618.27	850.69	851.31	0.00	120.	0.	3	0.00	0.00	0.00	0	0	40	41	0.	90.	90.	0.00	0.013
2	17	1000.0	1000.0	33.19	851.31	851.34	0.00	120.	0.	3	0.00	0.00	0.00	0	0	70	0	0.	45.	0.	15.00	0.013
2	18	729.0	729.0	91.60	851.35	851.45	0.00	108.	0.	3	0.00	0.00	0.00	0	0	42	43	0.	90.	90.	0.00	0.013
2	19	729.0	729.0	885.97	851.45	852.33	0.00	108.	0.	3	0.00	0.00	0.00	0	0	44	45	0.	90.	90.	6.00	0.013
2	20	698.0	698.0	300.34	852.34	852.64	0.00	108.	0.	3	0.00	0.00	0.00	0	21	80	0	2.	30.	0.	15.00	0.013
2	21	366.0	366.0	50.00	852.65	852.70	0.00	84.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	22	366.0	366.0	50.00	852.70	852.75	0.00	84.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	23	366.0	366.0	39.94	852.75	852.79	0.00	84.	0.	3	0.00	0.00	0.00	0	24	46	47	2.	90.	90.	0.00	0.013
2	24	366.0	366.0	678.83	852.79	854.15	0.00	84.	0.	3	0.00	0.00	0.00	0	0	48	0	0.	90.	0.	6.00	0.013
2	25	336.0	336.0	448.73	854.16	855.06	0.00	84.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	5.50	0.013

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
2	26	336.0	336.0	97.67	855.07	855.27	0.00	84.	0.	3	0.00	0.00	0.12	0	0	90	0	0.	62.	0.	0.00	0.013
2	27	306.0	306.0	57.67	855.27	855.38	0.00	84.	0.	3	0.00	0.00	0.06	0	0	29	31	0.	80.	83.	6.00	0.013
2	28	184.0	184.0	8.00	856.88	856.96	880.00	66.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	29	54.0	54.0	27.00	862.00	876.60	880.60	48.	0.	3	0.00	0.20	0.00	28	30	0	0	80.	0.	0.	28.00	0.013
2	30	22.0	22.0	36.00	878.00	878.56	881.56	30.	0.	1	0.00	0.20	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	31	54.0	54.0	44.00	862.00	876.91	880.91	48.	0.	3	0.00	0.20	0.00	28	32	0	0	83.	0.	0.	28.00	0.013
2	32	22.0	22.0	28.00	878.00	878.49	881.49	30.	0.	1	0.00	0.20	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	33	20.0	0.1	43.00	848.50	852.50	864.57	24.	0.	1	0.00	0.20	0.00	5	0	0	0	0.	0.	0.	0.00	0.013
2	34	30.0	0.1	41.00	849.35	852.50	865.10	24.	0.	1	0.00	0.20	0.00	6	0	0	0	0.	0.	0.	0.00	0.013
2	35	10.0	0.1	41.00	850.20	852.50	865.24	18.	0.	1	0.00	0.20	0.00	7	0	0	0	0.	0.	0.	0.00	0.013
2	36	32.0	0.1	38.50	851.10	852.50	866.07	24.	0.	1	0.00	0.20	0.00	11	0	0	0	0.	0.	0.	0.00	0.013
2	37	19.0	0.1	38.50	851.85	852.50	866.92	24.	0.	1	0.00	0.20	0.00	12	0	0	0	0.	0.	0.	0.00	0.013
2	38	20.0	0.1	55.00	853.80	863.98	867.98	24.	0.	1	0.00	0.20	0.00	15	0	0	0	0.	0.	0.	0.00	0.013
2	39	3.0	0.1	12.50	853.80	864.32	867.44	18.	0.	1	0.00	0.20	0.00	15	0	0	0	0.	0.	0.	0.00	0.013
2	40	9.0	0.1	52.50	856.00	865.35	869.35	18.	0.	1	0.00	0.20	0.00	17	0	0	0	0.	0.	0.	0.00	0.013
2	41	1.5	0.1	12.50	856.00	865.35	869.35	18.	0.	1	0.00	0.20	0.00	17	0	0	0	0.	0.	0.	0.00	0.013
2	42	22.0	0.1	50.00	856.35	866.30	870.30	24.	0.	1	0.00	0.20	0.00	19	0	0	0	0.	0.	0.	0.00	0.013
2	43	2.5	0.1	16.00	856.35	865.35	869.35	18.	0.	1	0.00	0.20	0.00	19	0	0	0	0.	0.	0.	0.00	0.013
2	44	14.0	0.1	50.00	858.30	867.83	871.83	24.	0.	1	0.00	0.20	0.00	20	0	0	0	0.	0.	0.	0.00	0.013
2	45	2.5	0.1	16.00	858.30	867.71	871.71	18.	0.	1	0.00	0.20	0.00	20	0	0	0	0.	0.	0.	0.00	0.013
2	46	14.0	0.1	55.00	859.30	869.73	873.73	24.	0.	1	0.00	0.20	0.00	24	0	0	0	0.	0.	0.	0.00	0.013
2	47	4.5	0.1	11.00	859.30	869.45	873.45	18.	0.	1	0.00	0.20	0.00	24	0	0	0	0.	0.	0.	0.00	0.013
2	48	30.0	30.0	55.00	860.70	870.07	875.07	42.	0.	1	0.00	0.20	0.00	25	0	0	0	0.	0.	0.	0.00	0.013
2	50	169.0	169.0	79.00	852.00	856.50	865.00	66.	0.	1	0.00	0.20	0.00	10	0	0	0	0.	0.	0.	0.00	0.013
2	60	40.0	40.0	7.00	860.00	866.00	0.00	45.	0.	3	0.00	0.00	0.00	14	0	0	0	0.	0.	0.	0.00	0.013

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
2	61	40.0	40.0	79.00	866.00	867.20	0.00	45.	0.	3	0.00	0.00	0.00	0	62	0	0	45.	0.	0.	0.00	0.013
2	62	40.0	40.0	38.00	867.20	868.10	872.10	36.	0.	1	0.00	0.20	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	70	277.0	271.0	107.00	857.50	858.00	0.00	72.	0.	3	0.00	0.00	0.00	18	0	72	74	0.	90.	45.	6.00	0.013
2	71	158.0	158.0	8.00	858.00	858.10	870.00	66.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	72	60.0	60.0	35.00	858.50	867.11	871.11	48.	0.	3	0.00	0.20	0.00	71	72	0	0	90.	0.	0.	28.00	0.013
2	73	31.0	31.0	28.00	869.00	870.00	873.00	30.	0.	1	0.00	0.20	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	74	60.0	60.0	41.00	858.50	868.44	872.44	48.	0.	3	0.00	0.20	0.00	71	75	0	0	45.	0.	0.	28.00	0.013
2	75	31.0	31.0	28.00	870.00	871.00	874.00	30.	0.	1	0.00	0.20	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	80	342.0	332.0	126.00	858.50	859.00	0.00	84.	0.	3	0.00	0.00	0.00	21	0	81	83	0.	90.	63.	6.00	0.013
2	81	252.0	252.0	8.00	859.00	859.10	873.00	72.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	82	45.0	45.0	9.00	860.00	870.04	0.00	48.	0.	3	0.00	0.20	0.00	81	82	0	0	90.	0.	0.	0.00	0.013
2	83	20.0	20.0	28.00	871.00	871.48	874.48	24.	0.	1	0.00	0.20	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	84	45.0	45.0	60.00	860.00	870.30	0.00	48.	0.	3	0.00	0.20	0.00	81	84	0	0	60.	0.	0.	0.00	0.013
2	85	20.0	20.0	28.00	871.00	871.85	874.85	24.	0.	1	0.00	0.20	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	90	30.0	30.0	10.00	862.00	870.00	880.00	36.	0.	1	0.00	0.00	0.00	27	0	0	0	0.	0.	0.	0.00	0.013

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1, CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
1	HYDRAULIC GRADE LINE CONTROL = 854.70																	
2	1209.0	96	144	8.00	6.80	PART	0.00378	20.8	22.5	846.71	846.90	851.55	851.38	4.84	4.48	0.00	0.00	
3	1209.0	132	0	11.00	8.18	PART	0.00321	15.9	12.8	846.98	847.45	855.16	858.30	8.18	10.85	0.00	0.00	
4	1209.0	132	0	11.00	8.18	PART	0.00321	12.8	14.9	847.47	847.57	858.30	856.34	10.83	8.77	0.00	0.00	
5	1209.0	132	0	11.00	8.18	PART	0.00321	14.9	13.0	847.57	847.95	856.34	858.37	8.77	10.42	0.00	0.00	
6	1209.0	132	0	11.00	8.18	PART	0.00321	13.0	13.1	847.95	848.37	858.37	858.68	10.42	10.31	0.00	0.00	
7	1209.0	132	0	11.00	8.18	PART	0.00321	13.1	13.6	848.38	848.60	858.68	858.37	10.30	9.77	0.00	0.00	
8	1209.0	96	144	8.00	6.80	FULL	0.00378	12.6	12.6	848.63	848.65	858.76	858.78	10.13	10.13	0.00	0.00	
9	1209.0	132	0	11.00	8.18	PART	0.00321	13.7	14.7	848.68	848.73	858.34	857.61	9.66	8.88	0.00	0.00	
10	1040.0	132	0	11.00	7.58	PART	0.00238	11.0	13.3	848.75	848.84	859.47	857.30	10.72	8.46	0.00	0.00	
11	1040.0	132	0	11.00	7.58	PART	0.00238	13.3	12.1	848.84	849.22	857.30	858.57	8.46	9.35	0.00	0.00	
12	1040.0	132	0	11.00	7.58	PART	0.00238	12.1	12.7	849.22	849.38	858.57	858.19	9.35	8.81	0.00	0.00	
13	1040.0	132	0	11.00	7.58	PART	0.00238	12.8	11.6	849.39	850.01	858.17	859.82	8.78	9.81	0.00	0.00	
14	1000.0	120	0	10.00	7.61	PART	0.00366	13.2	13.4	850.03	850.20	859.24	859.23	9.21	9.03	0.00	0.00	
15	1000.0	120	0	10.00	7.61	PART	0.00366	13.4	12.7	850.20	850.68	859.24	860.67	9.04	9.99	0.00	0.00	
16	1000.0	120	0	10.00	7.61	SEAL	0.00366	12.7	12.7	850.69	851.31	860.67	861.65	9.98	10.34	0.00	0.00	
	X = 488.73 X(N) = 0.00																	
17	1000.0	120	0	10.00	7.61	FULL	0.00366	12.7	12.7	851.31	851.34	861.65	861.77	10.34	10.43	0.00	0.00	
18	729.0	108	0	9.00	6.68	FULL	0.00341	11.5	11.5	851.35	851.45	862.74	863.05	11.39	11.60	0.00	0.00	
19	729.0	108	0	9.00	6.68	FULL	0.00341	11.5	11.5	851.45	852.33	863.05	866.07	11.60	13.74	0.00	0.00	
20	698.0	108	0	9.00	6.54	FULL	0.00312	11.0	11.0	852.34	852.64	866.41	867.35	14.07	14.71	0.00	0.00	
21	366.0	84	0	7.00	5.04	FULL	0.00328	9.5	9.5	852.65	852.70	868.38	868.55	15.73	15.85	0.00	0.00	
22	366.0	84	0	7.00	5.04	FULL	0.00328	9.5	9.5	852.70	852.75	868.55	868.71	15.85	15.96	0.00	0.00	
23	366.0	84	0	7.00	5.04	FULL	0.00328	9.5	9.5	852.75	852.79	868.71	868.85	15.96	16.06	0.00	0.00	
24	366.0	84	0	7.00	5.04	FULL	0.00328	9.5	9.5	852.79	854.15	868.85	871.08	16.06	16.93	0.00	0.00	

PR T: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
25	336.0	84	0	7.00	4.82	FULL	0.00277	8.7	8.7	854.16	855.06	871.52	872.76	17.36	17.70	0.00	0.00	
26	336.0	84	0	7.00	4.82	FULL	0.00277	8.7	8.7	855.07	855.27	872.76	873.03	17.69	17.76	0.00	0.00	
27	306.0	84	0	7.00	4.59	FULL	0.00229	8.0	8.0	855.27	855.38	873.39	873.52	18.12	18.14	0.00	0.00	
28	184.0	66	0	2.90	3.79	FULL	0.00300	7.7	7.7	856.88	856.96	874.46	874.48	17.58	17.52	875.41	880.00	
28	HYDRAULIC GRADE LINE CONTROL = 873.99																	
29	54.0	48	0	0.61	2.20	SEAL	0.00141	4.3	7.6	862.00	876.60	873.99	878.80	11.99	2.20	0.00	0.00	HYD JUMP
	X = 13.63 X(N) = 0.00 X(J) = 13.63 F(J) = 40.34 D(BJ) = 0.96 D(AJ) = 4.62																	
30	22.0	30	0	1.14	1.59	SEAL	0.00288	4.5	4.6	878.00	878.56	880.84	880.93	2.84	2.37	881.32	881.56	
	X = 26.80 X(N) = 0.00																	
28	HYDRAULIC GRADE LINE CONTROL = 873.99																	
31	54.0	48	0	0.68	2.20	SEAL	0.00141	4.3	7.6	862.00	876.91	873.99	879.11	11.99	2.20	0.00	0.00	HYD JUMP
	X = 21.87 X(N) = 0.00 X(J) = 21.87 F(J) = 39.99 D(BJ) = 0.96 D(AJ) = 4.60																	
32	22.0	30	0	1.11	1.59	FULL	0.00288	4.5	4.5	878.00	878.49	881.18	881.26	3.18	2.77	881.63	881.49	
4	HYDRAULIC GRADE LINE CONTROL = 856.34																	
33	20.0	24	0	0.74	1.61	FULL	0.00782	6.4	6.4	848.50	852.50	856.34	856.68	7.84	4.18	857.43	864.57	
5	HYDRAULIC GRADE LINE CONTROL = 858.37																	
34	30.0	24	0	0.97	1.86	FULL	0.01758	9.5	9.5	849.35	852.50	858.37	859.09	9.02	6.59	860.79	865.10	
	HYDRAULIC GRADE LINE CONTROL = 858.68																	
35	10.0	18	0	0.66	1.22	FULL	0.00906	5.7	5.7	850.20	852.50	858.68	859.05	8.48	6.55	859.64	865.24	

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
11	HYDRAULIC GRADE LINE CONTROL = 857.30																	
36	32.0	24	0	1.28	1.89	FULL	0.02001	10.2	10.2	851.10	852.50	857.30	858.07	6.20	5.57	860.00	866.07	
12	HYDRAULIC GRADE LINE CONTROL = 858.57																	
37	19.0	24	0	1.17	1.57	FULL	0.00705	6.0	6.0	851.85	852.50	858.57	858.84	6.72	6.34	859.52	866.92	
15	HYDRAULIC GRADE LINE CONTROL = 859.24																	
38	20.0	24	0	0.61	1.61	SEAL	0.00782	6.4	7.4	853.80	863.98	859.24	865.59	5.44	1.61	866.60	867.98	HYD JUMP
	X = 8.50 X(N) = 0.00 X(J) = 8.50 F(J) = 13.16 D(BJ) = 0.70 D(AJ) = 3.92																	
15	HYDRAULIC GRADE LINE CONTROL = 859.24																	
39	3.0	18	0	0.18	0.66	SEAL	0.00082	1.7	4.0	853.80	864.32	859.24	864.98	5.44	0.66	865.28	867.44	HYD JUMP
	X = 4.58 X(N) = 0.00 X(J) = 4.58 F(J) = 1.62 D(BJ) = 0.24 D(AJ) = 1.57																	
16	HYDRAULIC GRADE LINE CONTROL = 861.65																	
40	9.0	18	0	0.46	1.16	SEAL	0.00734	5.1	6.1	856.00	865.35	861.65	866.51	5.65	1.16	867.21	869.35	HYD JUMP
	X = 17.54 X(N) = 0.00 X(J) = 17.54 F(J) = 4.79 D(BJ) = 0.52 D(AJ) = 2.65																	
16	HYDRAULIC GRADE LINE CONTROL = 861.65																	
41	1.5	18	0	0.13	0.46	SEAL	0.00020	0.8	3.3	856.00	865.35	861.65	865.81	5.65	0.46	866.01	869.35	HYD JUMP
	X = 5.55 X(N) = 0.00 X(J) = 6.08 F(J) = 0.73 D(BJ) = 0.16 D(AJ) = 1.09																	

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
18	HYDRAULIC GRADE LINE CONTROL = 863.05																	
42	22.0	24	0	0.63	1.67	SEAL	0.00946	7.0	7.8	856.35	866.30	863.05	867.97	6.70	1.67	869.12	870.30	HYD JUMP
	X = 14.12 X(N) = 0.00 X(J) = 14.12 F(J) = 14.29 D(BJ) = 0.76 D(AJ) = 4.02																	
18	HYDRAULIC GRADE LINE CONTROL = 863.05																	
43	2.5	18	0	0.18	0.60	SEAL	0.00057	1.4	3.8	856.35	865.35	863.05	865.95	6.70	0.60	866.22	869.35	HYD JUMP
	X = 9.26 X(N) = 0.00 X(J) = 9.66 F(J) = 1.05 D(BJ) = 0.25 D(AJ) = 1.26																	
20	HYDRAULIC GRADE LINE CONTROL = 866.24																	
	14.0	24	0	0.51	1.34	SEAL	0.00383	4.5	6.2	858.30	867.83	866.24	869.17	7.94	1.34	869.90	871.83	HYD JUMP
	X = 27.81 X(N) = 0.00 X(J) = 27.81 F(J) = 7.43 D(BJ) = 0.63 D(AJ) = 2.74																	
20	HYDRAULIC GRADE LINE CONTROL = 866.24																	
45	2.5	18	0	0.18	0.60	SEAL	0.00057	1.4	3.8	858.30	867.71	866.24	868.31	7.94	0.60	868.58	871.71	HYD JUMP
	X = 10.96 X(N) = 0.00 X(J) = 11.46 F(J) = 0.95 D(BJ) = 0.27 D(AJ) = 1.19																	
24	HYDRAULIC GRADE LINE CONTROL = 868.85																	
46	14.0	24	0	0.51	1.34	SEAL	0.00383	4.5	6.2	859.30	869.73	868.85	871.07	9.55	1.34	871.80	873.73	HYD JUMP
	X = 37.02 X(N) = 0.00 X(J) = 37.02 F(J) = 7.18 D(BJ) = 0.65 D(AJ) = 2.66																	
24	HYDRAULIC GRADE LINE CONTROL = 868.85																	
47	4.5	18	0	0.21	0.81	SEAL	0.00184	2.5	4.6	859.30	869.45	868.85	870.26	9.55	0.81	870.66	873.45	HYD JUMP
	X = 8.64 X(N) = 0.00 X(J) = 8.64 F(J) = 1.84 D(BJ) = 0.39 D(AJ) = 1.58																	

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
25	HYDRAULIC GRADE LINE CONTROL = 871.30																	
48	30.0	42	0	0.63	1.69	SEAL	0.00089	3.1	6.5	860.70	870.07	871.30	871.76	10.60	1.69	872.55	875.07	HYD JUMP
	X = 41.89 X(N) = 0.00 X(J) = 46.21 F(J) = 13.18 D(BJ) = 1.01 D(AJ) = 2.68																	
10	HYDRAULIC GRADE LINE CONTROL = 858.54																	
50	169.0	66	0	1.71	3.62	SEAL	0.00253	7.1	10.2	852.00	856.50	858.54	860.12	6.54	3.62	862.06	865.00	HYD JUMP
	X = 14.15 X(N) = 0.00 X(J) = 14.15 F(J) = 109.02 D(BJ) = 2.19 D(AJ) = 5.75																	
12	HYDRAULIC GRADE LINE CONTROL = 858.18																	
[illegible]	40.0	45	0	0.48	1.92	PART	0.00109	22.6	10.5	860.00	866.00	860.81	867.41	0.81	1.41	0.00	0.00	
61	40.0	45	0	1.33	1.92	PART	0.00109	10.5	7.0	866.00	867.20	867.41	869.12	1.41	1.92	0.00	0.00	
62	40.0	36	0	1.30	2.06	PART	0.00360	11.2	7.8	867.20	868.10	868.71	870.16	1.51	2.06	871.28	872.10	HJ @ DJT
18	HYDRAULIC GRADE LINE CONTROL = 862.26																	
70	277.0	72	0	4.70	4.55	PART	0.00428	11.5	11.6	857.50	858.00	862.26	862.72	4.76	4.72	0.00	0.00	HJ @ UJT
71	158.0	66	0	2.49	3.50	FULL	0.00221	6.7	6.7	858.00	858.10	863.64	863.66	5.64	5.56	864.35	870.00	
71	HYDRAULIC GRADE LINE CONTROL = 863.18																	
72	60.0	48	0	0.78	2.33	PART	0.00174	24.2	7.9	858.50	867.11	859.51	869.44	1.01	2.33	0.00	0.00	
73	31.0	30	0	1.10	1.90	SEAL	0.00571	6.3	7.8	869.00	870.00	871.79	871.90	2.79	1.90	873.02	873.00	HYD JUMP
	X = 0.00 X(N) = 0.00 X(J) = 9.56 F(J) = 12.25 D(BJ) = 1.40 D(AJ) = 2.50																	

PROJECT: FRANCIS STREET STORM DRAIN
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
71	HYDRAULIC GRADE LINE CONTROL = 863.18																	
74	60.0	48	0	0.79	2.33	PART	0.00174	25.1	7.9	858.50	868.44	859.48	870.77	0.98	2.33	0.00	0.00	
75	31.0	30	0	1.10	1.90	PART	0.00571	11.6	7.8	870.00	871.00	871.34	872.90	1.34	1.90	874.02	874.00	HJ @ DJT
21	HYDRAULIC GRADE LINE CONTROL = 867.87																	
80	342.0	84	0	4.96	4.87	FULL	0.00287	8.9	8.9	858.50	859.00	867.87	868.23	9.37	9.23	0.00	0.00	
81	252.0	72	0	3.11	4.35	FULL	0.00354	8.9	8.9	859.00	859.10	868.99	869.01	9.99	9.91	870.25	873.00	
	HYDRAULIC GRADE LINE CONTROL = 868.61																	
82	45.0	48	0	0.46	2.01	SEAL	0.00098	3.6	7.1	860.00	870.04	868.61	872.05	8.61	2.01	0.00	0.00	HYD JUMP
	X = 4.10 X(N) = 0.00 X(J) = 4.10 F(J) = 30.66 D(BJ) = 0.90 D(AJ) = 4.03																	
83	20.0	24	0	1.21	1.61	FULL	0.00782	6.4	6.4	871.00	871.48	874.15	874.37	3.15	2.89	875.13	874.48	
81	HYDRAULIC GRADE LINE CONTROL = 868.61																	
84	45.0	48	0	0.74	2.01	SEAL	0.00098	3.6	7.1	860.00	870.30	868.61	872.31	8.61	2.01	0.00	0.00	HYD JUMP
	X = 26.99 X(N) = 0.00 X(J) = 27.75 F(J) = 28.56 D(BJ) = 0.95 D(AJ) = 3.85																	
85	20.0	24	0	1.01	1.61	FULL	0.00782	6.4	6.4	871.00	871.85	874.00	874.21	3.00	2.36	874.97	874.85	
27	HYDRAULIC GRADE LINE CONTROL = 873.21																	
90	30.0	36	0	0.46	1.77	FULL	0.00202	4.2	4.2	862.00	870.00	873.21	873.23	11.21	3.23	873.51	880.00	

V 1, FL 1, D 1 AND HG 1 REFER TO DOWNSTREAM END
V 2, FL 2, D 2 AND HG 2 REFER TO UPSTREAM END
X - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HG INTERSECTS SOFFIT IN SEAL CONDITION
X(N) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE WATER SURFACE REACHES NORMAL DEPTH BY EITHER DRAWDOWN OR BACKWATER
X(J) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HYDRAULIC JUMP OCCURS IN LINE
F(J) - THE COMPUTED FORCE AT THE HYDRAULIC JUMP
D(BJ) - DEPTH OF WATER BEFORE THE HYDRAULIC JUMP (UPSTREAM SIDE)
D(AJ) - DEPTH OF WATER AFTER THE HYDRAULIC JUMP (DOWNSTREAM SIDE)
SEAL INDICATES FLOW CHANGES FROM PART TO FULL OR FROM FULL TO PART
HYD JUMP INDICATES THAT FLOW CHANGES FROM SUPERCRITICAL TO SUBCRITICAL THROUGH A HYDRAULIC JUMP
HJ @ UJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE UPSTREAM END OF THE LINE
HJ @ DJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE DOWNSTREAM END OF THE LINE

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SECTION 4

CATCH BASIN DESIGN

Francis Street
Catch Basin Design

Note: the run-off (Q) to the following catch basins is estimated based on 3 cfs/acre. In most cases, the run-off contributing to the storm drain system from the hydrology analysis for these areas is 0.0 cfs. This is because by the time the peak flow of the entire drainage basin reaches these areas, the peak from these small areas has long since passed and there is negligible run-off remaining. The catch basins must be designed using the peak flow from the areas tributary to them, thence 3 cfs/acre is used.

Catch basins were located in sump areas (low points) and at other locations where the street capacity was exceeded and runoff spilled over the crown. Street capacity charts for flow vs. depth for various x-slopes and street grades are included in this section.

For in-line catch basins, The Los Angeles County Flood Control District nomographs for sizing in-line curb opening catch basins were used and can be found at the end of this section. The 4" gutter depression table was used for all designs.

For sump conditions, Plate 2.6-0651 (nomograph) from the L.A. County Road Department was used. This can also be found at the end of this section.

CATCH BASIN @ Station 28+60
Q_{100} = 5.07 acre @ 3 cfs/acre = 15 cfs
From street capacity chart, depth of flow (D) = 0.64' for street grade = 0.30%
Assume 14' catch basin on north side
From catch basin capacity tables, Q intercept = 15 cfs

Note: Q from 5.01 acre area will drain directly into back of this catch basin by reconstructing existing under sidewalk drains.

CATCH BASIN @ Station 35+36.34
Q_{100} = 4.77 acre @ 3 cfs/acre = 14 cfs
From street capacity chart, depth of flow (D) = 0.62' for street grade = 0.30%
Assume 14' catch basin on north side
From catch basin capacity tables, Q intercept = 14 cfs

CATCH BASIN @ Station 35+43.84
Q_{100} = 1.5 acre @ 3 cfs/acre = 4.5 cfs (from south 50' of Francis Street)
From street capacity chart, depth of flow (D) = 0.46' for street grade = 0.30%
Assume 7' catch basin on south side
From catch basin capacity tables, Q intercept = 4.5 cfs

CATCH BASIN @ Station 40+00 (north)
Q_{100} = 4.59 acre @ 3 cfs/acre = 14 cfs
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Therefore, L = 7'

CATCH BASIN @ Station 40+00 (south)
Q_{100} = 0.75 acre @ 3 cfs/acre = 2.5 cfs (from south 50' of Francis Street)
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Therefore, L = 3.5'

EXISTING 5' CATCH BASIN @ Station 48+88.65
Q_{100} = 7.18 acre @ 3 cfs/acre = 22 cfs
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Q = 2.2 (5) = 11 cfs < 22 cfs
Therefore, L needs to be 10'

CATCH BASIN @ Station 48+88.97
Q_{100} = 0.75 acre @ 3 cfs/acre = 2.5 cfs (from south 50' of Francis Street)
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Therefore, L = 3.5'

CATCH BASIN @ Station 50+28.70
Q_{100} = 2.80 acre @ 3 cfs/acre = 9 cfs
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Therefore, L = 4'

CATCH BASIN @ Station 50+28.48
Q_{100} = 0.50 acre @ 3 cfs/acre = 1.5 cfs (from south 50' of Francis Street)
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Therefore, L = 3.5'

CATCH BASIN @ Station 61+17.40
Q_{100} = 6.66 acre @ 3 cfs/acre = 20 cfs
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Therefore, L = 10'

EXISTING 10' CATCH BASIN @ Station 61+36.06
Q_{100} = 1.00 acre @ 3 cfs/acre = 3 cfs (from south 50' of Francis Street)
For sump condition, use Plate 2.6-0651 (nomograph) per L.A. County Road Department
Allowable ponding depth = top of curb
H=12", h=7.5"
H/h = 1.6 and Q/L = 2.2
Q = 2.2 (10) = 22 cfs > 3 cfs

CATCH BASIN @ Station 71+20.00
Q_{100} = 4.63 acre @ 3 cfs/acre = 14 cfs + 5 cfs (by-pass) = 19 cfs
From street capacity chart, depth of flow (D) = 0.78' for street grade = 0.20%
Assume 14' catch basin on north side
From catch basin capacity tables, Q intercept = 19 cfs
Therefore, Q by-pass = 0 cfs

CATCH BASIN @ Station 75+00.00
Q_{100} = 10.76 acre @ 3 cfs/acre = 32 cfs
From street capacity chart, depth of flow (D) = 0.80' for street grade = 0.20%
Assume 21' catch basin on north side
From catch basin capacity tables, Q intercept = 28 cfs
Therefore, Q by-pass = 32-28 = 4 cfs

EXISTING 14' CATCH BASIN @ Station 79+33.50
Q_{100} = 3.22 acre @ 3 cfs/acre = 10 cfs + 4 cfs (by-pass) = 14 cfs
From street capacity chart, depth of flow (D) = 0.71' for street grade = 0.16%
From catch basin capacity tables, Q intercept = 17 cfs
Therefore, Q by-pass = 0 cfs

CATCH BASIN @ Station 88+20.00
Q_{100} = 1.00 acre @ 3 cfs/acre = 3 cfs (from south 50' of Francis Street)
From street capacity chart, depth of flow (D) = 0.46' for street grade = 0.16%
Assume 4' catch basin on south side
From catch basin capacity tables, Q intercept = 3 cfs

STREET CAPACITY CHART - FRANCIS STREET

CAMPUS AVENUE TO BON VIEW AVENUE (36' HALF-WIDTH)
CURB HEIGHT = 8" X-SLOPE = 1.6% (AVERAGE)
GUTTER WIDTH = 2.0' STREET GRADE = 0.30%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.20	0.0	0.190	0.087	
0.20	0.21	0.6	0.213	0.075	
0.21	0.22	1.3	0.243	0.070	
0.22	0.25	1.9	0.278	0.068	
0.23	0.29	2.5	0.320	0.068	
0.24	0.33	3.1	0.368	0.069	
0.25	0.39	3.8	0.423	0.070	
0.26	0.46	4.4	0.483	0.073	
0.27	0.53	5.0	0.550	0.076	
0.28	0.62	5.6	0.623	0.079	
0.29	0.72	6.3	0.703	0.082	
0.30	0.83	6.9	0.788	0.086	
0.31	0.96	7.5	0.880	0.090	
0.32	1.09	8.1	0.978	0.094	
0.33	1.25	8.8	1.083	0.098	
0.34	1.41	9.4	1.193	0.102	
0.35	1.59	10.0	1.310	0.106	
0.36	1.79	10.6	1.433	0.110	
0.37	2.00	11.3	1.563	0.115	
0.38	2.23	11.9	1.698	0.119	
0.39	2.48	12.5	1.840	0.124	
0.40	2.74	13.1	1.988	0.128	
0.41	3.02	13.8	2.143	0.133	
0.42	3.32	14.4	2.303	0.137	
0.43	3.64	15.0	2.470	0.142	
0.44	3.98	15.6	2.643	0.146	
0.45	4.34	16.3	2.823	0.151	
0.46	4.72	16.9	3.008	0.156	
0.47	5.12	17.5	3.200	0.160	
0.48	5.54	18.1	3.398	0.165	
0.49	5.99	18.8	3.603	0.170	
0.50	6.45	19.4	3.813	0.174	
0.51	6.94	20.0	4.030	0.179	
0.52	7.46	20.6	4.253	0.184	
0.53	7.99	21.3	4.483	0.188	
0.54	8.55	21.9	4.718	0.193	
0.55	9.14	22.5	4.960	0.198	
0.56	9.75	23.1	5.208	0.203	
0.57	10.38	23.8	5.463	0.208	
0.58	11.05	24.4	5.723	0.212	
0.59	11.73	25.0	5.990	0.217	
0.60	12.45	25.6	6.263	0.222	
0.61	13.19	26.3	6.543	0.227	
0.62	13.96	26.9	6.828	0.232	
0.63	14.76	27.5	7.120	0.236	
0.64	15.59	28.1	7.418	0.241	
0.65	16.44	28.8	7.723	0.246	
0.66	17.33	29.4	8.033	0.251	
0.67	18.24	30.0	8.350	0.256	FLOW AT T.C.

STREET CAPACITY CHART - FRANCIS STREET

CURB HEIGHT = 8" X-SLOPE = 1.6% (AVERAGE)
GUTTER WIDTH = 2.0' STREET GRADE = 0.30%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	19.01	30.6	8.676	0.257	
0.69	19.81	31.3	9.013	0.258	
0.70	20.67	31.9	9.361	0.260	
0.71	21.56	32.5	9.720	0.262	
0.72	22.49	33.1	10.091	0.263	
0.73	23.47	33.8	10.473	0.266	FLOW AT CROWN
0.74	24.90	34.0	10.933	0.272	
0.75	26.21	34.0	11.330	0.279	
0.76	27.56	34.0	11.733	0.285	
0.77	28.94	34.0	12.140	0.291	
0.78	30.35	34.0	12.553	0.298	
0.79	31.80	34.0	12.970	0.304	
0.80	33.29	34.0	13.393	0.310	
0.81	34.81	34.0	13.820	0.316	
0.82	36.37	34.0	14.253	0.323	
0.83	37.96	34.0	14.690	0.329	
0.84	39.59	34.0	15.133	0.335	
0.85	41.26	34.0	15.580	0.341	
0.86	42.96	34.0	16.033	0.347	
0.87	44.70	34.0	16.490	0.353	
0.88	46.48	34.0	16.953	0.359	
0.89	48.30	34.0	17.420	0.365	
0.90	50.15	34.0	17.893	0.371	
0.91	52.04	34.0	18.370	0.377	FLOW AT R/W

STREET CAPACITY CHART - FRANCIS STREET

BON VIEW AVENUE TO GROVE AVENUE (38' HALF-WIDTH)
CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 0.50%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.26	0.0	0.190	0.087	
0.20	0.27	0.5	0.213	0.079	
0.21	0.30	1.0	0.240	0.075	
0.22	0.33	1.5	0.273	0.073	
0.23	0.38	2.0	0.310	0.073	
0.24	0.44	2.5	0.353	0.074	
0.25	0.50	3.0	0.400	0.076	
0.26	0.58	3.5	0.453	0.079	
0.27	0.67	4.0	0.510	0.081	
0.28	0.77	4.5	0.573	0.084	
0.29	0.88	5.0	0.640	0.088	
0.30	1.01	5.5	0.713	0.091	
0.31	1.15	6.0	0.790	0.095	
0.32	1.31	6.5	0.873	0.099	
0.33	1.48	7.0	0.960	0.103	
0.34	1.66	7.5	1.053	0.107	
0.35	1.86	8.0	1.150	0.111	
0.36	2.08	8.5	1.253	0.115	
0.37	2.31	9.0	1.360	0.120	
0.38	2.56	9.5	1.473	0.124	
0.39	2.83	10.0	1.590	0.128	
0.40	3.12	10.5	1.713	0.133	
0.41	3.43	11.0	1.840	0.137	
0.42	3.75	11.5	1.973	0.142	
0.43	4.10	12.0	2.110	0.146	
0.44	4.47	12.5	2.253	0.151	
0.45	4.86	13.0	2.400	0.155	
0.46	5.27	13.5	2.553	0.160	
0.47	5.70	14.0	2.710	0.165	
0.48	6.15	14.5	2.873	0.169	
0.49	6.63	15.0	3.040	0.174	
0.50	7.13	15.5	3.213	0.178	
0.51	7.65	16.0	3.390	0.183	
0.52	8.20	16.5	3.573	0.188	
0.53	8.78	17.0	3.760	0.193	
0.54	9.38	17.5	3.953	0.197	
0.55	10.00	18.0	4.150	0.202	
0.56	10.65	18.5	4.353	0.207	
0.57	11.33	19.0	4.560	0.211	
0.58	12.03	19.5	4.773	0.216	
0.59	12.77	20.0	4.990	0.221	
0.60	13.53	20.5	5.213	0.226	
0.61	14.32	21.0	5.440	0.230	
0.62	15.13	21.5	5.673	0.235	
0.63	15.98	22.0	5.910	0.240	
0.64	16.85	22.5	6.153	0.245	
0.65	17.76	23.0	6.400	0.250	
0.66	18.70	23.5	6.653	0.254	
0.67	19.66	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - FRANCIS STREET

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 0.50%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	20.43	24.5	7.175	0.259	
0.69	21.24	25.0	7.450	0.260	
0.70	22.10	25.5	7.735	0.261	
0.71	23.01	26.0	8.030	0.262	
0.72	23.97	26.5	8.335	0.263	
0.73	24.97	27.0	8.650	0.265	
0.74	26.03	27.5	8.975	0.267	
0.75	27.13	28.0	9.310	0.269	
0.76	28.29	28.5	9.655	0.271	
0.77	29.49	29.0	10.010	0.273	
0.78	30.75	29.5	10.375	0.275	
0.79	32.06	30.0	10.750	0.278	
0.80	33.42	30.5	11.135	0.281	
0.81	34.84	31.0	11.530	0.284	
0.82	36.31	31.5	11.935	0.286	
0.83	37.84	32.0	12.350	0.289	
0.84	39.42	32.5	12.775	0.293	
0.85	41.06	33.0	13.210	0.296	
0.86	42.75	33.5	13.655	0.299	
0.87	44.51	34.0	14.110	0.302	
0.88	46.32	34.5	14.575	0.306	
0.89	48.19	35.0	15.050	0.309	
0.90	50.12	35.5	15.535	0.313	
0.91	52.12	36.0	16.030	0.316	@ R/W & CROWN

STREET CAPACITY CHART - FRANCIS STREET

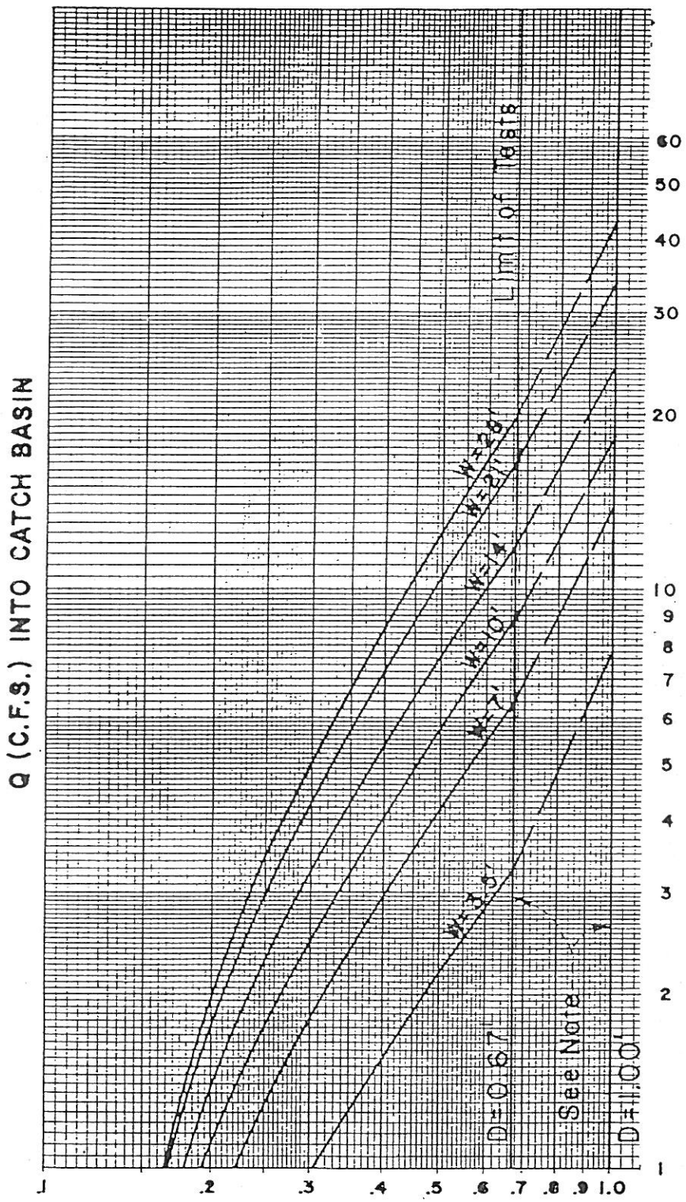
PARCO AVENUE TO WEST CUCAMONGA CHANNEL (36' HALF-WIDTH)
CURB HEIGHT = 8" X-SLOPE = 1.8% (AVERAGE)
GUTTER WIDTH = 2.0' STREET GRADE = 0.16%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

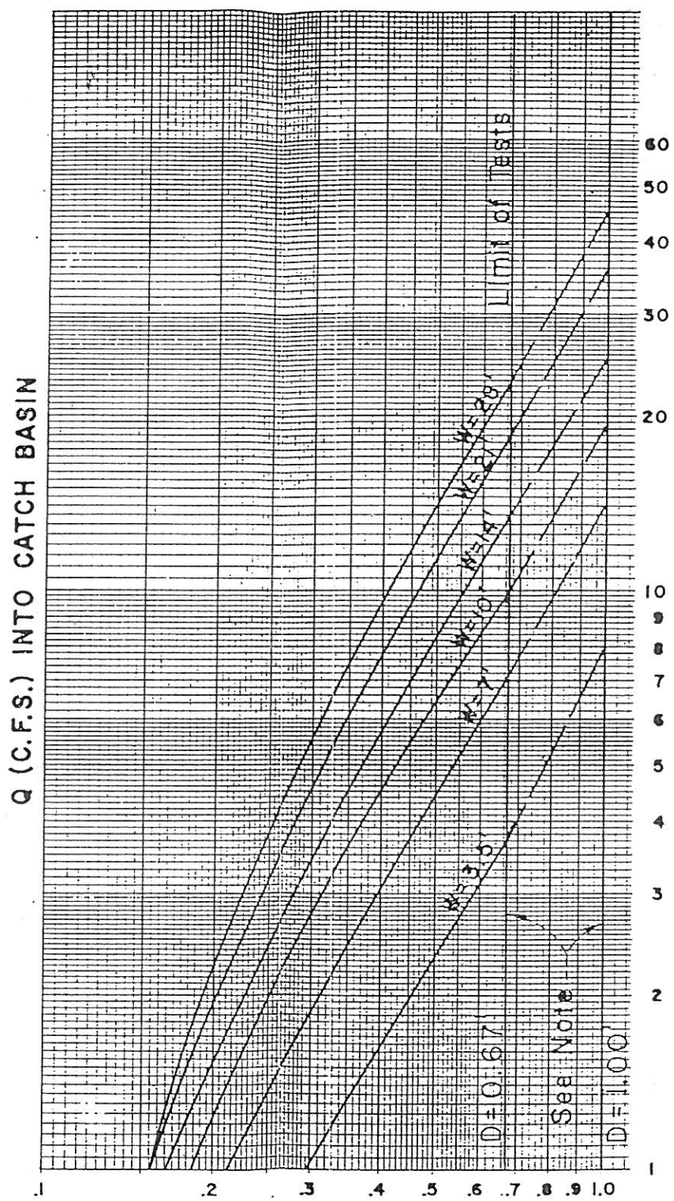
DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.15	0.0	0.190	0.087	
0.20	0.15	0.6	0.213	0.077	
0.21	0.17	1.1	0.241	0.073	
0.22	0.19	1.7	0.275	0.071	
0.23	0.21	2.2	0.314	0.071	
0.24	0.25	2.8	0.359	0.072	
0.25	0.28	3.3	0.410	0.073	
0.26	0.33	3.9	0.466	0.076	
0.27	0.38	4.4	0.528	0.079	
0.28	0.44	5.0	0.595	0.082	
0.29	0.51	5.6	0.668	0.085	
0.30	0.59	6.1	0.746	0.089	
0.31	0.67	6.7	0.830	0.092	
0.32	0.77	7.2	0.919	0.096	
0.33	0.87	7.8	1.014	0.100	
0.34	0.98	8.3	1.115	0.104	
0.35	1.10	8.9	1.221	0.109	
0.36	1.23	9.4	1.333	0.113	
0.37	1.38	10.0	1.450	0.117	
0.38	1.53	10.6	1.573	0.122	
0.39	1.69	11.1	1.701	0.126	
0.40	1.87	11.7	1.835	0.130	
0.41	2.06	12.2	1.974	0.135	
0.42	2.26	12.8	2.119	0.139	
0.43	2.47	13.3	2.270	0.144	
0.44	2.70	13.9	2.426	0.149	
0.45	2.93	14.4	2.588	0.153	
0.46	3.19	15.0	2.755	0.158	
0.47	3.45	15.6	2.928	0.162	
0.48	3.73	16.1	3.106	0.167	
0.49	4.03	16.7	3.290	0.172	
0.50	4.33	17.2	3.479	0.176	
0.51	4.66	17.8	3.674	0.181	
0.52	5.00	18.3	3.875	0.186	
0.53	5.35	18.9	4.081	0.191	
0.54	5.72	19.4	4.293	0.195	
0.55	6.11	20.0	4.510	0.200	
0.56	6.51	20.6	4.733	0.205	
0.57	6.93	21.1	4.961	0.209	
0.58	7.37	21.7	5.195	0.214	
0.59	7.82	22.2	5.434	0.219	
0.60	8.29	22.8	5.679	0.224	
0.61	8.78	23.3	5.930	0.229	
0.62	9.29	23.9	6.186	0.233	
0.63	9.81	24.4	6.448	0.238	
0.64	10.36	25.0	6.715	0.243	
0.65	10.92	25.6	6.988	0.248	
0.66	11.50	26.1	7.266	0.253	
0.67	12.10	26.7	7.550	0.257	FLOW AT T.C.

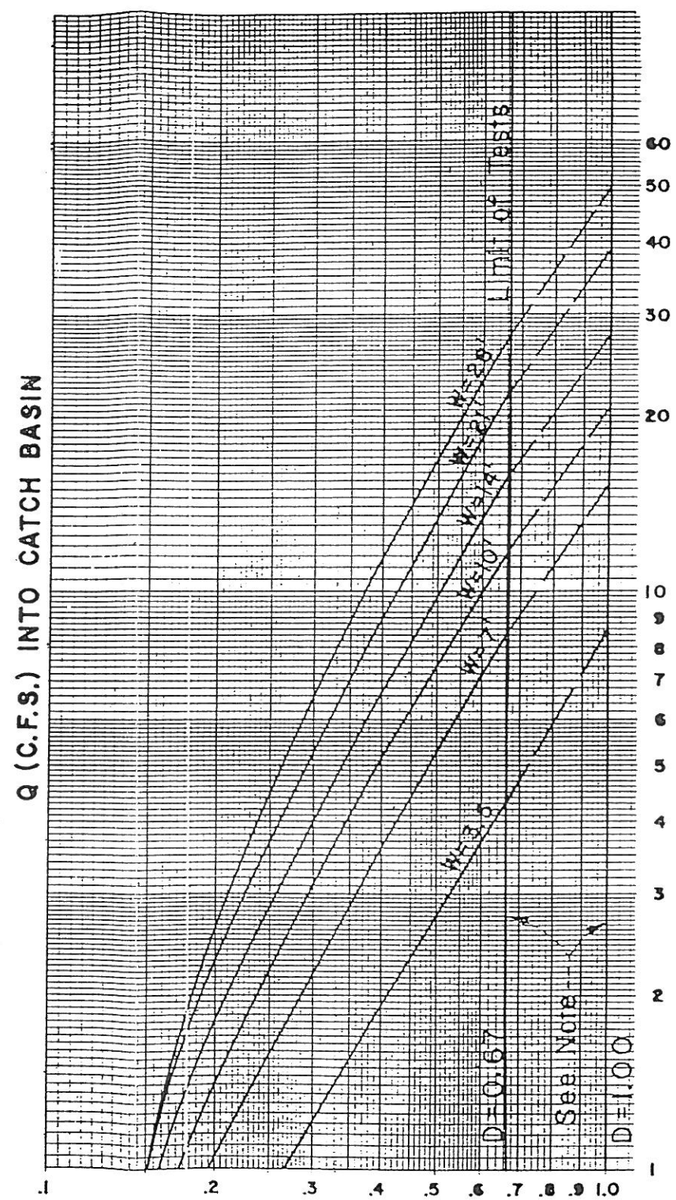
STREET CAPACITY CHART - FRANCIS STREET

CURB HEIGHT = 8" X-SLOPE = 1.8% (AVERAGE)
GUTTER WIDTH = 2.0' STREET GRADE = 0.16%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	12.59	27.2	7.842	0.258	
0.69	13.11	27.8	8.144	0.259	
0.70	13.65	28.3	8.458	0.260	
0.71	14.23	28.9	8.781	0.262	
0.72	14.83	29.4	9.115	0.263	
0.73	15.47	30.0	9.460	0.265	
0.74	16.13	30.6	9.815	0.267	
0.75	16.82	31.1	10.181	0.269	
0.76	17.55	31.7	10.558	0.272	
0.77	18.30	32.2	10.944	0.274	
0.78	19.09	32.8	11.342	0.277	
0.79	19.91	33.3	11.750	0.280	
0.80	20.76	33.9	12.169	0.283	FLOW AT CROWN
0.81	21.88	34.0	12.630	0.289	
0.82	22.97	34.0	13.063	0.296	
0.83	24.08	34.0	13.500	0.302	
0.84	25.22	34.0	13.943	0.309	
0.85	26.39	34.0	14.390	0.315	
0.86	27.59	34.0	14.843	0.321	
0.87	28.82	34.0	15.300	0.328	
0.88	30.07	34.0	15.763	0.334	
0.89	31.35	34.0	16.230	0.340	
0.90	32.66	34.0	16.703	0.347	
0.91	33.99	34.0	17.180	0.353	



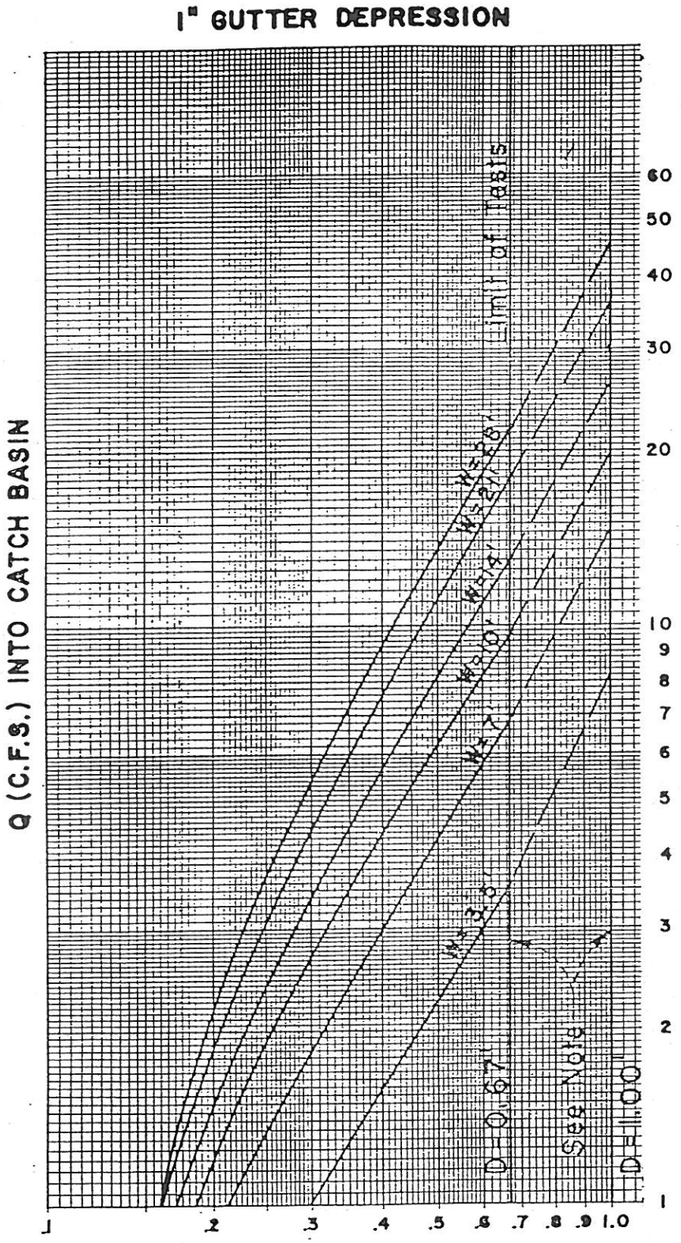


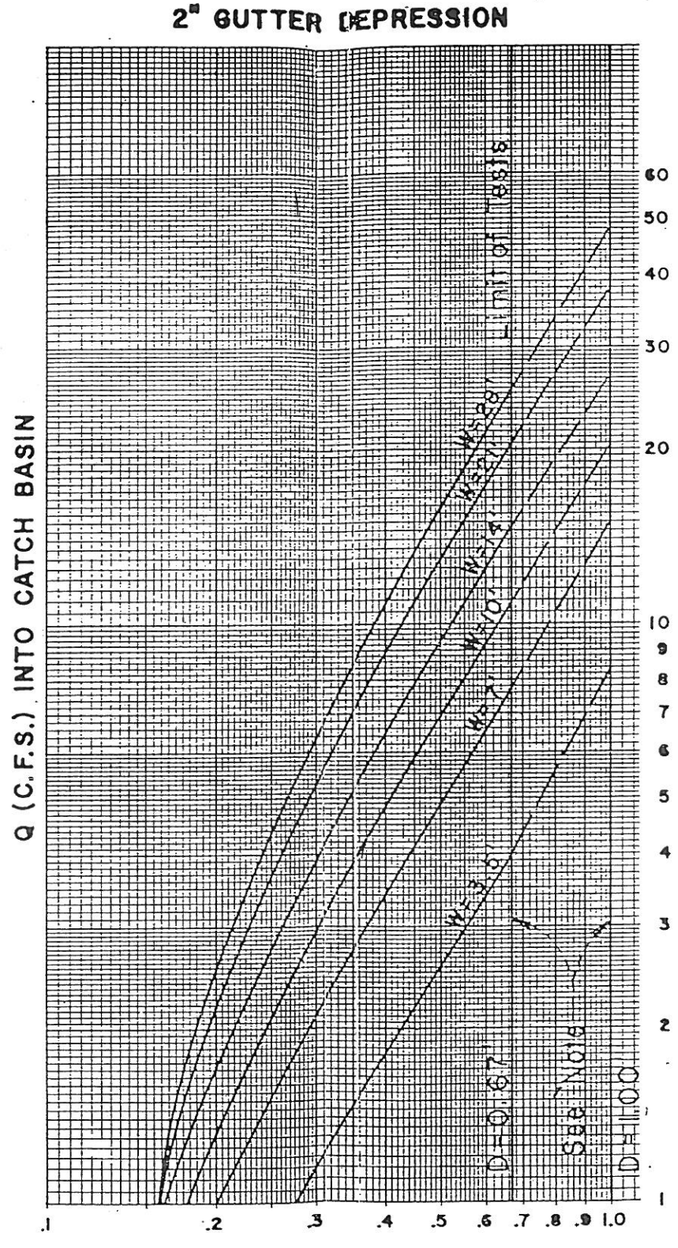


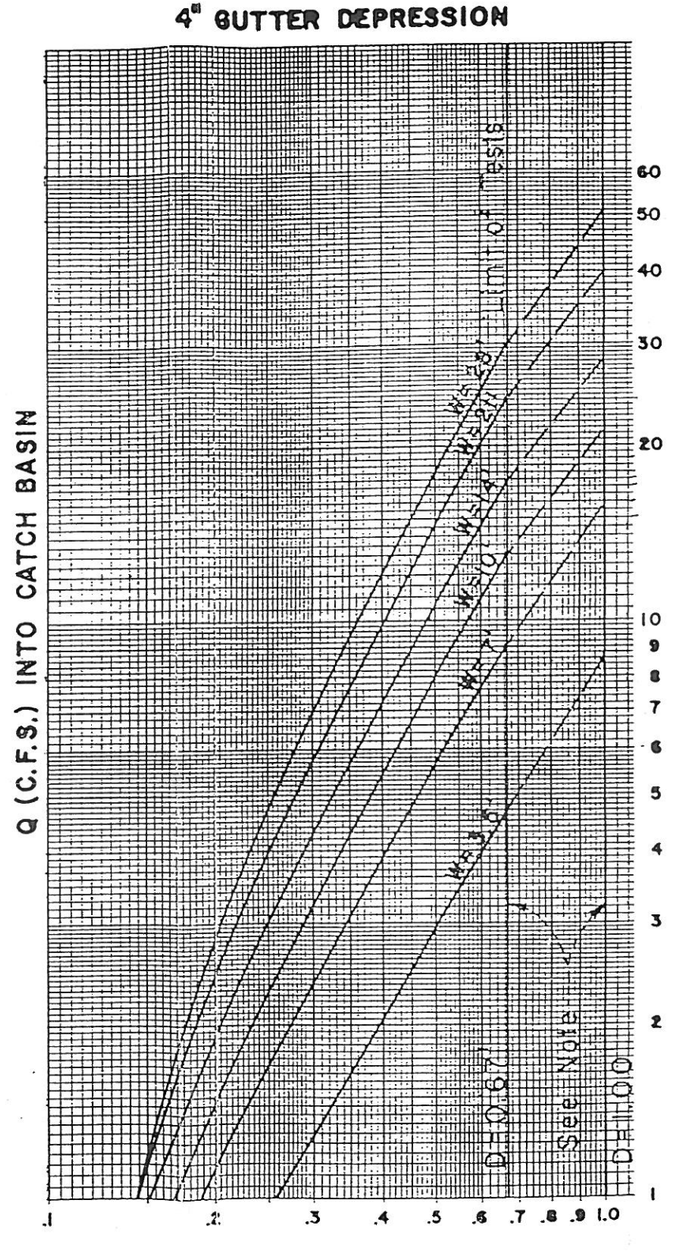
NOTE: Curves between D=0.67' and 1.0' are not from model test data and will be revised in the future when additional model test data are available.

CURB OPENING CATCH BASIN CAPACITIES

STREET SLOPE = .005



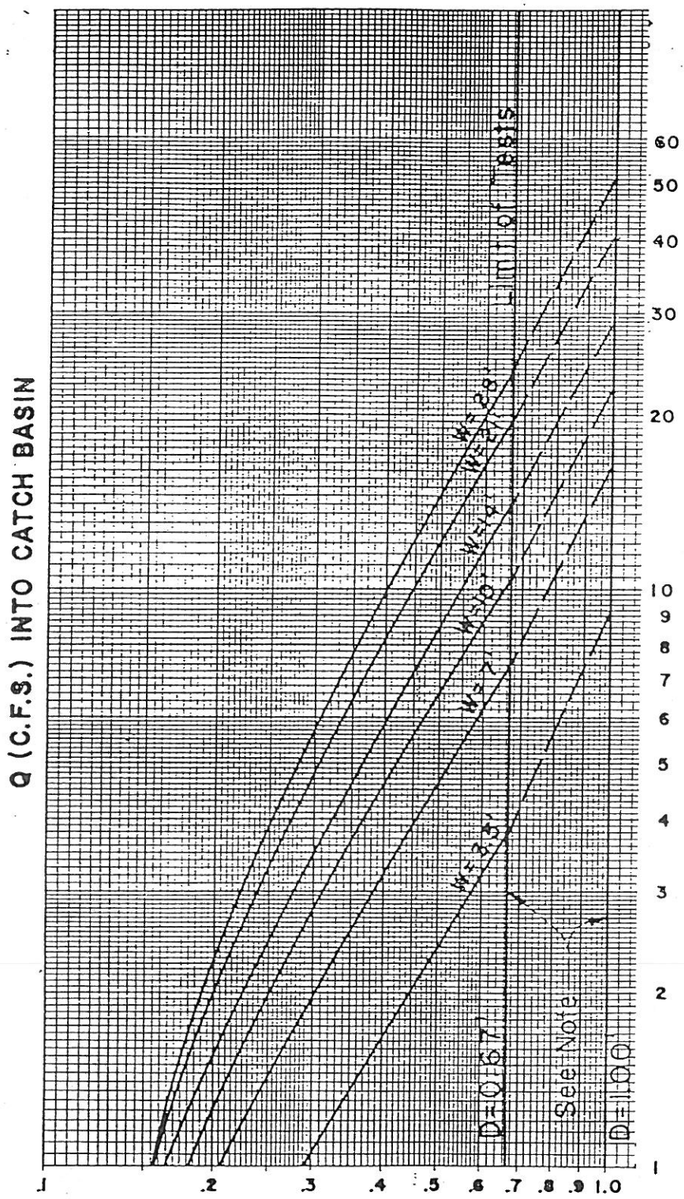


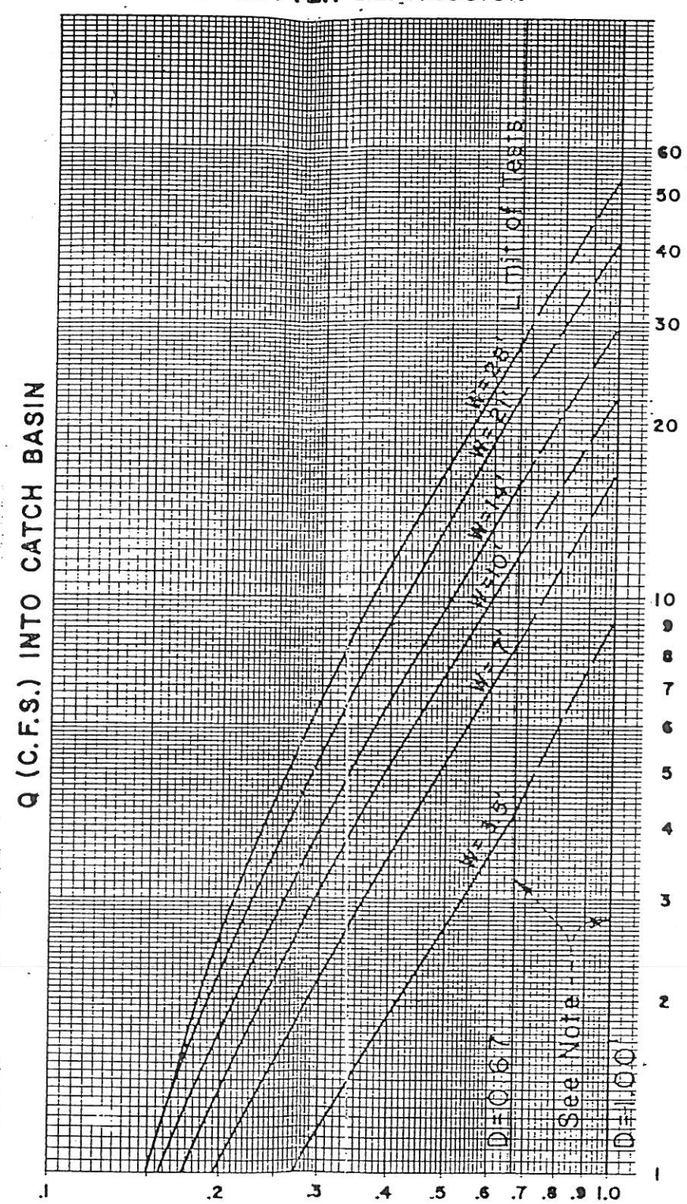


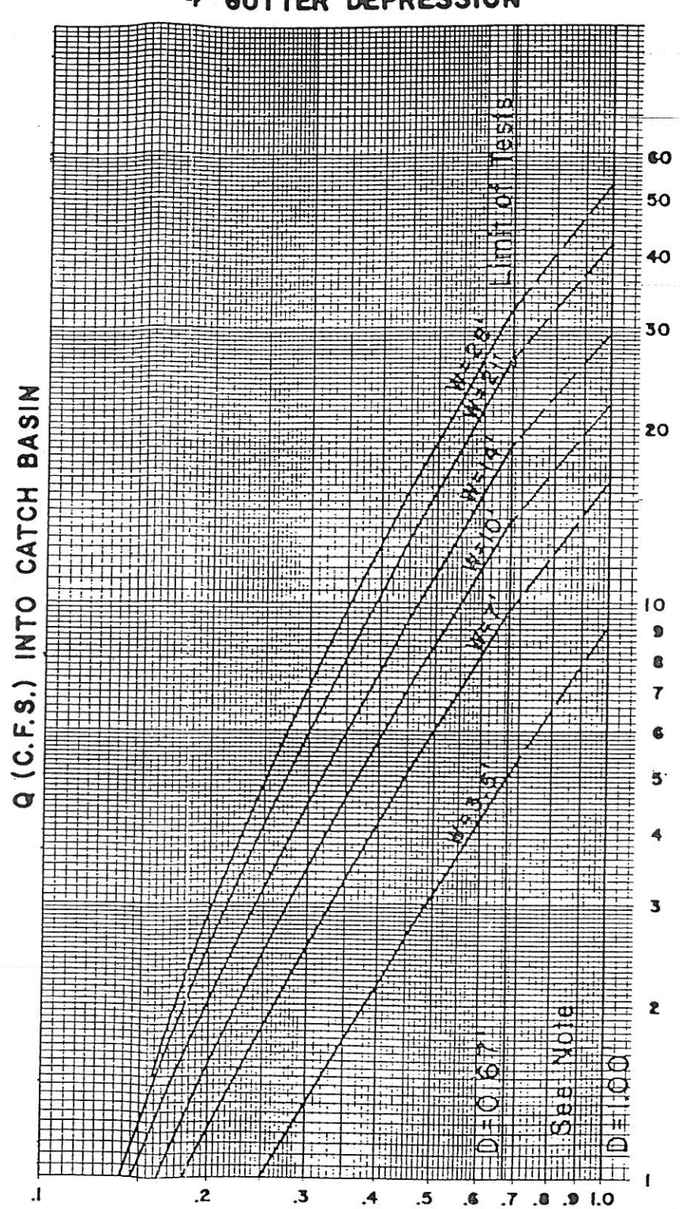
NOTE: Curves between D= 0.67' and 1.0' are not from model test data and will be revised in the future when additional model test data are available.

CURB OPENING CATCH BASIN CAPACITIES

STREET SLOPE = .01





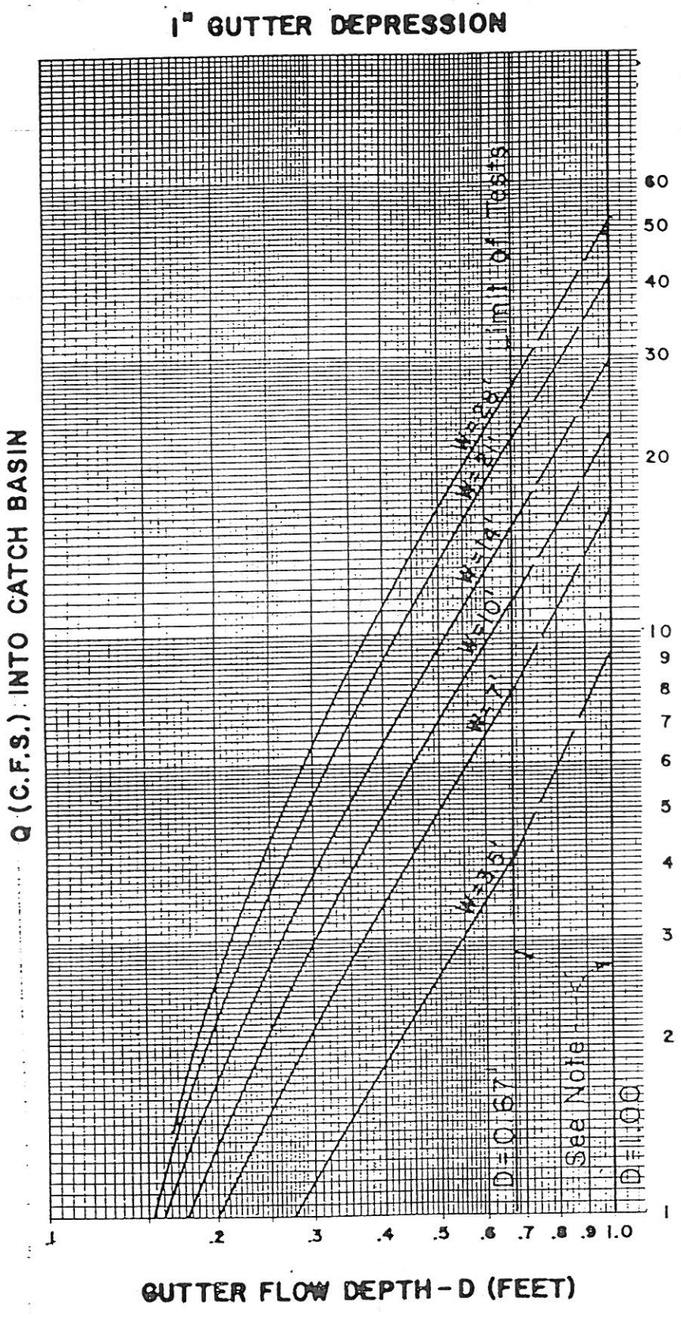


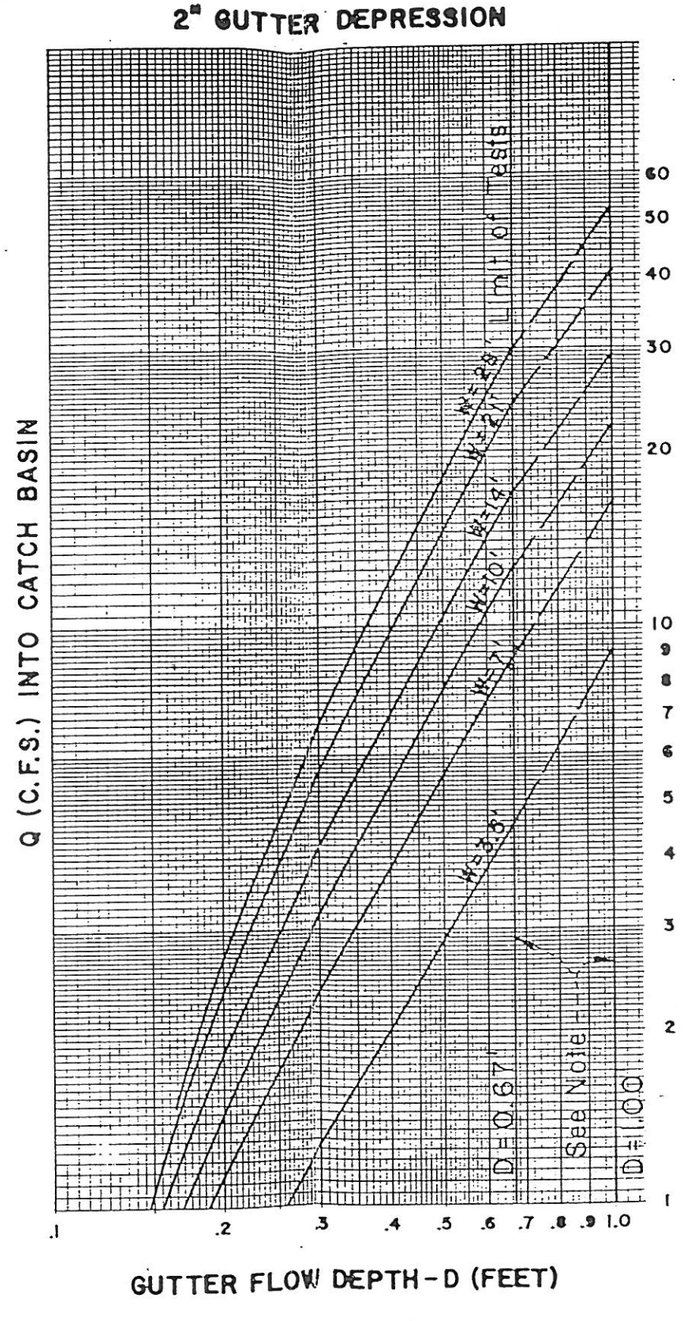
NOTE: Curves between D=0.67' and 1.0' are not from model test data and will be revised in the future when additional model test data are available.

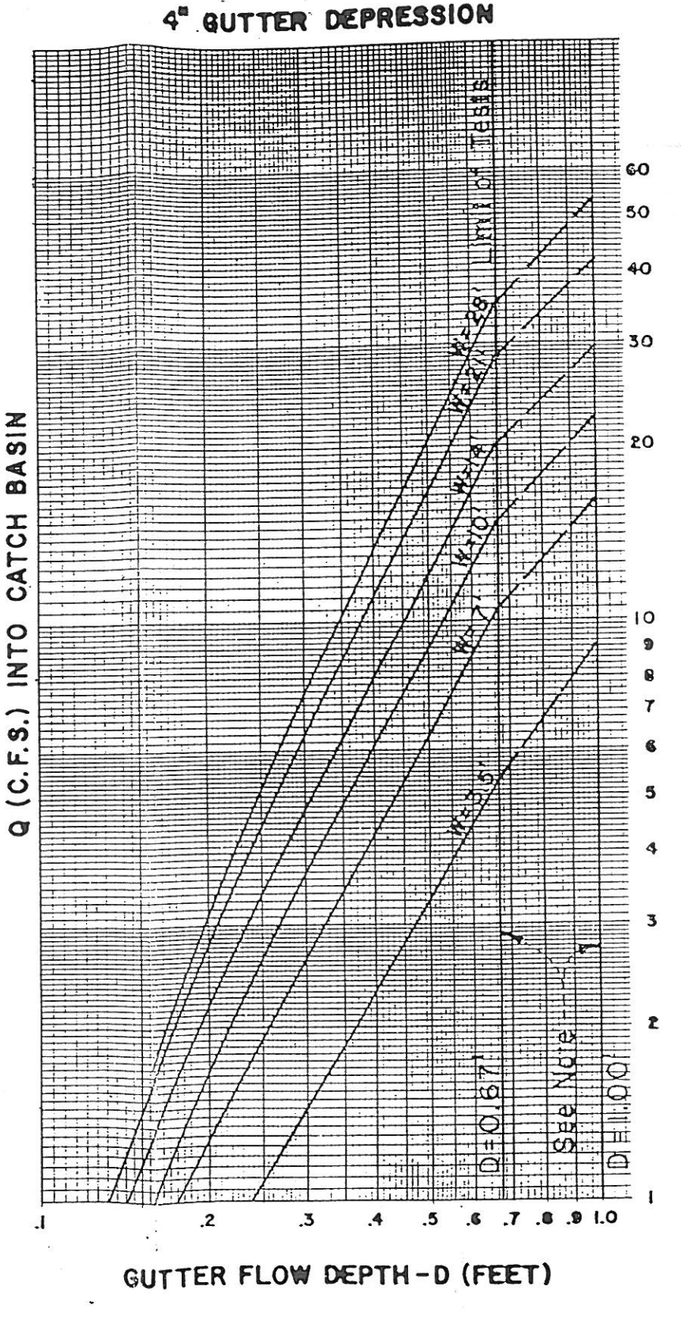
CURB OPENING CATCH BASIN CAPACITIES

STREET SLOPE = .03

D-10C



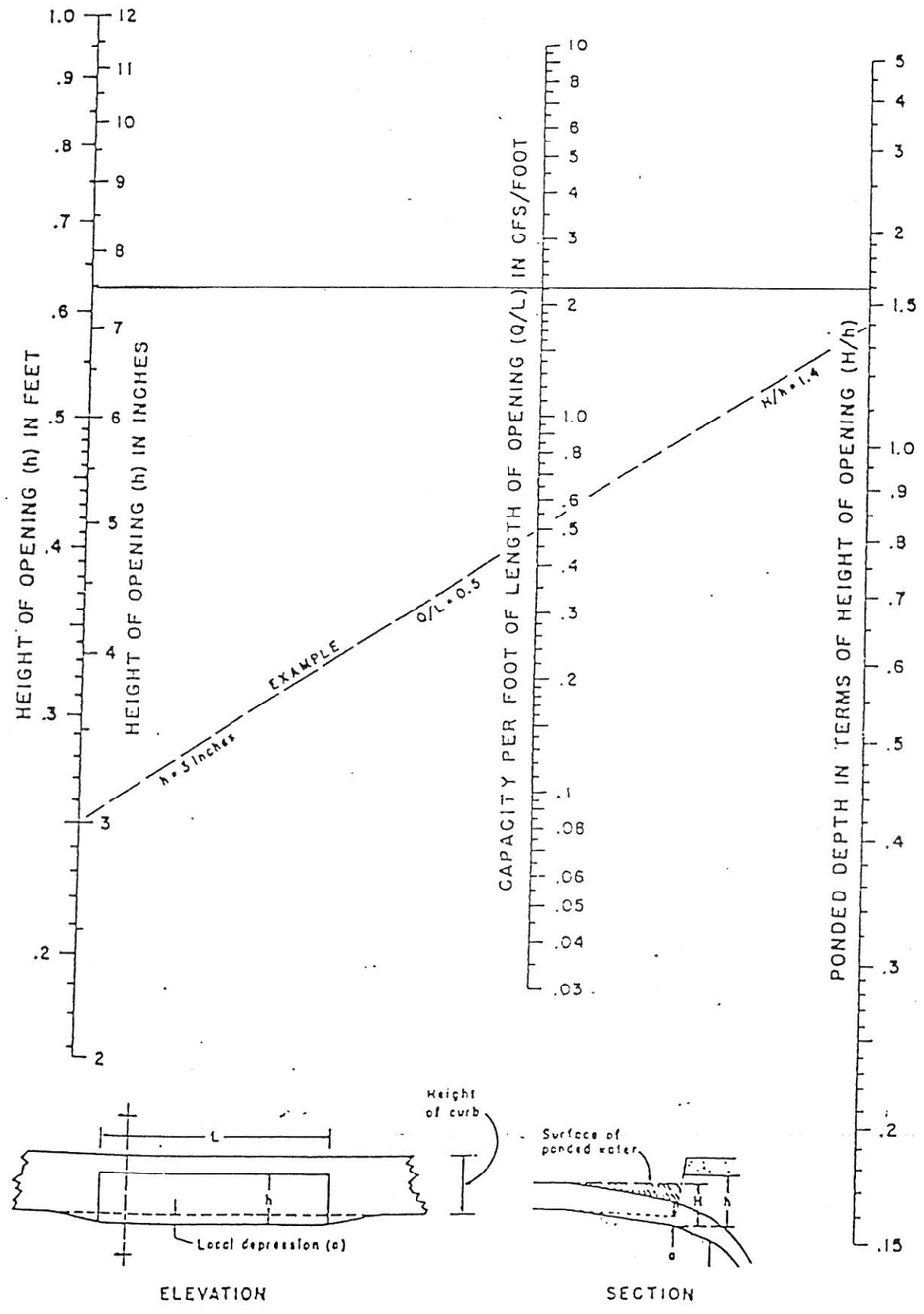




NOTE: Curves between D= 0.67' and 1.0' are not from model test data and will be revised in the future when additional model test data are available.

CURB OPENING CATCH BASIN CAPACITIES

STREET SLOPE = .05 D-10D



NOMOGRAM - CAPACITY, CURB INLET AT SAG

Plate 2.6-0651
(L.A.C.R.D.)

SECTION 5

GROVE AVENUE

The analysis of Grove Avenue is complex in that there is an existing storm drain from Francis Street to Mission Boulevard with multiple catch basins. The drainage areas and nodes shown on the hydrology map (Exhibit "A") assume all flow on Grove is surface flow and does not distinguish how much each side of the street carries. This was done solely to obtain a Q at the intersection of Francis and Grove in determining the overall Q of the entire drainage basin.

The existing facility was installed in 1989, but its upper reach (north of Locust) was only designed for a Q_{10}. Both the pipe and the inlets are undersized for a Q_{100} storm. It is therefore necessary to evaluate the existing system with a Q_{100} storm to determine the amount of interception and by-pass at each inlet and ultimately the total amount of by-pass or extra flow at the intersection of Francis and Grove. An additional catch basin will be installed to intercept this extra flow. Since Grove Avenue is 94' wide curb to curb, the elevation at the crown is much higher than at the right of way, which means that flow does not spill over from one side to the other. Each side of Grove had to be evaluated independently to see how much extra flow each side produces. That way the location, number, and size of the new catch basins will intercept 100% of the remaining runoff.

The initial west and east areas enter the storm drain via four inlets (as shown on the Grove Avenue Grade Separation plans); two just north of Mission Boulevard and two in the sump of the future underpass. Therefore, the upstream end of the storm drain system already has roughly 26 cfs which severely limits the amount of runoff which can enter the existing 30" pipe between Mission and Locust. At each subsequent downstream inlet, there is a maximum allowable Q that can be added to the pipe due to the hydraulic grade line of the main and the size of the lateral. This Q is usually less than the capacity of the inlet, therefore, some flow-by or by-pass will result. At points in the street where there is an inlet on both sides of the street and pipe capacity is near its limit, the allowable amount entering the pipe from each inlet was estimated by comparing the length of each inlet and the amount of runoff approaching each inlet. The amount of runoff remaining on the street accumulates as the pipe is flowing at maximum capacity and by the time it reaches Francis , there is too much for those last catch basins and laterals to handle, even though the 66" main line at this location could handle it.

Two hydraulic analyses were performed in conjunction with the catch basin design to determine allowable catch basin interceptions and maximum pipe capacity. The first analysis was for the purpose of analyzing the existing storm drain system to determine the remaining runoff at the intersection. The other analysis included the new catch basin and incorporated the connection of the existing 66" to the new storm drain. An exhibit is included in this Section which schematically shows the results of the second analysis. Q's for each side of the street were determined from the respective area ratio.

Street capacity charts showing depth vs. flow for Grove Avenue are included in this Section. The catch basin sizing tables can be found in Section 4. Also included, for reference, is the catch basin design diagram for the existing catch basins.

Grove Avenue (Existing Line VII-5b)
Existing Catch Basin Analysis
West Side

@ node 402 (Grove/Belmont), Q_{100} = 66% of 35 cfs = 23 cfs
From street capacity chart, depth of flow (D) = 0.59' for street grade = 1.6%
Existing 7' catch basin on west side
From catch basin capacity tables, Q intercept = 7 cfs
Maximum allowable Q to enter pipe = 7 cfs
Therefore, Q by-pass = 23-7 = 16 cfs

@ node 405 (Grove/Acacia), Q_{100} = 67% of 33 cfs + 50% of 34 cfs + 16 cfs (by-pass) = 55 cfs
From street capacity chart, depth of flow (D) = 0.79' for street grade = 1.4%
Existing 14' catch basin on west side
From catch basin capacity tables, Q intercept = 21 cfs
Maximum allowable Q to enter pipe = 6 cfs
Therefore, Q by-pass = 55-6 = 49 cfs

@ node 406, Q_{100} = 60% of 25 cfs + 49 cfs (by-pass) = 64 cfs
From street capacity chart, depth of flow (D) = 0.82' for street grade = 1.4%
Existing 14' catch basin on west side
From catch basin capacity tables, Q intercept = 22 cfs
Maximum allowable Q to enter pipe = 19 cfs
Therefore, Q by-pass = 64-19 = 45 cfs

@ node 407 (Grove/Locust), Q_{100} = 45% of 34 cfs + 45 cfs (by-pass) = 60 cfs
From street capacity chart, depth of flow (D) = 0.82' for street grade = 1.2%
Existing 14' catch basin on west side
From catch basin capacity tables, Q intercept = 39 cfs
Maximum allowable Q to enter pipe = 13 cfs
Therefore, Q by-pass = 60-13 = 47 cfs

@ node 408, Q_{100} = 7 cfs + 47 cfs (by-pass) = 54 cfs
From street capacity chart, depth of flow (D) = 0.82' for street grade = 1.0%
Existing 21' catch basin on west side
From catch basin capacity tables, Q intercept = 31 cfs
Maximum allowable Q to enter pipe = 31 cfs
Therefore, Q by-pass = 54-31 = 23 cfs

@ node 409 (Grove/Francis), Q_{100} = 35% of 17 cfs + 23 cfs (by-pass) = 29 cfs
From street capacity chart, depth of flow (D) = 0.70' for street grade = 0.92%
Existing 28' catch basin on west side
From catch basin capacity tables, Q intercept = 32 cfs
Maximum allowable Q to enter pipe = 29 cfs
Therefore, Q by-pass = 0 cfs

Grove Avenue (Existing Line VII-5b)
Existing Catch Basin Analysis
East Side

@ node 402 (Grove/Belmont), Q_{100} = 34% of 35 cfs = 12 cfs
From street capacity chart, depth of flow (D) = 0.49' for street grade = 1.6%
Existing 3.5' catch basin on east side
From catch basin capacity tables, Q intercept = 3 cfs
Maximum allowable Q to enter pipe = 3 cfs
Therefore, Q by-pass = 12-3 = 9 cfs

@ node 405 (Grove/Acacia), Q_{100} = 33% of 33 cfs + 50% of 34 cfs + 9 cfs (by-pass) = 37 cfs
From street capacity chart, depth of flow (D) = 0.70' for street grade = 1.4%
Existing 7' catch basin on east side
From catch basin capacity tables, Q intercept = 9 cfs
Maximum allowable Q to enter pipe = 3 cfs
Therefore, Q by-pass = 37-3 = 34 cfs

@ node 407 (Grove/Locust), Q_{100} = 65% of 34 cfs + 34 cfs (by-pass) = 56 cfs
From street capacity chart, depth of flow (D) = 0.81' for street grade = 1.2%
Existing 7' catch basin on east side
From catch basin capacity tables, Q intercept = 12 cfs
Maximum allowable Q to enter pipe = 7 cfs
Therefore, Q by-pass = 56-7 = 49 cfs

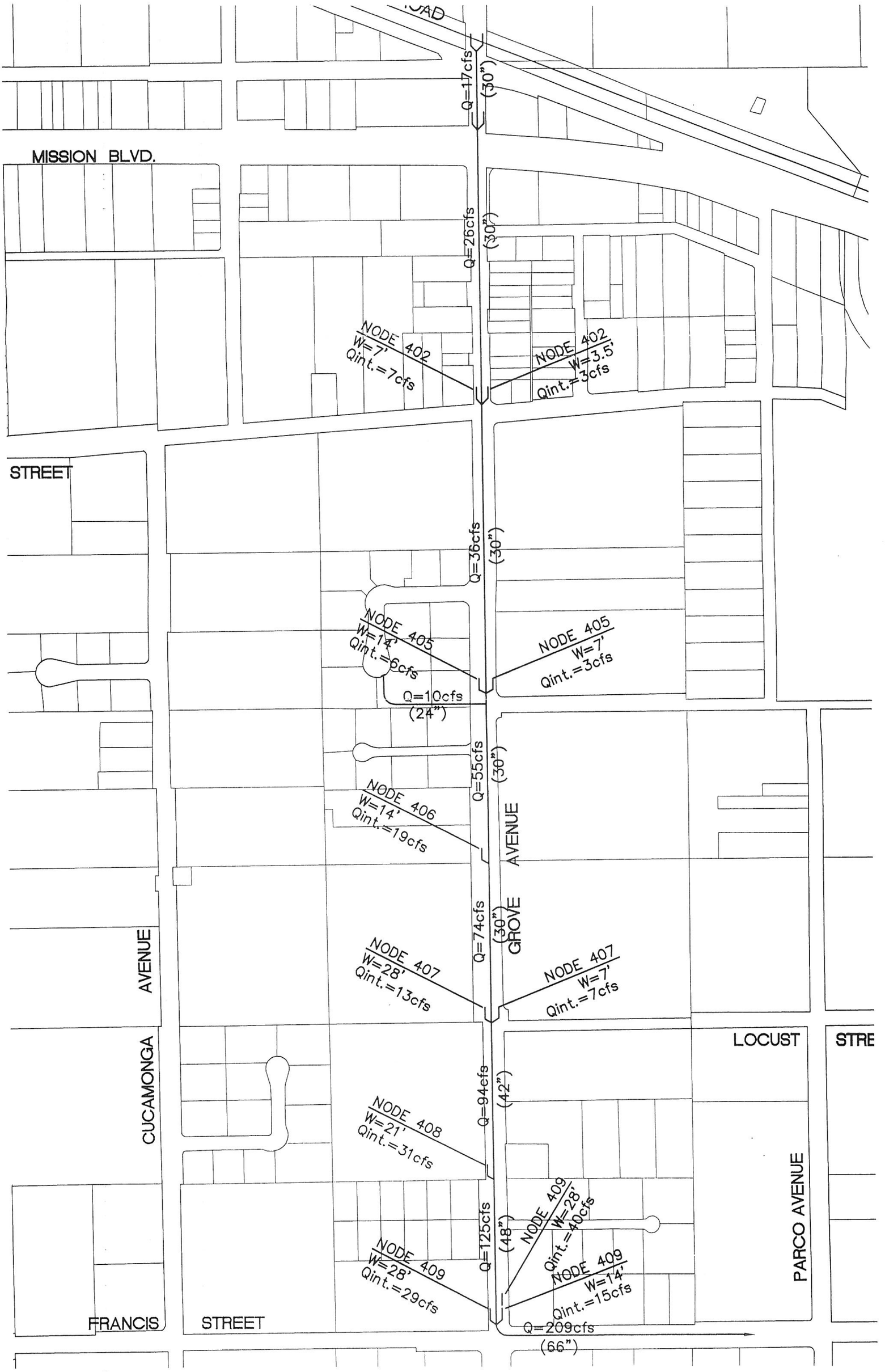
@ node 409 (Grove/Francis), Q_{100} = 65% of 17 cfs + 49 cfs (by-pass) = 60 cfs
From street capacity chart, depth of flow (D) = 0.84' for street grade = 0.92%
Existing 14' catch basin on east side
From catch basin capacity tables, Q intercept = 23 cfs
Maximum allowable Q to enter pipe = 23 cfs
Therefore, Q remaining = 60-23 = 37 cfs

Install new catch basin north of existing 14' catch basin to collect as much runoff as the existing system can handle. Then re-analyze existing 14' catch basin.

NEW CATCH BASIN @ NODE 409 (station 11+54)
Q_{100} = 65% of 17 cfs + 49 cfs (by-pass) = 60 cfs
From street capacity chart, depth of flow (D) = 0.84' for street grade = 0.92%
Assume 28' catch basin on east side
From catch basin capacity tables, Q intercept = 40 cfs
Therefore, Q by-pass = 60-40 = 20 cfs

@ node 409 (Grove/Francis), Q_{100} = 20 cfs
From street capacity chart, depth of flow (D) = 0.62' for street grade = 0.92%
Existing 14' catch basin on east side
From catch basin capacity tables, Q intercept = 15 cfs
Maximum allowable Q to enter pipe = 15 cfs
Therefore, Q by-pass = 20-15 = 5 cfs

Remaining 5 cfs to be picked up by new Francis Street catch basin at station 71+20


MISSION BLVD.
STREET
AVENUE
CUCAMONGA
AVENUE
GROVE
LOCUST
PARCO AVENUE
FRANCIS
STREET
Q=17cfs
(30")
Q=26cfs
(30")
NODE 402
W=7'
Qint.=7cfs
NODE 402
W=3.5'
Qint.=3cfs
Q=36cfs
(30")
NODE 405
W=14'
Qint.=6cfs
NODE 405
W=7'
Qint.=3cfs
Q=10cfs
(24")
Q=55cfs
(30")
NODE 406
W=14'
Qint.=19cfs
Q=74cfs
(30")
NODE 407
W=28'
Qint.=13cfs
NODE 407
W=7'
Qint.=7cfs
Q=94cfs
(42")
NODE 408
W=21'
Qint.=31cfs
Q=125cfs
(48")
NODE 409
W=28'
Qint.=40cfs
NODE 409
W=28'
Qint.=29cfs
NODE 409
W=14'
Qint.=15cfs
Q=209cfs
(66")

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 0.92%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.35	0.0	0.190	0.087	
0.20	0.37	0.5	0.213	0.079	
0.21	0.40	1.0	0.240	0.075	
0.22	0.45	1.5	0.273	0.073	
0.23	0.52	2.0	0.310	0.073	
0.24	0.59	2.5	0.353	0.074	
0.25	0.68	3.0	0.400	0.076	
0.26	0.79	3.5	0.453	0.079	
0.27	0.91	4.0	0.510	0.081	
0.28	1.05	4.5	0.573	0.084	
0.29	1.20	5.0	0.640	0.088	
0.30	1.37	5.5	0.713	0.091	
0.31	1.56	6.0	0.790	0.095	
0.32	1.77	6.5	0.873	0.099	
0.33	2.00	7.0	0.960	0.103	
0.34	2.25	7.5	1.053	0.107	
0.35	2.52	8.0	1.150	0.111	
0.36	2.82	8.5	1.253	0.115	
0.37	3.14	9.0	1.360	0.120	
0.38	3.48	9.5	1.473	0.124	
0.39	3.84	10.0	1.590	0.128	
0.40	4.23	10.5	1.713	0.133	
0.41	4.65	11.0	1.840	0.137	
0.42	5.09	11.5	1.973	0.142	
0.43	5.56	12.0	2.110	0.146	
0.44	6.06	12.5	2.253	0.151	
0.45	6.59	13.0	2.400	0.155	
0.46	7.14	13.5	2.553	0.160	
0.47	7.73	14.0	2.710	0.165	
0.48	8.34	14.5	2.873	0.169	
0.49	8.99	15.0	3.040	0.174	
0.50	9.67	15.5	3.213	0.178	
0.51	10.38	16.0	3.390	0.183	
0.52	11.13	16.5	3.573	0.188	
0.53	11.91	17.0	3.760	0.193	
0.54	12.72	17.5	3.953	0.197	
0.55	13.57	18.0	4.150	0.202	
0.56	14.45	18.5	4.353	0.207	
0.57	15.37	19.0	4.560	0.211	
0.58	16.32	19.5	4.773	0.216	
0.59	17.32	20.0	4.990	0.221	
0.60	18.35	20.5	5.213	0.226	
0.61	19.42	21.0	5.440	0.230	
0.62	20.53	21.5	5.673	0.235	
0.63	21.67	22.0	5.910	0.240	
0.64	22.86	22.5	6.153	0.245	
0.65	24.09	23.0	6.400	0.250	
0.66	25.36	23.5	6.653	0.254	
0.67	26.67	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 0.92%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	27.71	24.5	7.175	0.259	
0.69	28.81	25.0	7.450	0.260	
0.70	29.98	25.5	7.735	0.261	
0.71	31.21	26.0	8.030	0.262	
0.72	32.51	26.5	8.335	0.263	
0.73	33.88	27.0	8.650	0.265	
0.74	35.31	27.5	8.975	0.267	
0.75	36.81	28.0	9.310	0.269	
0.76	38.37	28.5	9.655	0.271	
0.77	40.01	29.0	10.010	0.273	
0.78	41.71	29.5	10.375	0.275	
0.79	43.49	30.0	10.750	0.278	
0.80	46.38	30.5	11.288	0.285	
0.81	49.40	31.0	11.840	0.291	
0.82	52.55	31.5	12.408	0.298	
0.83	55.84	32.0	12.990	0.304	
0.84	59.26	32.5	13.588	0.311	
0.85	62.82	33.0	14.200	0.318	
0.86	66.53	33.5	14.828	0.325	
0.87	70.38	34.0	15.470	0.331	
0.88	74.38	34.5	16.128	0.338	
0.89	78.53	35.0	16.800	0.345	
0.90	82.82	35.5	17.488	0.352	
0.91	87.28	36.0	18.190	0.359	
0.92	91.88	36.5	18.908	0.366	
0.93	96.65	37.0	19.640	0.373	FLOW AT R/W

note: street crown is higher than r/w.
curb to curb width = 94'

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.00%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.37	0.0	0.190	0.087	
0.20	0.39	0.5	0.213	0.079	
0.21	0.42	1.0	0.240	0.075	
0.22	0.47	1.5	0.273	0.073	
0.23	0.54	2.0	0.310	0.073	
0.24	0.62	2.5	0.353	0.074	
0.25	0.71	3.0	0.400	0.076	
0.26	0.82	3.5	0.453	0.079	
0.27	0.95	4.0	0.510	0.081	
0.28	1.09	4.5	0.573	0.084	
0.29	1.25	5.0	0.640	0.088	
0.30	1.43	5.5	0.713	0.091	
0.31	1.63	6.0	0.790	0.095	
0.32	1.85	6.5	0.873	0.099	
0.33	2.09	7.0	0.960	0.103	
0.34	2.35	7.5	1.053	0.107	
0.35	2.63	8.0	1.150	0.111	
0.36	2.94	8.5	1.253	0.115	
0.37	3.27	9.0	1.360	0.120	
0.38	3.62	9.5	1.473	0.124	
0.39	4.00	10.0	1.590	0.128	
0.40	4.41	10.5	1.713	0.133	
0.41	4.85	11.0	1.840	0.137	
0.42	5.31	11.5	1.973	0.142	
0.43	5.80	12.0	2.110	0.146	
0.44	6.32	12.5	2.253	0.151	
0.45	6.87	13.0	2.400	0.155	
0.46	7.45	13.5	2.553	0.160	
0.47	8.06	14.0	2.710	0.165	
0.48	8.70	14.5	2.873	0.169	
0.49	9.37	15.0	3.040	0.174	
0.50	10.08	15.5	3.213	0.178	
0.51	10.82	16.0	3.390	0.183	
0.52	11.60	16.5	3.573	0.188	
0.53	12.41	17.0	3.760	0.193	
0.54	13.26	17.5	3.953	0.197	
0.55	14.14	18.0	4.150	0.202	
0.56	15.06	18.5	4.353	0.207	
0.57	16.02	19.0	4.560	0.211	
0.58	17.02	19.5	4.773	0.216	
0.59	18.06	20.0	4.990	0.221	
0.60	19.13	20.5	5.213	0.226	
0.61	20.24	21.0	5.440	0.230	
0.62	21.40	21.5	5.673	0.235	
0.63	22.60	22.0	5.910	0.240	
0.64	23.84	22.5	6.153	0.245	
0.65	25.12	23.0	6.400	0.250	
0.66	26.44	23.5	6.653	0.254	
0.67	27.81	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = ~~0.92%~~ 1.00%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	28.89	24.5	7.175	0.259	
0.69	30.04	25.0	7.450	0.260	
0.70	31.26	25.5	7.735	0.261	
0.71	32.54	26.0	8.030	0.262	
0.72	33.90	26.5	8.335	0.263	
0.73	35.32	27.0	8.650	0.265	
0.74	36.81	27.5	8.975	0.267	
0.75	38.37	28.0	9.310	0.269	
0.76	40.01	28.5	9.655	0.271	
0.77	41.71	29.0	10.010	0.273	
0.78	43.49	29.5	10.375	0.275	
0.79	45.34	30.0	10.750	0.278	
0.80	48.35	30.5	11.288	0.285	
0.81	51.50	31.0	11.840	0.291	
0.82	54.79	31.5	12.408	0.298	
0.83	58.21	32.0	12.990	0.304	
0.84	61.78	32.5	13.588	0.311	
0.85	65.50	33.0	14.200	0.318	
0.86	69.36	33.5	14.828	0.325	
0.87	73.38	34.0	15.470	0.331	
0.88	77.54	34.5	16.128	0.338	
0.89	81.87	35.0	16.800	0.345	
0.90	86.35	35.5	17.488	0.352	
0.91	90.99	36.0	18.190	0.359	
0.92	95.80	36.5	18.908	0.366	
0.93	100.77	37.0	19.640	0.373	FLOW AT R/W

note: street crown is higher than r/w.
curb to curb width = 94'

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.20%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.40	0.0	0.190	0.087	
0.20	0.42	0.5	0.213	0.079	
0.21	0.46	1.0	0.240	0.075	
0.22	0.52	1.5	0.273	0.073	
0.23	0.59	2.0	0.310	0.073	
0.24	0.68	2.5	0.353	0.074	
0.25	0.78	3.0	0.400	0.076	
0.26	0.90	3.5	0.453	0.079	
0.27	1.04	4.0	0.510	0.081	
0.28	1.19	4.5	0.573	0.084	
0.29	1.37	5.0	0.640	0.088	
0.30	1.57	5.5	0.713	0.091	
0.31	1.78	6.0	0.790	0.095	
0.32	2.02	6.5	0.873	0.099	
0.33	2.29	7.0	0.960	0.103	
0.34	2.57	7.5	1.053	0.107	
0.35	2.88	8.0	1.150	0.111	
0.36	3.22	8.5	1.253	0.115	
0.37	3.58	9.0	1.360	0.120	
0.38	3.97	9.5	1.473	0.124	
0.39	4.39	10.0	1.590	0.128	
0.40	4.83	10.5	1.713	0.133	
0.41	5.31	11.0	1.840	0.137	
0.42	5.81	11.5	1.973	0.142	
0.43	6.35	12.0	2.110	0.146	
0.44	6.92	12.5	2.253	0.151	
0.45	7.52	13.0	2.400	0.155	
0.46	8.16	13.5	2.553	0.160	
0.47	8.83	14.0	2.710	0.165	
0.48	9.53	14.5	2.873	0.169	
0.49	10.27	15.0	3.040	0.174	
0.50	11.04	15.5	3.213	0.178	
0.51	11.86	16.0	3.390	0.183	
0.52	12.71	16.5	3.573	0.188	
0.53	13.60	17.0	3.760	0.193	
0.54	14.53	17.5	3.953	0.197	
0.55	15.49	18.0	4.150	0.202	
0.56	16.50	18.5	4.353	0.207	
0.57	17.55	19.0	4.560	0.211	
0.58	18.64	19.5	4.773	0.216	
0.59	19.78	20.0	4.990	0.221	
0.60	20.96	20.5	5.213	0.226	
0.61	22.18	21.0	5.440	0.230	
0.62	23.44	21.5	5.673	0.235	
0.63	24.75	22.0	5.910	0.240	
0.64	26.11	22.5	6.153	0.245	
0.65	27.51	23.0	6.400	0.250	
0.66	28.96	23.5	6.653	0.254	
0.67	30.46	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = ~~0.92%~~ 1.20%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	31.65	24.5	7.175	0.259	
0.69	32.91	25.0	7.450	0.260	
0.70	34.24	25.5	7.735	0.261	
0.71	35.65	26.0	8.030	0.262	
0.72	37.13	26.5	8.335	0.263	
0.73	38.69	27.0	8.650	0.265	
0.74	40.32	27.5	8.975	0.267	
0.75	42.03	28.0	9.310	0.269	
0.76	43.82	28.5	9.655	0.271	
0.77	45.69	29.0	10.010	0.273	
0.78	47.64	29.5	10.375	0.275	
0.79	49.67	30.0	10.750	0.278	
0.80	52.97	30.5	11.288	0.285	
0.81	56.42	31.0	11.840	0.291	
0.82	60.02	31.5	12.408	0.298	
0.83	63.77	32.0	12.990	0.304	
0.84	67.68	32.5	13.588	0.311	
0.85	71.75	33.0	14.200	0.318	
0.86	75.98	33.5	14.828	0.325	
0.87	80.38	34.0	15.470	0.331	
0.88	84.95	34.5	16.128	0.338	
0.89	89.68	35.0	16.800	0.345	
0.90	94.59	35.5	17.488	0.352	
0.91	99.68	36.0	18.190	0.359	
0.92	104.94	36.5	18.908	0.366	
0.93	110.38	37.0	19.640	0.373	FLOW AT R/W

note: street crown is higher than r/w.
curb to curb width = 94'

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8"
GUTTER WIDTH = 2.0'
GUTTER HIKEUP = 0.19'

X-SLOPE = 2.0%
STREET GRADE = 1.40%
MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD, RAD.	REMARKS
0.19	0.44	0.0	0.190	0.087	
0.20	0.46	0.5	0.213	0.079	
0.21	0.50	1.0	0.240	0.075	
0.22	0.56	1.5	0.273	0.073	
0.23	0.64	2.0	0.310	0.073	
0.24	0.73	2.5	0.353	0.074	
0.25	0.84	3.0	0.400	0.076	
0.26	0.97	3.5	0.453	0.079	
0.27	1.12	4.0	0.510	0.081	
0.28	1.29	4.5	0.573	0.084	
0.29	1.48	5.0	0.640	0.088	
0.30	1.69	5.5	0.713	0.091	
0.31	1.93	6.0	0.790	0.095	
0.32	2.19	6.5	0.873	0.099	
0.33	2.47	7.0	0.960	0.103	
0.34	2.78	7.5	1.053	0.107	
0.35	3.11	8.0	1.150	0.111	
0.36	3.48	8.5	1.253	0.115	
0.37	3.87	9.0	1.360	0.120	
0.38	4.29	9.5	1.473	0.124	
0.39	4.74	10.0	1.590	0.128	
0.40	5.22	10.5	1.713	0.133	
0.41	5.73	11.0	1.840	0.137	
0.42	6.28	11.5	1.973	0.142	
0.43	6.86	12.0	2.110	0.146	
0.44	7.47	12.5	2.253	0.151	
0.45	8.12	13.0	2.400	0.155	
0.46	8.81	13.5	2.553	0.160	
0.47	9.53	14.0	2.710	0.165	
0.48	10.29	14.5	2.873	0.169	
0.49	11.09	15.0	3.040	0.174	
0.50	11.93	15.5	3.213	0.178	
0.51	12.81	16.0	3.390	0.183	
0.52	13.73	16.5	3.573	0.188	
0.53	14.69	17.0	3.760	0.193	
0.54	15.69	17.5	3.953	0.197	
0.55	16.74	18.0	4.150	0.202	
0.56	17.82	18.5	4.353	0.207	
0.57	18.96	19.0	4.560	0.211	
0.58	20.14	19.5	4.773	0.216	
0.59	21.36	20.0	4.990	0.221	
0.60	22.63	20.5	5.213	0.226	
0.61	23.95	21.0	5.440	0.230	
0.62	25.32	21.5	5.673	0.235	
0.63	26.74	22.0	5.910	0.240	
0.64	28.20	22.5	6.153	0.245	
0.65	29.72	23.0	6.400	0.250	
0.66	31.29	23.5	6.653	0.254	
0.67	32.90	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8"
GUTTER WIDTH = 2.0'
GUTTER HIKEUP = 0.19'

X-SLOPE = 2.0%
STREET GRADE = ~~0.92%~~ 1.40%
MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	34.18	24.5	7.175	0.259	
0.69	35.54	25.0	7.450	0.260	
0.70	36.98	25.5	7.735	0.261	
0.71	38.50	26.0	8.030	0.262	
0.72	40.11	26.5	8.335	0.263	
0.73	41.79	27.0	8.650	0.265	
0.74	43.55	27.5	8.975	0.267	
0.75	45.40	28.0	9.310	0.269	
0.76	47.34	28.5	9.655	0.271	
0.77	49.35	29.0	10.010	0.273	
0.78	51.46	29.5	10.375	0.275	
0.79	53.65	30.0	10.750	0.278	
0.80	57.21	30.5	11.288	0.285	
0.81	60.94	31.0	11.840	0.291	
0.82	64.82	31.5	12.408	0.298	
0.83	68.88	32.0	12.990	0.304	
0.84	73.10	32.5	13.588	0.311	
0.85	77.50	33.0	14.200	0.318	
0.86	82.07	33.5	14.828	0.325	
0.87	86.82	34.0	15.470	0.331	
0.88	91.75	34.5	16.128	0.338	
0.89	96.87	35.0	16.800	0.345	
0.90	102.17	35.5	17.488	0.352	
0.91	107.66	36.0	18.190	0.359	
0.92	113.35	36.5	18.908	0.366	
0.93	119.23	37.0	19.640	0.373	FLOW AT R/W

note: street crown is higher than r/w.
curb to curb width = 94'

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.60%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.47	0.0	0.190	0.087	
0.20	0.49	0.5	0.213	0.079	
0.21	0.53	1.0	0.240	0.075	
0.22	0.60	1.5	0.273	0.073	
0.23	0.68	2.0	0.310	0.073	
0.24	0.78	2.5	0.353	0.074	
0.25	0.90	3.0	0.400	0.076	
0.26	1.04	3.5	0.453	0.079	
0.27	1.20	4.0	0.510	0.081	
0.28	1.38	4.5	0.573	0.084	
0.29	1.58	5.0	0.640	0.088	
0.30	1.81	5.5	0.713	0.091	
0.31	2.06	6.0	0.790	0.095	
0.32	2.34	6.5	0.873	0.099	
0.33	2.64	7.0	0.960	0.103	
0.34	2.97	7.5	1.053	0.107	
0.35	3.33	8.0	1.150	0.111	
0.36	3.72	8.5	1.253	0.115	
0.37	4.13	9.0	1.360	0.120	
0.38	4.58	9.5	1.473	0.124	
0.39	5.07	10.0	1.590	0.128	
0.40	5.58	10.5	1.713	0.133	
0.41	6.13	11.0	1.840	0.137	
0.42	6.71	11.5	1.973	0.142	
0.43	7.33	12.0	2.110	0.146	
0.44	7.99	12.5	2.253	0.151	
0.45	8.69	13.0	2.400	0.155	
0.46	9.42	13.5	2.553	0.160	
0.47	10.19	14.0	2.710	0.165	
0.48	11.00	14.5	2.873	0.169	
0.49	11.86	15.0	3.040	0.174	
0.50	12.75	15.5	3.213	0.178	
0.51	13.69	16.0	3.390	0.183	
0.52	14.67	16.5	3.573	0.188	
0.53	15.70	17.0	3.760	0.193	
0.54	16.77	17.5	3.953	0.197	
0.55	17.89	18.0	4.150	0.202	
0.56	19.06	18.5	4.353	0.207	
0.57	20.27	19.0	4.560	0.211	
0.58	21.53	19.5	4.773	0.216	
0.59	22.84	20.0	4.990	0.221	
0.60	24.20	20.5	5.213	0.226	
0.61	25.61	21.0	5.440	0.230	
0.62	27.07	21.5	5.673	0.235	
0.63	28.58	22.0	5.910	0.240	
0.64	30.15	22.5	6.153	0.245	
0.65	31.77	23.0	6.400	0.250	
0.66	33.45	23.5	6.653	0.254	
0.67	35.18	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - GROVE AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = ~~0.92%~~ 1.60%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	36.54	24.5	7.175	0.259	
0.69	38.00	25.0	7.450	0.260	
0.70	39.54	25.5	7.735	0.261	
0.71	41.16	26.0	8.030	0.262	
0.72	42.88	26.5	8.335	0.263	
0.73	44.67	27.0	8.650	0.265	
0.74	46.56	27.5	8.975	0.267	
0.75	48.54	28.0	9.310	0.269	
0.76	50.60	28.5	9.655	0.271	
0.77	52.76	29.0	10.010	0.273	
0.78	55.01	29.5	10.375	0.275	
0.79	57.35	30.0	10.750	0.278	
0.80	61.16	30.5	11.288	0.285	
0.81	65.14	31.0	11.840	0.291	
0.82	69.30	31.5	12.408	0.298	
0.83	73.63	32.0	12.990	0.304	
0.84	78.15	32.5	13.588	0.311	
0.85	82.85	33.0	14.200	0.318	
0.86	87.74	33.5	14.828	0.325	
0.87	92.82	34.0	15.470	0.331	
0.88	98.09	34.5	16.128	0.338	
0.89	103.56	35.0	16.800	0.345	
0.90	109.22	35.5	17.488	0.352	
0.91	115.10	36.0	18.190	0.359	
0.92	121.17	36.5	18.908	0.366	
0.93	127.46	37.0	19.640	0.373	FLOW AT R/W

note: street crown is higher than r/w.
curb to curb width = 94'

PROJECT: ~~FRANCIS STREET~~ GROVE AVENUE STORM DRAIN (EXIST. 66")

DESIGNER:

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
8	1						860.25															
2	2	177.0	177.0	29.50	853.80	854.10	0.00	66.	0.	3	0.00	0.00	0.00	1	0	0	0	0.	0.	0.	0.00	0.013
2	3	177.0	177.0	148.96	854.10	854.32	0.00	66.	0.	3	0.00	0.00	0.17	0	0	0	0	0.	0.	0.	4.66	0.013
2	4	177.0	177.0	449.09	854.33	855.00	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	5	177.0	177.0	495.34	855.01	855.75	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	6	177.0	177.0	137.10	855.76	856.03	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	35.00	0.013
2	7	177.0	177.0	80.00	856.10	856.26	0.00	24.	144.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	35.00	0.013
2	8	177.0	177.0	208.24	856.33	856.75	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	9	177.0	177.0	314.10	856.76	857.64	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	25.00	0.013
2	10	177.0	177.0	10.00	857.71	857.74	0.00	36.	84.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	25.00	0.013
2	11	177.0	177.0	121.24	857.81	858.15	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	12	177.0	177.0	501.00	858.16	859.57	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	13	177.0	177.0	82.69	859.58	859.81	0.00	66.	0.	3	0.00	0.00	0.00	0	0	54	0	0.	90.	0.	0.00	0.013
2	14	154.0	154.0	22.95	859.81	859.88	0.00	66.	0.	3	0.00	0.00	0.00	0	0	52	0	0.	30.	0.	9.70	0.013
2	15	125.0	125.0	233.16	860.36	862.88	0.00	48.	0.	3	0.00	0.00	0.00	0	0	50	0	0.	30.	0.	0.00	0.013
2	16	125.0	125.0	260.00	862.88	866.57	0.00	48.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	8.70	0.013
2	17	94.0	94.0	168.18	867.18	874.18	0.00	42.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	18	94.0	94.0	257.37	874.18	875.93	0.00	42.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	19	94.0	94.0	344.54	875.96	878.30	0.00	42.	0.	3	0.00	0.00	0.00	0	0	49	0	0.	90.	0.	0.00	0.013
2	20	87.0	87.0	36.57	878.30	878.55	0.00	42.	0.	3	0.00	0.00	0.00	0	0	47	0	0.	30.	0.	8.50	0.013
2	21	75.0	75.0	389.17	879.27	884.72	0.00	36.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	22	75.0	75.0	179.17	884.79	887.66	0.00	36.	0.	3	0.00	0.00	0.00	0	0	46	0	0.	30.	0.	7.50	0.013
2	23	55.0	55.0	105.67	888.27	889.95	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	24	55.0	55.0	295.34	890.02	894.75	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	25	55.0	55.0	210.29	894.81	897.33	0.00	30.	0.	3	0.00	0.00	0.00	0	0	45	0	0.	30.	0.	0.00	0.013

PROJECT: ~~FRANCIS STREET~~ STORM DRAIN (EXIST. 66")
DESIGNER:

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
2	26	45.0	45.0	79.28	897.33	898.28	0.00	30.	0.	3	0.00	0.00	0.00	0	0	43	44	0.	30.	90.	7.50	0.013
2	27	36.0	36.0	243.59	898.37	901.30	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	28	36.0	36.0	295.34	901.36	905.03	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	29	36.0	36.0	295.34	905.08	907.21	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	30	36.0	36.0	356.53	907.24	911.52	0.00	30.	0.	3	0.00	0.00	0.00	0	0	41	42	0.	30.	30.	7.50	0.013
2	31	26.0	26.0	277.45	911.55	913.33	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	32	26.0	26.0	295.34	913.36	915.25	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	33	26.0	26.0	312.56	915.28	917.28	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	34	26.0	26.0	232.17	917.32	917.95	0.00	30.	0.	3	0.00	0.00	0.00	0	0	39	40	0.	73.	27.	4.66	0.013
2	35	17.0	17.0	200.17	917.97	918.48	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	36	17.0	17.0	208.00	918.50	919.04	0.00	30.	0.	3	0.00	0.00	0.00	0	37	38	0	80.	35.	0.	4.66	0.013
2	37	12.0	12.0	84.00	920.04	920.70	924.70	18.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	38	5.0	5.0	22.00	920.04	920.70	924.70	18.	0.	1	0.00	0.00	0.00	37	0	0	0	0.	0.	0.	0.00	0.013
2	39	5.0	5.0	94.00	918.96	928.98	932.98	18.	0.	1	0.00	0.00	0.00	35	0	0	0	0.	0.	0.	0.00	0.013
2	40	4.0	4.0	28.00	918.96	929.13	933.13	18.	0.	1	0.00	0.00	0.00	35	0	0	0	0.	0.	0.	0.00	0.013
2	41	7.0	7.0	157.00	911.52	915.72	920.22	24.	0.	1	0.00	0.00	0.00	31	0	0	0	0.	0.	0.	0.00	0.013
2	42	3.0	3.0	20.00	912.02	914.24	918.24	18.	0.	1	0.00	0.00	0.00	31	0	0	0	0.	0.	0.	0.00	0.013
2	43	6.0	6.0	96.20	898.30	899.36	905.28	18.	0.	1	0.00	0.00	0.00	27	0	0	0	0.	0.	0.	0.00	0.013
2	44	3.0	3.0	10.00	898.30	901.75	904.75	18.	0.	1	0.00	0.00	0.00	27	0	0	0	0.	0.	0.	0.00	0.013
2	45	10.0	10.0	20.00	897.34	897.40	0.00	24.	0.	1	0.00	0.00	0.00	26	0	0	0	0.	0.	0.	0.00	0.013
2	46	19.0	19.0	93.20	887.66	889.79	895.29	24.	0.	1	0.00	0.00	0.00	23	0	0	0	0.	0.	0.	0.00	0.013
2	47	13.0	13.0	35.80	879.44	882.30	0.00	24.	0.	3	0.00	0.00	0.00	21	0	0	0	0.	0.	0.	0.00	0.013
2	48	13.0	13.0	55.00	882.30	882.60	888.10	24.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	49	7.0	7.0	9.00	879.05	883.28	887.28	24.	0.	1	0.00	0.00	0.00	20	0	0	0	0.	0.	0.	0.00	0.013
2	50	31.0	31.0	69.00	867.08	867.59	0.00	24.	0.	3	0.00	0.00	0.00	16	0	0	0	0.	0.	0.	0.00	0.013

PROJECT: ~~FRANCIS STREET~~ STORM DRAIN (EXIST. 66")
DESIGNER:

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
2	51	31.0	31.0	40.00	867.59	874.09	879.09	24.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	52	29.0	29.0	24.00	861.54	861.96	0.00	24.	0.	3	0.00	0.00	0.00	15	0	0	0	0.	0.	0.	0.00	0.013
2	53	29.0	29.0	57.64	861.96	868.10	871.60	24.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	54	23.0	23.0	12.00	861.56	867.08	871.08	24.	0.	1	0.00	0.00	0.00	14	0	0	0	0.	0.	0.	0.00	0.013

PROJECT: ~~FRANCIS STREET~~ STORM DRAIN (EXIST. 66")
DESIGNER:

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
1	HYDRAULIC GRADE LINE CONTROL = 860.25																	
2	177.0	66	0	2.82	3.71	FULL	0.00278	7.5	7.5	853.80	854.10	860.25	860.33	6.45	6.23	0.00	0.00	
3	177.0	66	0	5.50	3.71	FULL	0.00278	7.5	7.5	854.10	854.32	860.33	860.89	6.23	6.57	0.00	0.00	
4	177.0	66	0	5.50	3.71	FULL	0.00278	7.5	7.5	854.33	855.00	860.91	862.15	6.58	7.15	0.00	0.00	
5	177.0	66	0	5.50	3.71	FULL	0.00278	7.5	7.5	855.01	855.75	862.17	863.54	7.16	7.79	0.00	0.00	
6	177.0	66	0	5.50	3.71	FULL	0.00278	7.5	7.5	855.76	856.03	863.55	863.94	7.79	7.91	0.00	0.00	
7	177.0	24	144	2.00	1.89	FULL	0.00511	7.4	7.4	856.10	856.26	864.09	864.50	7.99	8.24	0.00	0.00	
8	177.0	66	0	5.50	3.71	FULL	0.00278	7.5	7.5	856.33	856.75	864.62	865.20	8.29	8.45	0.00	0.00	
9	177.0	66	0	4.49	3.71	FULL	0.00278	7.5	7.5	856.76	857.64	865.21	866.08	8.45	8.44	0.00	0.00	
	177.0	36	84	2.95	2.71	FULL	0.00509	8.4	8.4	857.71	857.74	865.94	865.99	8.23	8.25	0.00	0.00	
11	177.0	66	0	4.49	3.71	FULL	0.00278	7.5	7.5	857.81	858.15	866.33	866.67	8.52	8.52	0.00	0.00	
12	177.0	66	0	4.48	3.71	FULL	0.00278	7.5	7.5	858.16	859.57	866.68	868.07	8.52	8.50	0.00	0.00	
13	177.0	66	0	4.51	3.71	FULL	0.00278	7.5	7.5	859.58	859.81	868.09	868.32	8.51	8.51	0.00	0.00	
14	154.0	66	0	3.83	3.45	FULL	0.00210	6.5	6.5	859.81	859.88	868.74	868.78	8.93	8.90	0.00	0.00	
15	125.0	48	0	2.80	3.35	FULL	0.00757	9.9	9.9	860.36	862.88	868.01	869.78	7.65	6.90	0.00	0.00	
16	125.0	48	0	2.54	3.35	FULL	0.00757	9.9	9.9	862.88	866.57	869.13	871.11	6.25	4.54	0.00	0.00	HJ @ UJT
17	94.0	42	0	1.66	2.99	PART	0.00873	20.9	10.7	867.18	874.18	868.84	877.17	1.66	2.99	0.00	0.00	
18	94.0	42	0	3.50	2.99	SEAL	0.00873	10.7	9.8	874.18	875.93	877.17	879.50	2.99	3.57	0.00	0.00	
	X = 220.38 X(N) = 0.00																	
19	94.0	42	0	3.50	2.99	FULL	0.00873	9.8	9.8	875.96	878.30	879.50	882.51	3.54	4.21	0.00	0.00	
20	87.0	42	0	3.50	2.90	FULL	0.00748	9.0	9.0	878.30	878.55	882.93	883.21	4.63	4.66	0.00	0.00	
21	75.0	36	0	2.34	2.72	SEAL	0.01264	10.6	13.5	879.27	884.72	883.00	886.92	3.73	2.20	0.00	0.00	HYD JUMP
	X = 379.19 X(N) = 0.00 X(J) = 379.19 F(J) = 36.85 D(BJ) = 2.21 D(AJ) = 3.21																	
22	75.0	36	0	2.20	2.72	PART	0.01264	13.3	11.1	884.79	887.66	887.03	890.38	2.24	2.72	0.00	0.00	
23	55.0	30	0	2.50	2.35	FULL	0.01798	11.2	11.2	888.27	889.95	891.02	892.92	2.75	2.97	0.00	0.00	
24	55.0	30	0	2.50	2.35	FULL	0.01798	11.2	11.2	890.02	894.75	892.92	898.23	2.90	3.48	0.00	0.00	

PROJECT: ~~FRANCIS STREET~~ STORM DRAIN (EXIST. 66")
DESIGNER:

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
25	55.0	30	0	2.50	2.35	FULL	0.01798	11.2	11.2	894.81	897.33	898.23	902.02	3.42	4.69	0.00	0.00	
26	45.0	30	0	2.50	2.22	FULL	0.01204	9.2	9.2	897.33	898.28	903.13	904.09	5.80	5.81	0.00	0.00	
27	36.0	30	0	1.69	2.03	FULL	0.00770	7.3	7.3	898.37	901.30	904.92	906.80	6.55	5.50	0.00	0.00	
28	36.0	30	0	1.67	2.03	FULL	0.00770	7.3	7.3	901.36	905.03	906.80	909.07	5.44	4.04	0.00	0.00	
29	36.0	30	0	2.50	2.03	FULL	0.00770	7.3	7.3	905.08	907.21	909.07	911.35	3.99	4.14	0.00	0.00	
30	36.0	30	0	1.69	2.03	FULL	0.00770	7.3	7.3	907.24	911.52	911.35	914.10	4.11	2.58	0.00	0.00	
31	26.0	30	0	1.68	1.74	FULL	0.00402	5.3	5.3	911.55	913.33	914.78	915.90	3.23	2.57	0.00	0.00	
32	26.0	30	0	1.68	1.74	SEAL	0.00402	5.3	6.7	913.36	915.25	915.89	917.08	2.53	1.83	0.00	0.00	HJ @ UJT
	X = 14.04 X(N) = 195.56																	
33	26.0	30	0	1.68	1.74	PART	0.00402	7.4	8.0	915.28	917.28	916.96	918.84	1.68	1.56	0.00	0.00	
	X = 0.00 X(N) = 238.75																	
	26.0	30	0	2.50	1.74	PART	0.00402	7.1	5.5	917.32	917.95	919.06	920.27	1.74	2.32	0.00	0.00	
35	17.0	30	0	1.72	1.39	FULL	0.00172	3.5	3.5	917.97	918.48	920.73	921.07	2.76	2.59	0.00	0.00	
36	17.0	30	0	1.71	1.39	SEAL	0.00172	3.5	3.5	918.50	919.04	921.07	921.40	2.57	2.36	0.00	0.00	
	X = 84.84 X(N) = 0.00																	
37	12.0	18	0	1.50	1.31	FULL	0.01305	6.8	6.8	920.04	920.70	921.73	922.83	1.69	2.13	923.54	924.70	
	HYDRAULIC GRADE LINE CONTROL = 921.57																	
38	5.0	18	0	0.54	0.86	SEAL	0.00227	2.8	4.8	920.04	920.70	921.57	921.56	1.53	0.86	921.91	924.70	HYD JUMP
	X = 0.95 X(N) = 0.00 X(J) = 11.99 F(J) = 1.26 D(BJ) = 0.65 D(AJ) = 1.11																	
35	HYDRAULIC GRADE LINE CONTROL = 920.50																	
39	5.0	18	0	0.39	0.86	PART	0.00227	13.9	4.8	918.96	928.98	919.35	929.84	0.39	0.86	930.19	932.98	
	X = 0.00 X(N) = 56.43																	
	HYDRAULIC GRADE LINE CONTROL = 920.50																	
40	4.0	18	0	0.25	0.76	PART	0.00145	19.4	4.4	918.96	929.13	919.22	929.89	0.26	0.76	930.20	933.13	

JECT: ~~FRANCIS STREE~~T STORM DRAIN (EXIST. 66")
DESIGNER:

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
31	HYDRAULIC GRADE LINE CONTROL = 914.44																	
41	7.0	24	0	0.59	0.93	SEAL	0.00096	2.2	4.9	911.52	915.72	914.44	916.65	2.92	0.93	917.02	920.22	HYD JUMP
	X = 35.56 X(N) = 0.00 X(J) = 55.52 F(J) = 2.16 D(BJ) = 0.59 D(AJ) = 1.42																	
31	HYDRAULIC GRADE LINE CONTROL = 914.44																	
42	3.0	18	0	0.30	0.66	SEAL	0.00082	1.7	4.0	912.02	914.24	914.44	914.90	2.42	0.66	915.15	918.24	HYD JUMP
	X = 8.32 X(N) = 0.00 X(J) = 11.84 F(J) = 0.86 D(BJ) = 0.38 D(AJ) = 1.07																	
27	HYDRAULIC GRADE LINE CONTROL = 904.50																	
	6.0	18	0	0.79	0.94	FULL	0.00326	3.4	3.4	898.30	899.36	904.50	904.82	6.20	5.46	905.00	905.28	
27	HYDRAULIC GRADE LINE CONTROL = 904.50																	
44	3.0	18	0	0.23	0.66	FULL	0.00082	1.7	1.7	898.30	901.75	904.50	904.51	6.20	2.76	904.56	904.75	
26	HYDRAULIC GRADE LINE CONTROL = 902.58																	
45	10.0	24	0	1.36	1.13	FULL	0.00195	3.2	3.2	897.34	897.40	902.58	902.61	5.24	5.21	902.77	0.00	
23	HYDRAULIC GRADE LINE CONTROL = 890.70																	
46	19.0	24	0	1.06	1.57	SEAL	0.00705	6.0	7.2	887.66	889.79	890.70	891.36	3.04	1.57	892.16	895.29	HYD JUMP
	X = 65.65 X(N) = 0.00 X(J) = 66.37 F(J) = 6.68 D(BJ) = 1.22 D(AJ) = 1.97																	
2	HYDRAULIC GRADE LINE CONTROL = 882.72																	
47	13.0	24	0	0.61	1.29	SEAL	0.00330	4.1	6.1	879.44	882.30	883.10	883.59	3.66	1.29	0.00	0.00	HYD JUMP
	X = 21.37 X(N) = 0.00 X(J) = 21.37 F(J) = 4.90 D(BJ) = 0.80 D(AJ) = 2.02																	

PROJECT: ~~FRANCIS STREET~~ STORM DRAIN (EXIST. 66")
DESIGNER:

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
48	13.0	24	0	1.33	1.29	PART	0.00330	6.1	5.9	882.30	882.60	883.59	883.93	1.29	1.33	884.46	888.10	
	X = 0.00 X(N) = 7.12																	
20	HYDRAULIC GRADE LINE CONTROL = 882.72																	
49	7.0	24	0	0.29	0.93	SEAL	0.00096	2.2	4.9	879.05	883.28	882.72	884.21	3.67	0.93	884.58	887.28	HYD JUMP
	X = 3.57 X(N) = 0.00 X(J) = 3.92 F(J) = 3.12 D(BJ) = 0.44 D(AJ) = 1.82																	
14	HYDRAULIC GRADE LINE CONTROL = 868.40																	
50	31.0	24	0	2.00	1.87	PART	0.01878	17.0	26.2	867.08	867.59	868.20	868.40	1.12	0.81	0.00	0.00	
51	31.0	24	0	0.80	1.87	PART	0.01878	26.3	10.1	867.59	874.09	868.39	875.96	0.80	1.87	877.56	879.09	
	HYDRAULIC GRADE LINE CONTROL = 868.53																	
52	29.0	24	0	1.59	1.84	FULL	0.01643	9.2	9.2	861.54	861.96	868.40	868.79	6.86	6.83	0.00	0.00	
53	29.0	24	0	0.87	1.84	SEAL	0.01643	9.2	9.6	861.96	868.10	868.79	869.94	6.83	1.84	871.37	871.60	HYD JUMP
	X = 46.37 X(N) = 0.00 X(J) = 46.37 F(J) = 13.52 D(BJ) = 1.28 D(AJ) = 2.65																	
14	HYDRAULIC GRADE LINE CONTROL = 868.53																	
54	23.0	24	0	0.52	1.71	SEAL	0.01034	7.3	8.1	861.56	867.08	868.53	868.79	6.97	1.71	869.79	871.08	HYD JUMP
	X = 9.97 X(N) = 0.00 X(J) = 9.97 F(J) = 9.88 D(BJ) = 1.13 D(AJ) = 2.47																	

V 1, FL 1, D 1 AND HG 1 REFER TO DOWNSTREAM END

V 2, FL 2, D 2 AND HG 2 REFER TO UPSTREAM END

X - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HG INTERSECTS SOFFIT IN SEAL CONDITION

Y(N) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE WATER SURFACE REACHES NORMAL DEPTH BY EITHER DRAWDOWN OR BACKWATER

X(J) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HYDRAULIC JUMP OCCURS IN LINE

F(J) - THE COMPUTED FORCE AT THE HYDRAULIC JUMP

D(BJ) - DEPTH OF WATER BEFORE THE HYDRAULIC JUMP (UPSTREAM SIDE)

D(AJ) - DEPTH OF WATER AFTER THE HYDRAULIC JUMP (DOWNSTREAM SIDE)

SEAL INDICATES FLOW CHANGES FROM PART TO FULL OR FROM FULL TO PART

HYD JUMP INDICATES THAT FLOW CHANGES FROM SUPERCRITICAL TO SUBCRITICAL THROUGH A HYDRAULIC JUMP

HJ @ UJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE UPSTREAM END OF THE LINE

HJ @ DJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE DOWNSTREAM END OF THE LINE

EOJ 6/29/2000 8:39

PROJECT: GROVE AVENUE STORM DRAIN (EXIST. 66", MODIFIED)
DESIGNER: SB&O INC.

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
8	1						858.54															
2	8	209.0	209.0	163.00	856.42	856.75	0.00	66.	0.	3	0.00	0.00	0.00	1	0	0	0	0.	0.	0.	4.66	0.013
2	9	209.0	209.0	314.10	856.76	857.64	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	25.00	0.013
2	10	209.0	209.0	10.00	857.71	857.74	0.00	36.	84.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	25.00	0.013
2	11	209.0	209.0	121.24	857.81	858.15	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	12	209.0	209.0	501.00	858.16	859.57	0.00	66.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	13	209.0	209.0	82.69	859.58	859.81	0.00	66.	0.	3	0.00	0.00	0.00	0	0	54	0	0.	90.	0.	0.00	0.013
2	14	194.0	194.0	22.95	859.81	859.88	0.00	66.	0.	3	0.00	0.00	0.00	0	0	52	55	0.	30.	90.	9.70	0.013
2	15	125.0	125.0	233.16	860.36	862.88	0.00	48.	0.	3	0.00	0.00	0.00	0	0	50	0	0.	30.	0	0.00	0.013
2	16	125.0	125.0	260.00	862.88	866.57	0.00	48.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	8.70	0.013
2	17	94.0	94.0	168.18	867.18	874.18	0.00	42.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	18	94.0	94.0	257.37	874.18	875.93	0.00	42.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	19	94.0	94.0	344.54	875.96	878.30	0.00	42.	0.	3	0.00	0.00	0.00	0	0	49	0	0.	90.	0.	0.00	0.013
2	20	87.0	87.0	36.57	878.30	878.55	0.00	42.	0.	3	0.00	0.00	0.00	0	0	47	0	0.	30.	0.	8.50	0.013
2	21	75.0	75.0	389.17	879.27	884.72	0.00	36.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	22	75.0	75.0	179.17	884.79	887.66	0.00	36.	0.	3	0.00	0.00	0.00	0	0	46	0	0.	30.	0.	7.50	0.013
2	23	55.0	55.0	105.67	888.27	889.95	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	24	55.0	55.0	295.34	890.02	894.75	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	25	55.0	55.0	210.29	894.81	897.33	0.00	30.	0.	3	0.00	0.00	0.00	0	0	45	0	0.	30.	0.	0.00	0.013
2	26	45.0	45.0	79.28	897.33	898.28	0.00	30.	0.	3	0.00	0.00	0.00	0	0	43	44	0.	30.	90.	7.50	0.013
2	27	36.0	36.0	243.59	898.37	901.30	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	28	36.0	36.0	295.34	901.36	905.03	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	29	36.0	36.0	295.34	905.08	907.21	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	30	36.0	36.0	356.53	907.24	911.52	0.00	30.	0.	3	0.00	0.00	0.00	0	0	41	42	0.	30.	30.	7.50	0.013
2	31	26.0	26.0	277.45	911.55	913.33	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013

PROJECT: GROVE AVENUE STORM DRAIN (EXIST. 66", MODIFIED)
DESIGNER: SB&O INC.

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
2	32	26.0	26.0	295.34	913.36	915.25	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	33	26.0	26.0	312.56	915.28	917.28	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	34	26.0	26.0	232.17	917.32	917.95	0.00	30.	0.	3	0.00	0.00	0.00	0	0	39	40	0.	73.	27.	4.66	0.013
2	35	17.0	17.0	200.17	917.97	918.48	0.00	30.	0.	3	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	4.66	0.013
2	36	17.0	17.0	208.00	918.50	919.04	0.00	30.	0.	3	0.00	0.00	0.00	0	37	38	0	80.	35.	0.	4.66	0.013
2	37	12.0	12.0	84.00	920.04	920.70	924.70	18.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	38	5.0	5.0	22.00	920.04	920.70	924.70	18.	0.	1	0.00	0.00	0.00	37	0	0	0	0.	0.	0.	0.00	0.013
2	39	5.0	5.0	94.00	918.96	928.98	932.98	18.	0.	1	0.00	0.00	0.00	35	0	0	0	0.	0.	0.	0.00	0.013
2	40	4.0	4.0	28.00	918.96	929.13	933.13	18.	0.	1	0.00	0.00	0.00	35	0	0	0	0.	0.	0.	0.00	0.013
2	41	7.0	7.0	157.00	911.52	915.72	920.22	24.	0.	1	0.00	0.00	0.00	31	0	0	0	0.	0.	0.	0.00	0.013
2	42	3.0	3.0	20.00	912.02	914.24	918.24	18.	0.	1	0.00	0.00	0.00	31	0	0	0	0.	0.	0.	0.00	0.013
2	43	6.0	6.0	96.20	898.30	899.36	905.28	18.	0.	1	0.00	0.00	0.00	27	0	0	0	0.	0.	0.	0.00	0.013
2	44	3.0	3.0	10.00	898.30	901.75	904.75	18.	0.	1	0.00	0.00	0.00	27	0	0	0	0.	0.	0.	0.00	0.013
2	45	10.0	10.0	20.00	897.34	897.40	0.00	24.	0.	1	0.00	0.00	0.00	26	0	0	0	0.	0.	0.	0.00	0.013
2	46	19.0	19.0	93.20	887.66	889.79	895.29	24.	0.	1	0.00	0.00	0.00	23	0	0	0	0.	0.	0.	0.00	0.013
2	47	13.0	13.0	35.80	879.44	882.30	0.00	24.	0.	3	0.00	0.00	0.00	21	0	0	0	0.	0.	0.	0.00	0.013
2	48	13.0	13.0	55.00	882.30	882.60	888.10	24.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	49	7.0	7.0	9.00	879.05	883.28	887.28	24.	0.	1	0.00	0.00	0.00	20	0	0	0	0.	0.	0.	0.00	0.013
2	50	31.0	31.0	69.00	867.08	867.59	0.00	24.	0.	3	0.00	0.00	0.00	16	0	0	0	0.	0.	0.	0.00	0.013
2	51	31.0	31.0	40.00	867.59	874.09	879.09	24.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	52	29.0	29.0	24.00	861.54	861.96	0.00	24.	0.	3	0.00	0.00	0.00	15	0	0	0	0.	0.	0.	0.00	0.013
2	53	29.0	29.0	57.64	861.96	868.10	871.60	24.	0.	1	0.00	0.00	0.00	0	0	0	0	0.	0.	0.	0.00	0.013
2	54	15.0	15.0	12.00	861.56	867.08	871.08	24.	0.	1	0.00	0.00	0.00	14	0	0	0	0.	0.	0.	0.00	0.013
2	55	40.0	40.0	12.00	861.00	868.10	872.10	36.	0.	1	0.00	0.00	0.00	15	0	0	0	0.	0.	0.	0.00	0.013

PROJECT: GROVE AVENUE STORM DRAIN (EXIST. 66", MODIFIED)
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
1	HYDRAULIC GRADE LINE CONTROL = 858.54																	
8	209.0	66	0	5.50	4.04	PART	0.00387	11.2	9.3	856.42	856.75	860.46	861.66	4.04	4.91	0.00	0.00	
9	209.0	66	0	5.50	4.04	PART	0.00387	9.4	9.3	856.76	857.64	861.65	862.56	4.89	4.92	0.00	0.00	
10	209.0	36	84	3.00	3.00	FULL	0.00710	10.0	10.0	857.71	857.74	862.37	862.40	4.66	4.66	0.00	0.00	
11	209.0	66	0	5.50	4.04	PART	0.00387	9.7	9.8	857.81	858.15	862.46	862.79	4.65	4.64	0.00	0.00	
12	209.0	66	0	5.50	4.04	PART	0.00387	9.8	9.1	858.16	859.57	862.78	864.65	4.62	5.08	0.00	0.00	
13	209.0	66	0	5.50	4.04	PART	0.00387	9.1	9.9	859.58	859.81	864.64	864.36	5.06	4.55	0.00	0.00	
14	194.0	66	0	5.50	3.90	PART	0.00334	8.3	10.1	859.81	859.88	865.01	864.02	5.20	4.14	0.00	0.00	
15	125.0	48	0	2.80	3.35	SEAL	0.00757	9.9	14.7	860.36	862.88	864.97	865.44	4.61	2.56	0.00	0.00	HYD JUMP
	X = 155.85 X(N) = 0.00 X(J) = 155.85 F(J) = 65.11 D(BJ) = 2.66 D(AJ) = 4.10																	
	125.0	48	0	2.54	3.35	PART	0.00757	14.7	13.9	862.88	866.57	865.44	869.26	2.56	2.69	0.00	0.00	
17	94.0	42	0	1.66	2.99	PART	0.00873	19.3	10.7	867.18	874.18	868.95	877.17	1.77	2.99	0.00	0.00	
18	94.0	42	0	3.50	2.99	SEAL	0.00873	10.7	9.8	874.18	875.93	877.17	879.50	2.99	3.57	0.00	0.00	
	X = 220.38 X(N) = 0.00																	
19	94.0	42	0	3.50	2.99	FULL	0.00873	9.8	9.8	875.96	878.30	879.50	882.51	3.54	4.21	0.00	0.00	
20	87.0	42	0	3.50	2.90	FULL	0.00748	9.0	9.0	878.30	878.55	882.93	883.21	4.63	4.66	0.00	0.00	
21	75.0	36	0	2.34	2.72	SEAL	0.01264	10.6	13.5	879.27	884.72	883.00	886.92	3.73	2.20	0.00	0.00	HYD JUMP
	X = 379.19 X(N) = 0.00 X(J) = 379.19 F(J) = 36.85 D(BJ) = 2.21 D(AJ) = 3.21																	
22	75.0	36	0	2.20	2.72	PART	0.01264	13.3	11.1	884.79	887.66	887.03	890.38	2.24	2.72	0.00	0.00	
23	55.0	30	0	2.50	2.35	FULL	0.01798	11.2	11.2	888.27	889.95	891.02	892.92	2.75	2.97	0.00	0.00	
24	55.0	30	0	2.50	2.35	FULL	0.01798	11.2	11.2	890.02	894.75	892.92	898.23	2.90	3.48	0.00	0.00	
25	55.0	30	0	2.50	2.35	FULL	0.01798	11.2	11.2	894.81	897.33	898.23	902.02	3.42	4.69	0.00	0.00	
26	45.0	30	0	2.50	2.22	FULL	0.01204	9.2	9.2	897.33	898.28	903.13	904.09	5.80	5.81	0.00	0.00	
27	36.0	30	0	1.69	2.03	FULL	0.00770	7.3	7.3	898.37	901.30	904.92	906.80	6.55	5.50	0.00	0.00	
	36.0	30	0	1.67	2.03	FULL	0.00770	7.3	7.3	901.36	905.03	906.80	909.07	5.44	4.04	0.00	0.00	
29	36.0	30	0	2.50	2.03	FULL	0.00770	7.3	7.3	905.08	907.21	909.07	911.35	3.99	4.14	0.00	0.00	

ECT: GROVE AVENUE STORM DRAIN (EXIST. 66", MODIFIED)
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
30	36.0	30	0	1.69	2.03	FULL	0.00770	7.3	7.3	907.24	911.82	911.35	914.10	4.11	2.58	0.00	0.00	
31	26.0	30	0	1.68	1.74	FULL	0.00402	5.3	5.3	911.55	913.23	914.78	915.90	3.23	2.57	0.00	0.00	
32	26.0	30	0	1.68	1.74	SEAL	0.00402	5.3	6.7	913.36	915.25	915.89	917.08	2.53	1.83	0.00	0.00	HJ @ UJT
	X = 14.04 X(N) = 195.56																	
33	26.0	30	0	1.68	1.74	PART	0.00402	7.4	8.0	915.28	917.28	916.96	918.84	1.68	1.56	0.00	0.00	
	X = 0.00 X(N) = 238.75																	
34	26.0	30	0	2.50	1.74	PART	0.00402	7.1	5.5	917.32	917.95	919.06	920.27	1.74	2.32	0.00	0.00	
35	17.0	30	0	1.72	1.39	FULL	0.00172	3.5	3.5	917.97	918.48	920.73	921.07	2.76	2.59	0.00	0.00	
36	17.0	30	0	1.71	1.39	SEAL	0.00172	3.5	3.5	918.50	919.14	921.07	921.40	2.57	2.36	0.00	0.00	
	X = 84.84 X(N) = 0.00																	
37	12.0	18	0	1.50	1.31	FULL	0.01305	6.8	6.8	920.04	920.70	921.73	922.83	1.69	2.13	923.54	924.70	

HYDRAULIC GRADE LINE CONTROL = 921.57

38	5.0	18	0	0.54	0.86	SEAL	0.00227	2.8	4.8	920.04	920.70	921.57	921.56	1.53	0.86	921.91	924.70	HYD JUMP
	X = 0.95 X(N) = 0.00 X(J) = 11.99 F(J) = 1.26 D(BJ) = 0.65 D(AJ) = 1.11																	

HYDRAULIC GRADE LINE CONTROL = 920.50

39	5.0	18	0	0.39	0.86	PART	0.00227	13.9	4.8	918.96	928.95	919.35	929.84	0.39	0.86	930.19	932.98	
	X = 0.00 X(N) = 56.43																	

HYDRAULIC GRADE LINE CONTROL = 920.50

40	4.0	18	0	0.25	0.76	PART	0.00145	19.4	4.4	918.96	929.13	919.22	929.89	0.26	0.76	930.20	933.13	

HYDRAULIC GRADE LINE CONTROL = 914.44

41	7.0	24	0	0.59	0.93	SEAL	0.00096	2.2	4.9	911.52	915.72	914.44	916.65	2.92	0.93	917.02	920.22	HYD JUMP
	X = 35.56 X(N) = 0.00 X(J) = 55.52 F(J) = 2.16 D(BJ) = 0.59 D(AJ) = 1.42																	

PROJECT: GROVE AVENUE STORM DRAIN (EXIST. 66", MODIFIED)
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
31	HYDRAULIC GRADE LINE CONTROL = 914.44																	
42	3.0	18	0	0.30	0.66	SEAL	0.00082	1.7	4.0	912.02	914.24	914.44	914.90	2.42	0.66	915.15	918.24	HYD JUMP
	X = 8.32 X(N) = 0.00 X(J) = 11.84 F(J) = 0.86 D(BJ) = 0.38 D(AJ) = 1.07																	
27	HYDRAULIC GRADE LINE CONTROL = 904.50																	
43	6.0	18	0	0.79	0.94	FULL	0.00326	3.4	3.4	898.30	899.36	904.50	904.82	6.20	5.46	905.00	905.28	
27	HYDRAULIC GRADE LINE CONTROL = 904.50																	
44	3.0	18	0	0.23	0.66	FULL	0.00082	1.7	1.7	898.30	901.75	904.50	904.51	6.20	2.76	904.56	904.75	
26	HYDRAULIC GRADE LINE CONTROL = 902.58																	
45	10.0	24	0	1.36	1.13	FULL	0.00195	3.2	3.2	897.34	897.40	902.58	902.61	5.24	5.21	902.77	0.00	
23	HYDRAULIC GRADE LINE CONTROL = 890.70																	
46	19.0	24	0	1.06	1.57	SEAL	0.00705	6.0	7.2	887.66	889.79	890.70	891.36	3.04	1.57	892.16	895.29	HYD JUMP
	X = 65.65 X(N) = 0.00 X(J) = 66.37 F(J) = 6.68 D(BJ) = 1.22 D(AJ) = 1.97																	
20	HYDRAULIC GRADE LINE CONTROL = 882.72																	
47	13.0	24	0	0.61	1.29	SEAL	0.00330	4.1	6.1	879.44	882.30	883.10	883.59	3.66	1.29	0.00	0.00	HYD JUMP
	X = 21.37 X(N) = 0.00 X(J) = 21.37 F(J) = 4.90 D(BJ) = 0.80 D(AJ) = 2.02																	
48	13.0	24	0	1.33	1.29	PART	0.00330	6.1	5.9	882.30	882.60	883.59	883.93	1.29	1.33	884.46	888.10	
	X = 0.00 X(N) = 7.12																	

P. ..CT: GROVE AVENUE STORM DRAIN (EXIST. 66", MODIFIED)
DESIGNER: SB&O INC.

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
20	HYDRAULIC GRADE LINE CONTROL = 882.72																	
49	7.0	24	0	0.29	0.93	SEAL	0.00096	2.2	4.9	879.05	883.28	882.72	884.21	3.67	0.93	884.58	887.28	HYD JUMP
	X = 3.57 X(N) = 0.00 X(J) = 3.92 F(J) = 3.12 D(BJ) = 0.44 D(AJ) = 1.82																	
16	HYDRAULIC GRADE LINE CONTROL = 865.44																	
50	31.0	24	0	2.00	1.87	PART	0.01878	14.3	20.8	867.08	867.59	868.38	868.55	1.30	0.96	0.00	0.00	
51	31.0	24	0	0.80	1.87	PART	0.01878	20.8	10.1	867.59	874.09	868.55	875.96	0.96	1.87	877.56	879.09	
15	HYDRAULIC GRADE LINE CONTROL = 864.49																	
-	29.0	24	0	1.59	1.84	PART	0.01643	19.3	22.1	861.54	861.96	862.51	862.83	0.97	0.87	0.00	0.00	
53	29.0	24	0	0.87	1.84	PART	0.01643	22.1	9.6	861.96	868.10	862.83	869.94	0.87	1.84	871.37	871.60	
14	HYDRAULIC GRADE LINE CONTROL = 864.68																	
54	15.0	24	0	0.42	1.40	PART	0.00440	19.6	6.4	861.56	867.05	862.14	868.48	0.58	1.40	869.11	871.08	
15	HYDRAULIC GRADE LINE CONTROL = 864.49																	
55	40.0	36	0	0.56	2.06	PART	0.00360	23.4	7.8	861.00	868.10	861.87	870.16	0.87	2.06	871.09	872.10	

V 1, FL 1, D 1 AND HG 1 REFER TO DOWNSTREAM END
V 2, FL 2, D 2 AND HG 2 REFER TO UPSTREAM END
X - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HG INTERSECTS SOFFIT IN SEAL CONDITION
X(N) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE WATER SURFACE REACHES NORMAL DEPTH BY EITHER DRAWDOWN OR BACKWATER
X(J) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HYDRAULIC JUMP OCCURS IN LINE
F(J) - THE COMPUTED FORCE AT THE HYDRAULIC JUMP
D(BJ) - DEPTH OF WATER BEFORE THE HYDRAULIC JUMP (UPSTREAM SIDE)
D(AJ) - DEPTH OF WATER AFTER THE HYDRAULIC JUMP (DOWNSTREAM SIDE)
SEAL INDICATES FLOW CHANGES FROM PART TO FULL OR FROM FULL TO PART
HYD JUMP INDICATES THAT FLOW CHANGES FROM SUPERCRITICAL TO SUBCRITICAL THROUGH A HYDRAULIC JUMP
HJ @ UJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE UPSTREAM END OF THE LINE
HJ @ DJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE DOWNSTREAM END OF THE LINE

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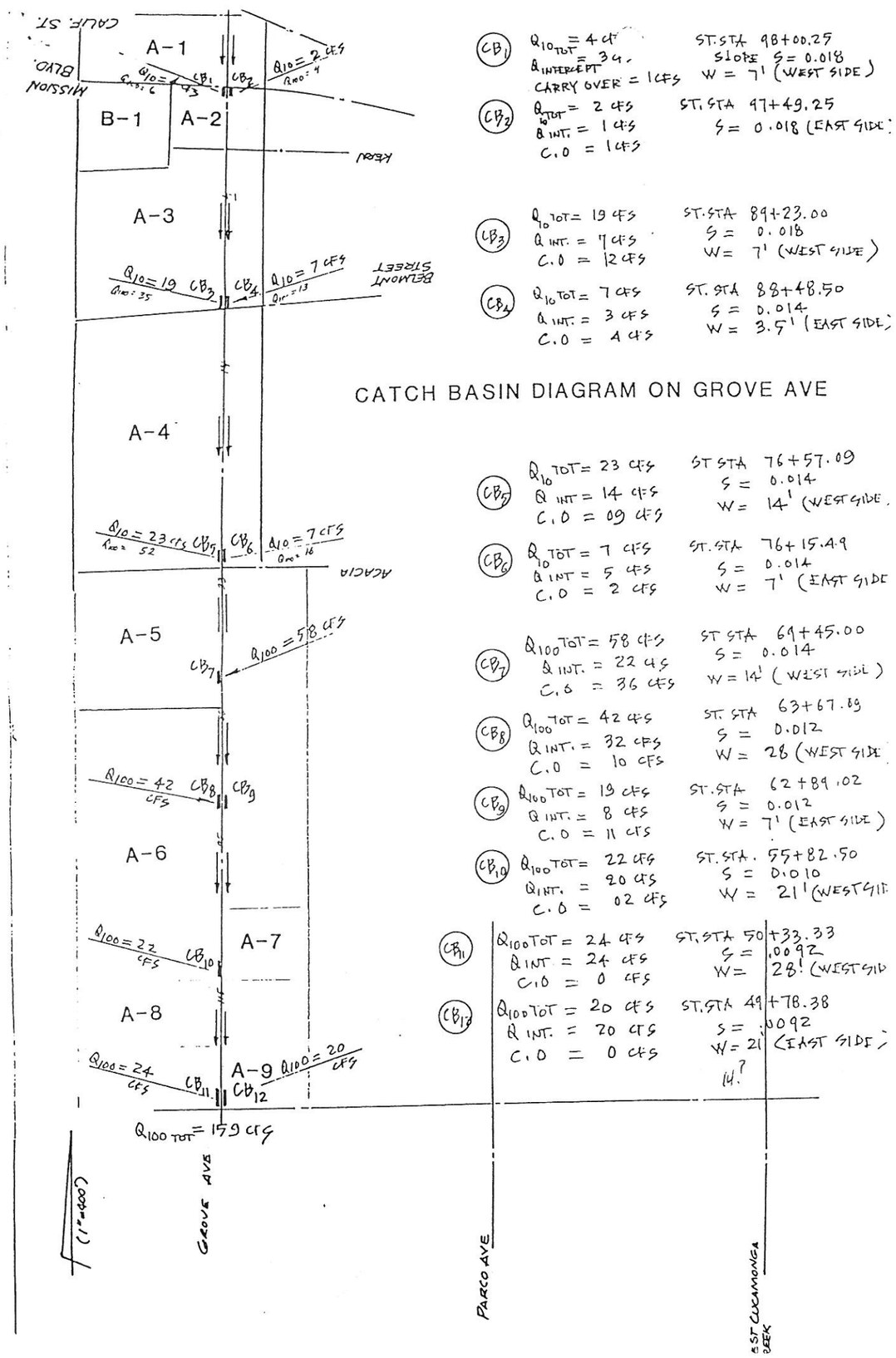
CATCH BASIN DIAGRAM ON GROVE AVE



CB1
$Q_{10\,TOT}$ = 4 CFS
$Q_{INTERCEPT}$ = 3 CFS
CARRY OVER = 1 CFS
ST. STA 98+00.25
SLOPE S = 0.018
W = 7' (WEST SIDE)

CB2
$Q_{10\,TOT}$ = 2 CFS
$Q_{INT.}$ = 1 CFS
C.O = 1 CFS
ST. STA 97+49.25
S = 0.018 (EAST SIDE)

CB3
$Q_{10\,TOT}$ = 19 CFS
$Q_{INT.}$ = 7 CFS
C.O = 12 CFS
ST. STA 89+23.00
S = 0.018
W = 7' (WEST SIDE)

CB4
$Q_{10\,TOT}$ = 7 CFS
$Q_{INT.}$ = 3 CFS
C.O = 4 CFS
ST. STA 88+48.50
S = 0.014
W = 3.5' (EAST SIDE)

CB5
$Q_{10\,TOT}$ = 23 CFS
Q_{INT} = 14 CFS
C.O = 09 CFS
ST STA 76+57.09
S = 0.014
W = 14' (WEST SIDE)

CB6
$Q_{10\,TOT}$ = 7 CFS
Q_{INT} = 5 CFS
C.O = 2 CFS
ST. STA 76+15.49
S = 0.014
W = 7' (EAST SIDE)

CB7
$Q_{100\,TOT}$ = 58 CFS
$Q_{INT.}$ = 22 CFS
C.O = 36 CFS
ST STA 69+45.00
S = 0.014
W = 14' (WEST SIDE)

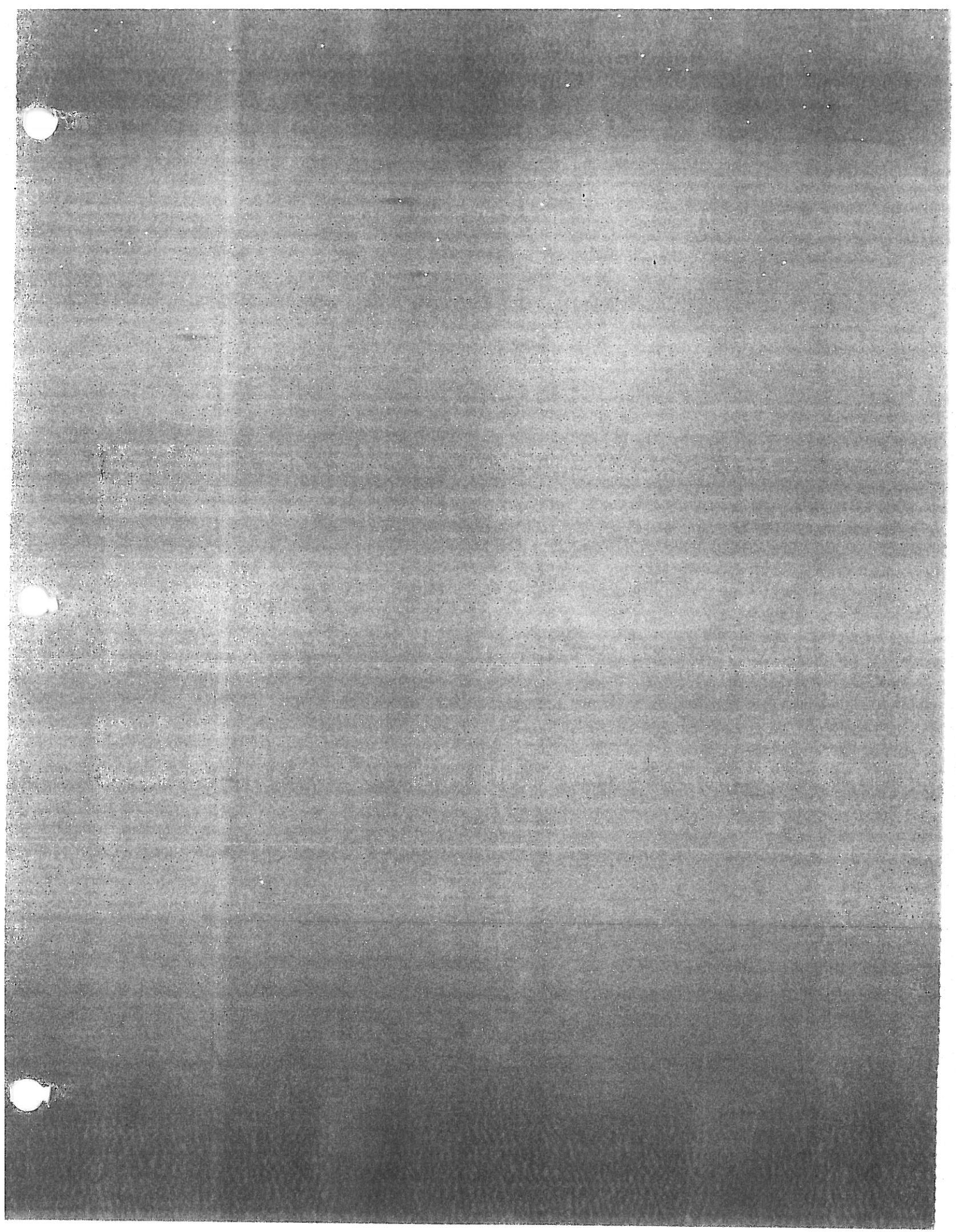
CB8
$Q_{100\,TOT}$ = 42 CFS
$Q_{INT.}$ = 32 CFS
C.O = 10 CFS
ST. STA 63+67.89
S = 0.012
W = 28 (WEST SIDE)

CB9
$Q_{100\,TOT}$ = 19 CFS
$Q_{INT.}$ = 8 CFS
C.O = 11 CFS
ST. STA 62+89.02
S = 0.012
W = 7' (EAST SIDE)

CB10
$Q_{100\,TOT}$ = 22 CFS
$Q_{INT.}$ = 20 CFS
C.O = 02 CFS
ST. STA. 55+82.50
S = 0.010
W = 21' (WEST SIDE)

CB11
$Q_{100\,TOT}$ = 24 CFS
Q_{INT} = 24 CFS
C.O = 0 CFS
ST. STA 50+33.33
S = .0092
W = 28' (WEST SIDE)

CB12
$Q_{100\,TOT}$ = 20 CFS
$Q_{INT.}$ = 20 CFS
C.O = 0 CFS
ST. STA 49+78.38
S = .0092
W = 21' (EAST SIDE)
14?



SECTION 6

PRELIMINARY DESIGN OF MASTER PLANNED FACILITIES

In addition to the design and construction of the Francis Street Storm Drain, stub-outs will be provided at each major intersection for the future extension of those master planned facilities. They are: Cucamonga Avenue (line V-7), Bon View Avenue (line V-6), and Campus Avenue (line V-5). Preliminary pipe sizes and catch basin sizes and locations have been calculated in order to justify that the stub-outs and future pipe extensions will work hydraulically and that the last set of catch basins located just north of Francis Street will provide 100% interception when all the other catch basins are in place and the drainage basin is at ultimate build-out.

It is not within the scope of this report to determine whether the last set of catch basins, constructed as part of this project, will intercept an acceptable amount of run-off in this interim condition from the existing partially built-out drainage basins, or at what time in the future development of each drainage basin does the extension of the north-south line and construction of the next set of the ultimate catch basins become vitally necessary. It's quite possible that the existing Q_{100} from the Cucamonga Avenue, Bon View Avenue, or Campus Avenue drainage basins already warrants an extension of the proposed stub-out at Francis Street to the next set of required catch basins at Acacia Street. Again, further calculations would need to be performed to determine at what point the existing Q_{100} exceeds the right-of-way.

A 45" stub-out from the County's 66" line exists in Parco Avenue. A recent industrial project at Parco Avenue and Locust Street installed a storm drain line in Parco (line VII-5a) and connected to the 45" stub-out. A bleeder line was also installed because the invert of the new 57" pipe was lower than that of the existing 45" stub-out. This project will remove conflicting portions of the 45" pipe to install a 63" pipe from the 57" manhole and tie into the city's existing 66" pipe on the north side of Francis Street. This connection will be possible because the City's 66" pipe will be cut west of the squash box at Parco and connected to the new storm drain. The squash box will be abandoned in place. The two existing laterals on Parco Avenue which currently tie into the 45" manhole will be reconnected to the 63" pipe with a junction structure. According to Thomsen Engineering's hydrology study, the existing grated catch basins on Parco Avenue have sufficient capacity to fully intercept the surface run-off coming down Parco. There are no additional catch basins proposed for this intersection area.

Street capacity charts showing depth vs. flow for Cucamonga Avenue, Bon View Avenue, and Campus Avenue are included in this Section. The Los Angeles County Flood Control District nomographs for sizing in-line curb opening catch basins can be found in Section 3. The 4" gutter depression table was used for all designs.

Campus Avenue (Line V-5)
Preliminary Catch Basin Design

Street grade = 1.17%

Note: the master plan shows line V-5 extending up to Maitland, however, the first set of catch basins are not needed until the flow reaches Belmont.

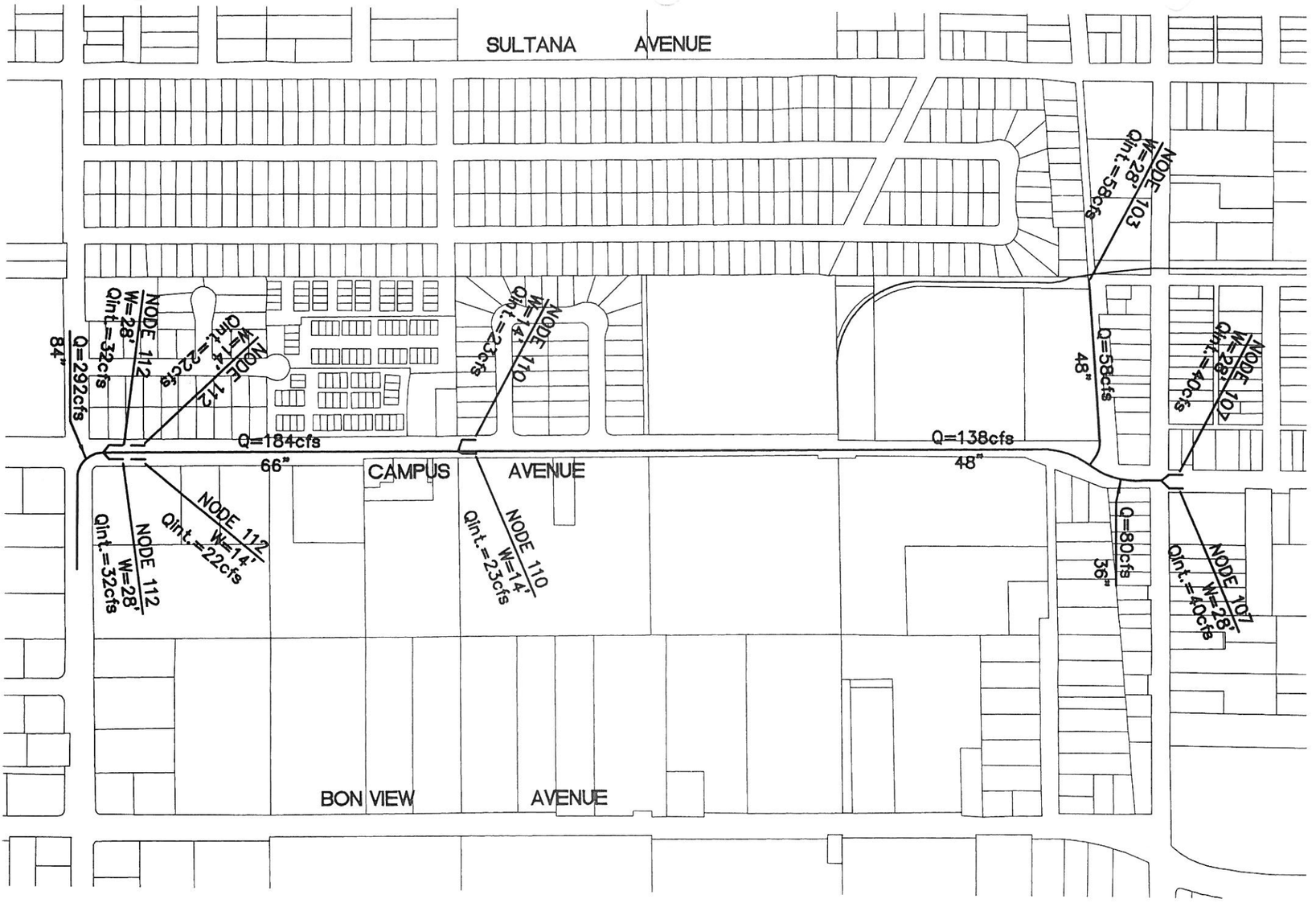
@ node 107 (Campus/Belmont), Q_{100} = 120 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.83' (this exceeds crown by 0.04')
Assume 28' catch basin on each side
From catch basin capacity tables, Q intercept = 40 cfs (80 cfs total)
Therefore, Q by-pass = 120-80 = 40 cfs

@ node 103 (Monterey/Phillips), Q_{100} = 58 cfs
Assume catch basin and pipe installed from node 103 to Campus main line.
If allowed to surface flow to Campus, then additional catch basins needed at node 108.
Q intercept = 58 cfs

@ node 110 (Campus/Locust), Q_{100} = 268 - (80+58) = 130 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.85' (this exceeds crown by 0.06')
Assume 14' catch basin on each side
From catch basin capacity tables, Q intercept = 23 cfs (46 cfs total)
Therefore, Q by-pass = 130-46 = 84 cfs

@ node 112 (Campus/Francis), Q_{100} = 295 - (80+58+46) = 111 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.82'
Assume 14' catch basin on each side
From catch basin capacity tables, Q intercept = 22 cfs (44 cfs total)
Therefore, Q by-pass = 111-44 = 67 cfs

@ node 112 (Campus/Francis), Q_{100} = 67 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.70'
Assume 28' catch basin on each side
From catch basin capacity tables, Q intercept = 32 cfs (64 cfs total)
Therefore, Q by-pass = 67-64 = 3 cfs


SULTANA AVENUE
NODE 103
W=28'
Qint.=56cfs
Q=58cfs
48"
NODE 107
W=28'
Qint.=40cfs
NODE 112
W=28'
Qint.=32cfs
Q=292cfs
84"
NODE 111
W=14'
Qint.=22cfs
NODE 110
W=14'
Qint.=23cfs
Q=184cfs
66"
CAMPUS AVENUE
Q=138cfs
48"
NODE 112
W=14'
Qint.=22cfs
NODE 112
W=28'
Qint.=32cfs
NODE 110
W=14'
Qint.=23cfs
Q=80cfs
36"
NODE 107
W=28'
Qint.=40cfs
BON VIEW AVENUE

STREET CAPACITY CHART - CAMPUS AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.17%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.40	0.0	0.190	0.087	
0.20	0.42	0.5	0.213	0.079	
0.21	0.46	1.0	0.240	0.075	
0.22	0.51	1.5	0.273	0.073	
0.23	0.58	2.0	0.310	0.073	
0.24	0.67	2.5	0.353	0.074	
0.25	0.77	3.0	0.400	0.076	
0.26	0.89	3.5	0.453	0.079	
0.27	1.03	4.0	0.510	0.081	
0.28	1.18	4.5	0.573	0.084	
0.29	1.35	5.0	0.640	0.088	
0.30	1.55	5.5	0.713	0.091	
0.31	1.76	6.0	0.790	0.095	
0.32	2.00	6.5	0.873	0.099	
0.33	2.26	7.0	0.960	0.103	
0.34	2.54	7.5	1.053	0.107	
0.35	2.85	8.0	1.150	0.111	
0.36	3.18	8.5	1.253	0.115	
0.37	3.54	9.0	1.360	0.120	
0.38	3.92	9.5	1.473	0.124	
0.39	4.33	10.0	1.590	0.128	
0.40	4.77	10.5	1.713	0.133	
0.41	5.24	11.0	1.840	0.137	
0.42	5.74	11.5	1.973	0.142	
0.43	6.27	12.0	2.110	0.146	
0.44	6.83	12.5	2.253	0.151	
0.45	7.43	13.0	2.400	0.155	
0.46	8.05	13.5	2.553	0.160	
0.47	8.71	14.0	2.710	0.165	
0.48	9.41	14.5	2.873	0.169	
0.49	10.14	15.0	3.040	0.174	
0.50	10.91	15.5	3.213	0.178	
0.51	11.71	16.0	3.390	0.183	
0.52	12.55	16.5	3.573	0.188	
0.53	13.43	17.0	3.760	0.193	
0.54	14.34	17.5	3.953	0.197	
0.55	15.30	18.0	4.150	0.202	
0.56	16.29	18.5	4.353	0.207	
0.57	17.33	19.0	4.560	0.211	
0.58	18.41	19.5	4.773	0.216	
0.59	19.53	20.0	4.990	0.221	
0.60	20.69	20.5	5.213	0.226	
0.61	21.90	21.0	5.440	0.230	
0.62	23.15	21.5	5.673	0.235	
0.63	24.44	22.0	5.910	0.240	
0.64	25.78	22.5	6.153	0.245	
0.65	27.17	23.0	6.400	0.250	
0.66	28.60	23.5	6.653	0.254	
0.67	30.08	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - CAMPUS AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.17%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	31.25	24.5	7.175	0.259	
0.69	32.49	25.0	7.450	0.260	
0.70	33.81	25.5	7.735	0.261	
0.71	35.20	26.0	8.030	0.262	
0.72	36.66	26.5	8.335	0.263	
0.73	38.20	27.0	8.650	0.265	
0.74	39.82	27.5	8.975	0.267	
0.75	41.51	28.0	9.310	0.269	
0.76	43.27	28.5	9.655	0.271	
0.77	45.12	29.0	10.010	0.273	
0.78	47.04	29.5	10.375	0.275	
0.79	49.05	30.0	10.750	0.278	FLOW AT CROWN
0.80	51.55	30.0	11.133	0.284	
0.81	54.11	30.0	11.520	0.290	
0.82	56.74	30.0	11.913	0.297	
0.83	59.44	30.0	12.310	0.303	
0.84	62.21	30.0	12.713	0.309	
0.85	65.04	30.0	13.120	0.315	
0.86	67.94	30.0	13.533	0.321	
0.87	70.91	30.0	13.950	0.327	
0.88	73.95	30.0	14.373	0.333	
0.89	77.06	30.0	14.800	0.339	
0.90	80.24	30.0	15.233	0.345	
0.91	83.49	30.0	15.670	0.351	FLOW AT R/W

Bon View Avenue (Line V-6)
Preliminary Catch Basin Design

Street grade = 1.35%

Note: the master plan shows line V-6 extending up to Belmont

@ node 207 (Bon View/Belmont), Q_{100} = 91 cfs (before confluence w/ node 203)
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.73' (for street grade = 1.7%)
Assume 14' catch basin on each side
From catch basin capacity tables, Q intercept = 20 cfs (40 cfs total)
Therefore, Q by-pass = 91-40 = 51 cfs

@ node 203 (@ Bonview Park), Q_{100} = 110 cfs
Assume catch basin and pipe installed from node 203 to Bon View main line.
If allowed to surface flow to Bon View, then additional catch basins needed prior to node 208.
Q intercept = 110 cfs

@ node 208.5 (Bon View/Acacia), Q_{100} = 257 - (40+110) = 107 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.79'
Assume 21' catch basin on each side
From catch basin capacity tables, Q intercept = 30 cfs (60 cfs total)
Therefore, Q by-pass = 107-60 = 47 cfs

@ node 210 (Bon View/Locust), Q_{100} = 307 - (40+110+60) = 97 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.77'
Assume 14' catch basin on each side
From catch basin capacity tables, Q intercept = 21 cfs (42 cfs total)
Therefore, Q by-pass = 97-42 = 55 cfs

@ node 212 (Bon View/Francis), Q_{100} = 342 - (40+110+60+42) = 90 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.75'
Assume 14' catch basin on each side
From catch basin capacity tables, Q intercept = 20 cfs (40 cfs total)
Therefore, Q by-pass = 90-40 = 50 cfs

@ node 212 (Bon View/Francis), Q_{100} = 50 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.62'
Assume 28' catch basin on each side
From catch basin capacity tables, Q intercept = 26 cfs (52 cfs total)
Therefore, 100% interception

CAMPUS AVENUE
BON VIEW AVENUE
CUCAMONGA AVENUE
FRANCIS
BELMONT STREET
Q=342cfs
84"
Q=252cfs
66"
Q=210cfs
54"
Q=150cfs
48"
Q=110cfs
48"
Q=40cfs
30"
NODE 212
W=28'
Qint.=25cfs
NODE 212
W=14'
Qint.=20cfs
NODE 210
W=14'
Qint.=21cfs
NODE 208.5
W=21'
Qint.=30cfs
NODE 207
W=14'
Qint.=20cfs
NODE 203
W=28'
Qint.=110cfs

STREET CAPACITY CHART - BONVIEW AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.35%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.19	0.43	0.0	0.190	0.087	
0.20	0.45	0.5	0.213	0.079	
0.21	0.49	1.0	0.240	0.075	
0.22	0.55	1.5	0.273	0.073	
0.23	0.62	2.0	0.310	0.073	
0.24	0.72	2.5	0.353	0.074	
0.25	0.83	3.0	0.400	0.076	
0.26	0.95	3.5	0.453	0.079	
0.27	1.10	4.0	0.510	0.081	
0.28	1.27	4.5	0.573	0.084	
0.29	1.45	5.0	0.640	0.088	
0.30	1.66	5.5	0.713	0.091	
0.31	1.89	6.0	0.790	0.095	
0.32	2.15	6.5	0.873	0.099	
0.33	2.42	7.0	0.960	0.103	
0.34	2.73	7.5	1.053	0.107	
0.35	3.06	8.0	1.150	0.111	
0.36	3.41	8.5	1.253	0.115	
0.37	3.80	9.0	1.360	0.120	
0.38	4.21	9.5	1.473	0.124	
0.39	4.65	10.0	1.590	0.128	
0.40	5.13	10.5	1.713	0.133	
0.41	5.63	11.0	1.840	0.137	
0.42	6.17	11.5	1.973	0.142	
0.43	6.74	12.0	2.110	0.146	
0.44	7.34	12.5	2.253	0.151	
0.45	7.98	13.0	2.400	0.155	
0.46	8.65	13.5	2.553	0.160	
0.47	9.36	14.0	2.710	0.165	
0.48	10.11	14.5	2.873	0.169	
0.49	10.89	15.0	3.040	0.174	
0.50	11.71	15.5	3.213	0.178	
0.51	12.58	16.0	3.390	0.183	
0.52	13.48	16.5	3.573	0.188	
0.53	14.42	17.0	3.760	0.193	
0.54	15.41	17.5	3.953	0.197	
0.55	16.43	18.0	4.150	0.202	
0.56	17.50	18.5	4.353	0.207	
0.57	18.62	19.0	4.560	0.211	
0.58	19.78	19.5	4.773	0.216	
0.59	20.98	20.0	4.990	0.221	
0.60	22.23	20.5	5.213	0.226	
0.61	23.52	21.0	5.440	0.230	
0.62	24.87	21.5	5.673	0.235	
0.63	26.26	22.0	5.910	0.240	
0.64	27.69	22.5	6.153	0.245	
0.65	29.18	23.0	6.400	0.250	
0.66	30.72	23.5	6.653	0.254	
0.67	32.31	24.0	6.910	0.259	FLOW AT T.C.

STREET CAPACITY CHART - BONVIEW AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.35%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	33.57	24.5	7.175	0.259	
0.69	34.90	25.0	7.450	0.260	
0.70	36.32	25.5	7.735	0.261	
0.71	37.81	26.0	8.030	0.262	
0.72	39.38	26.5	8.335	0.263	
0.73	41.04	27.0	8.650	0.265	
0.74	42.77	27.5	8.975	0.267	
0.75	44.58	28.0	9.310	0.269	
0.76	46.48	28.5	9.655	0.271	
0.77	48.46	29.0	10.010	0.273	
0.78	50.53	29.5	10.375	0.275	
0.79	52.68	30.0	10.750	0.278	FLOW AT CROWN
0.80	55.37	30.0	11.133	0.284	
0.81	58.12	30.0	11.520	0.290	
0.82	60.95	30.0	11.913	0.297	
0.83	63.85	30.0	12.310	0.303	
0.84	66.82	30.0	12.713	0.309	
0.85	69.87	30.0	13.120	0.315	
0.86	72.98	30.0	13.533	0.321	
0.87	76.17	30.0	13.950	0.327	
0.88	79.44	30.0	14.373	0.333	
0.89	82.78	30.0	14.800	0.339	
0.90	86.19	30.0	15.233	0.345	
0.91	89.68	30.0	15.670	0.351	FLOW AT R/W

Cucamonga Avenue (Line V-7)
Preliminary Catch Basin Design

Street grade = 1.25%

Note: the master plan shows line V-7 extending up to Belmont

@ node 304 (Cucamonga/Belmont), Q_{100} = 132 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.85' (this exceeds crown by 0.06')
Assume 28' catch basin on each side
From catch basin capacity tables, Q intercept = 41 cfs (82 cfs total)
Therefore, Q by-pass = 132-82 = 50 cfs

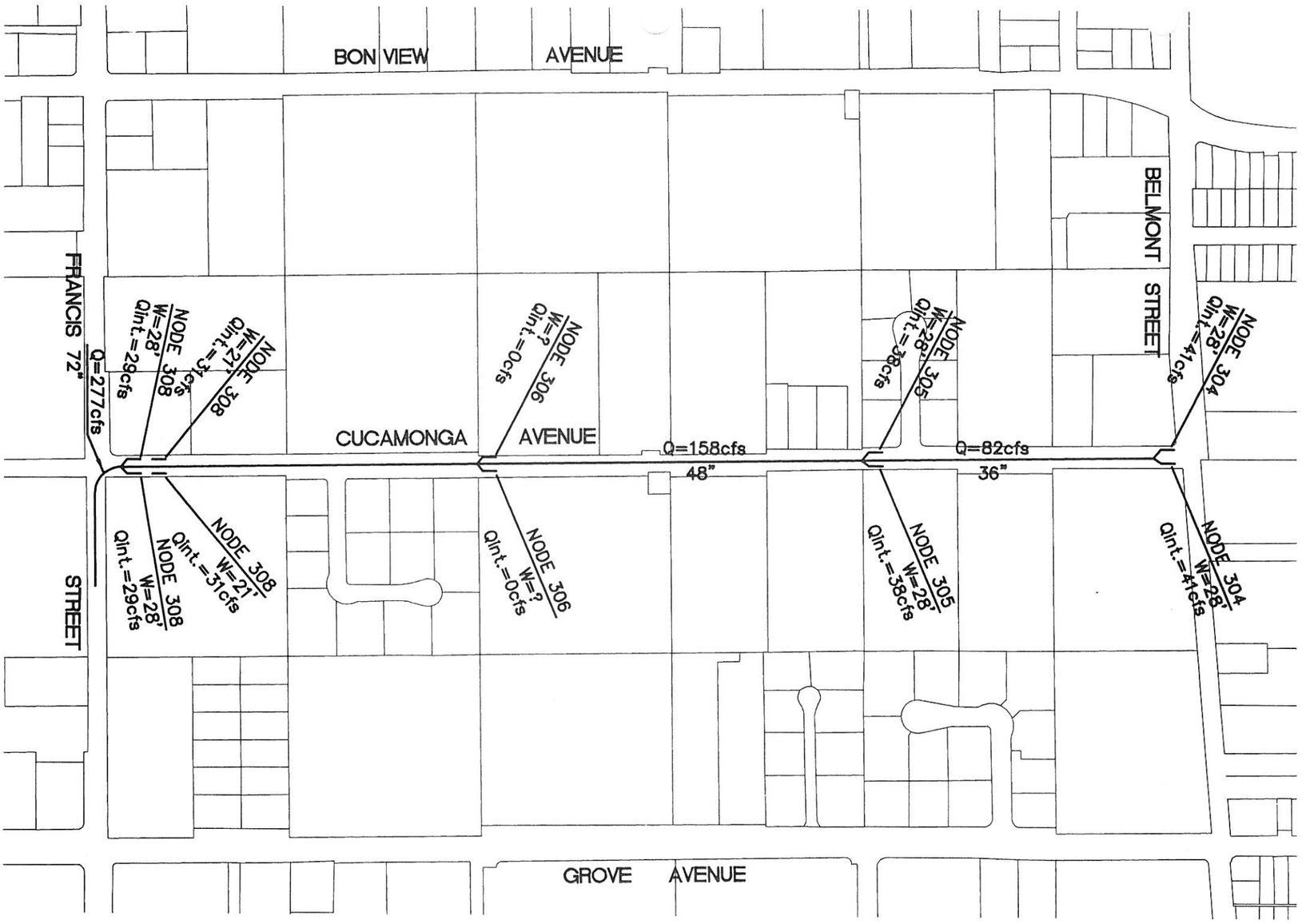
@ node 305 (Cucamonga/Acacia), Q_{100} = 187-(82) = 105 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.80'
Assume 28' catch basin on each side
From catch basin capacity tables, Q intercept = 38 cfs (76 cfs total)
Therefore, Q by-pass = 105-76 = 29 cfs

@ node 308 (Cucamonga/Francis), Q_{100} = 277 - (82+76) = 119 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.82'
Assume 21' catch basin on each side
From catch basin capacity tables, Q intercept = 31 cfs (62 cfs total)
Therefore, Q by-pass = 119-62 = 57 cfs

@ node 308 (Cucamonga/Francis), Q_{100} = 57 cfs
Assume flow is equal on both sides of street
From street capacity chart, depth of flow (D) = 0.65'
Assume 28' catch basin on each side
From catch basin capacity tables, Q intercept = 29 cfs (58 cfs total)
Therefore, 100% interception

Note:

This scenario does not include catch basins at node 306, however, the City may wish to install future catch basins here to reduce the amount of runoff to node 308.


BON VIEW AVENUE
BELMONT STREET
FRANCIS STREET
CUCAMONGA AVENUE
GROVE AVENUE
72"
Q=277cfs
NODE 308
W=28'
Qint.=29cfs
NODE 308
W=21'
Qint.=31cfs
NODE 308
W=28'
Qint.=29cfs
NODE 306
W=?
Qint.=0cfs
Q=158cfs
48"
NODE 305
W=28'
Qint.=38cfs
Q=82cfs
36"
NODE 304
W=28'
Qint.=41cfs

STREET CAPACITY CHART - CUCAMONGA AVENUE

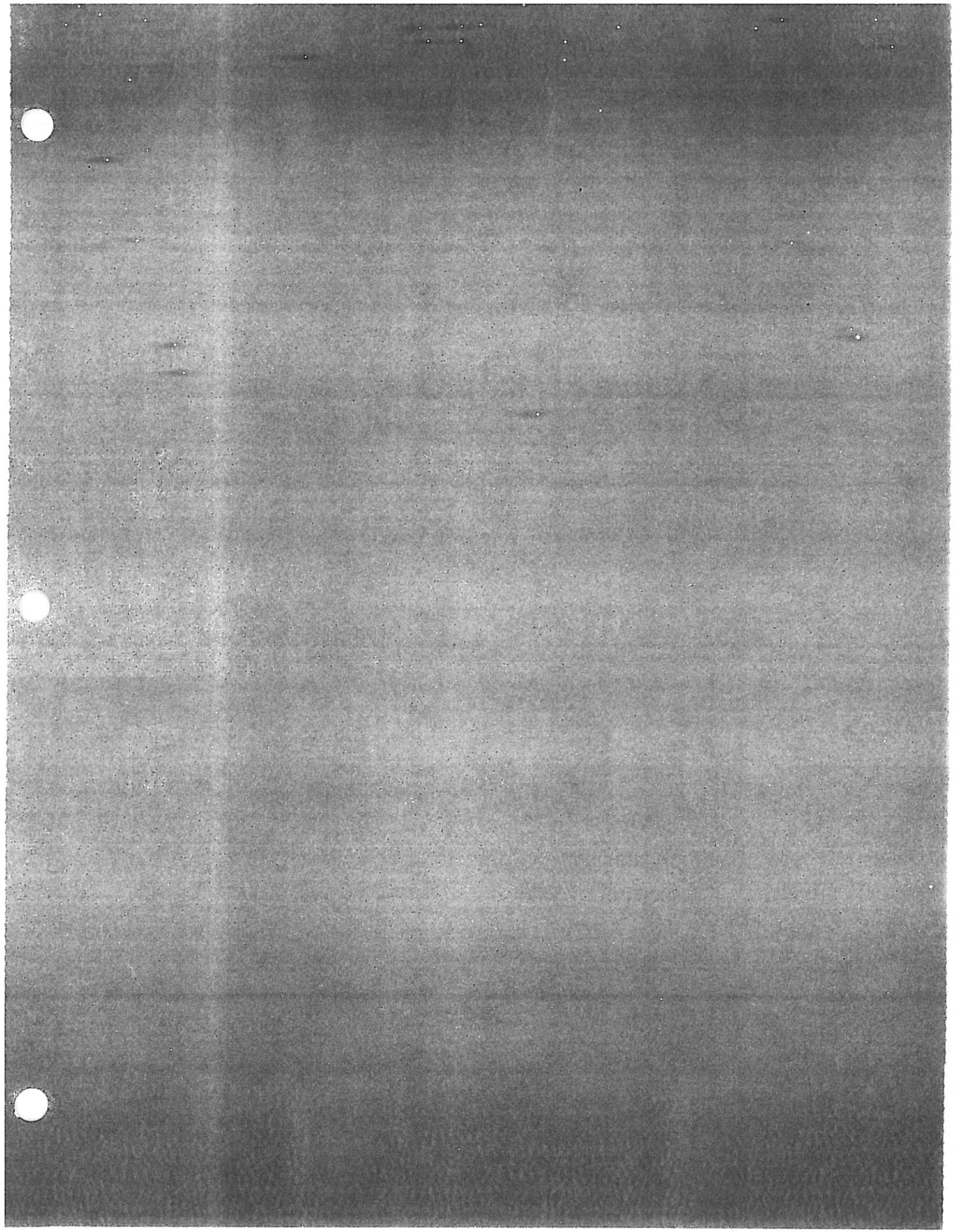
CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.25%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD., RAD.	REMARKS
0.19	0.41	0.0	0.190	0.087	
0.20	0.43	0.5	0.213	0.079	
0.21	0.47	1.0	0.240	0.075	
0.22	0.53	1.5	0.273	0.073	
0.23	0.60	2.0	0.310	0.073	
0.24	0.69	2.5	0.353	0.074	
0.25	0.80	3.0	0.400	0.076	
0.26	0.92	3.5	0.453	0.079	
0.27	1.06	4.0	0.510	0.081	
0.28	1.22	4.5	0.573	0.084	
0.29	1.40	5.0	0.640	0.088	
0.30	1.60	5.5	0.713	0.091	
0.31	1.82	6.0	0.790	0.095	
0.32	2.07	6.5	0.873	0.099	
0.33	2.33	7.0	0.960	0.103	
0.34	2.62	7.5	1.053	0.107	
0.35	2.94	8.0	1.150	0.111	
0.36	3.28	8.5	1.253	0.115	
0.37	3.65	9.0	1.360	0.120	
0.38	4.05	9.5	1.473	0.124	
0.39	4.48	10.0	1.590	0.128	
0.40	4.93	10.5	1.713	0.133	
0.41	5.42	11.0	1.840	0.137	
0.42	5.93	11.5	1.973	0.142	
0.43	6.48	12.0	2.110	0.146	
0.44	7.06	12.5	2.253	0.151	
0.45	7.68	13.0	2.400	0.155	
0.46	8.32	13.5	2.553	0.160	
0.47	9.01	14.0	2.710	0.165	
0.48	9.73	14.5	2.873	0.169	
0.49	10.48	15.0	3.040	0.174	
0.50	11.27	15.5	3.213	0.178	
0.51	12.10	16.0	3.390	0.183	
0.52	12.97	16.5	3.573	0.188	
0.53	13.88	17.0	3.760	0.193	
0.54	14.83	17.5	3.953	0.197	
0.55	15.81	18.0	4.150	0.202	
0.56	16.84	18.5	4.353	0.207	
0.57	17.91	19.0	4.560	0.211	
0.58	19.03	19.5	4.773	0.216	
0.59	20.19	20.0	4.990	0.221	
0.60	21.39	20.5	5.213	0.226	
0.61	22.63	21.0	5.440	0.230	
0.62	23.93	21.5	5.673	0.235	
0.63	25.26	22.0	5.910	0.240	
0.64	26.65	22.5	6.153	0.245	
0.65	28.08	23.0	6.400	0.250	
0.66	29.56	23.5	6.653	0.254	
0.67	31.09	24.0	6.910	0.259	FLOW AT T.C.

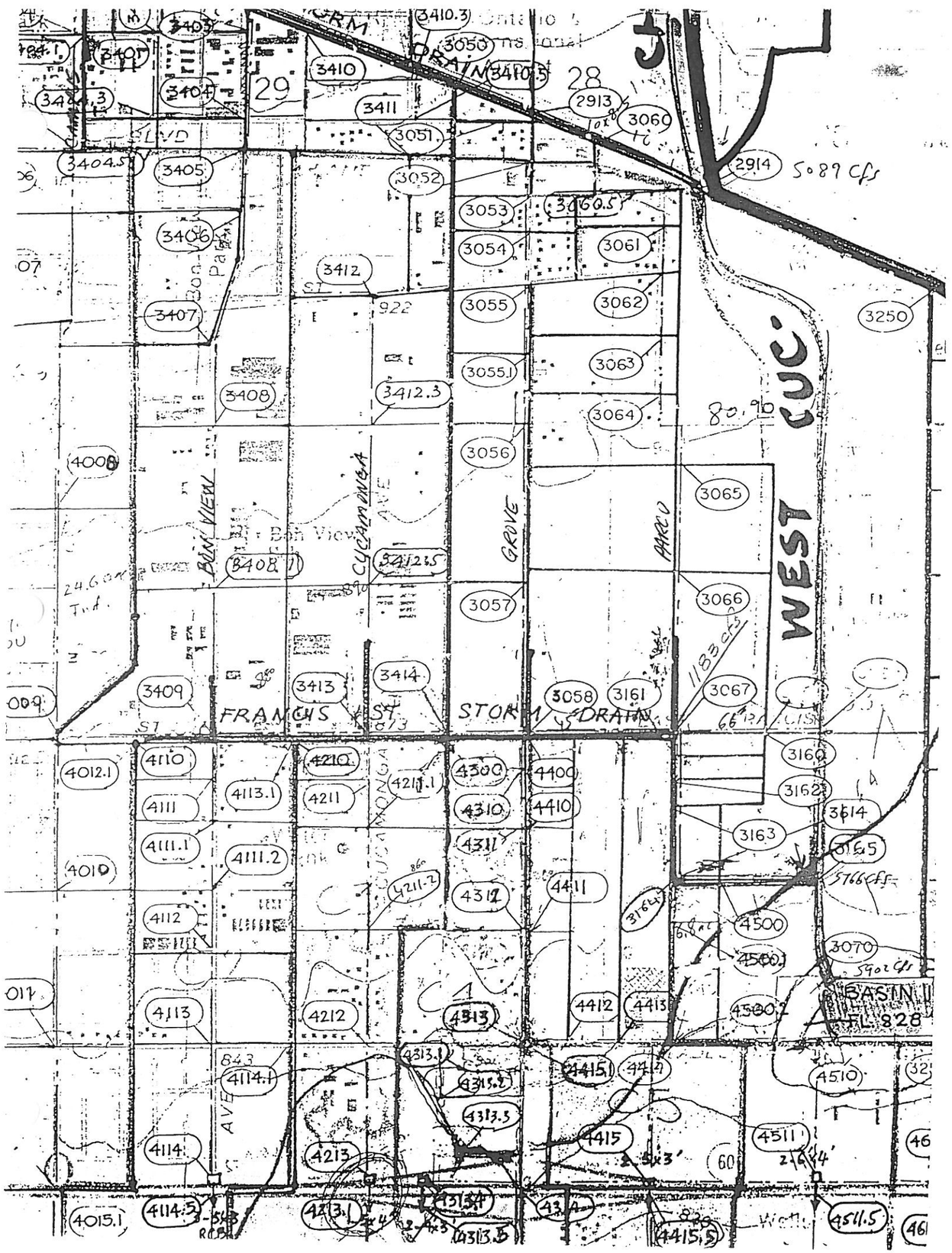
STREET CAPACITY CHART - CUCAMONGA AVENUE

CURB HEIGHT = 8" X-SLOPE = 2.0%
GUTTER WIDTH = 2.0' STREET GRADE = 1.25%
GUTTER HIKEUP = 0.19' MANNING'S N = 0.015

DEPTH AT CURB	FLOW AT GUTTER	WIDTH OF FLOW	AREA	HYD. RAD.	REMARKS
0.68	32.30	24.5	7.175	0.259	
0.69	33.59	25.0	7.450	0.260	
0.70	34.95	25.5	7.735	0.261	
0.71	36.38	26.0	8.030	0.262	
0.72	37.90	26.5	8.335	0.263	
0.73	39.49	27.0	8.650	0.265	
0.74	41.15	27.5	8.975	0.267	
0.75	42.90	28.0	9.310	0.269	
0.76	44.73	28.5	9.655	0.271	
0.77	46.63	29.0	10.010	0.273	
0.78	48.62	29.5	10.375	0.275	
0.79	50.69	30.0	10.750	0.278	FLOW AT CROWN
0.80	53.28	30.0	11.133	0.284	
0.81	55.93	30.0	11.520	0.290	
0.82	58.65	30.0	11.913	0.297	
0.83	61.44	30.0	12.310	0.303	
0.84	64.30	30.0	12.713	0.309	
0.85	67.23	30.0	13.120	0.315	
0.86	70.23	30.0	13.533	0.321	
0.87	73.30	30.0	13.950	0.327	
0.88	76.44	30.0	14.373	0.333	
0.89	79.65	30.0	14.800	0.339	
0.90	82.94	30.0	15.233	0.345	
0.91	86.30	30.0	15.670	0.351	FLOW AT R/W



APPENDIX



WEST CUC
FRANCIS ST STORM DRAIN
BON VIEW
CUCAMONGA
GROVE
PARCO
BASIN
FL 828
5089 cfs
5766 cfs
5902 cfs
1183 cfs
80.90
29
28

```
 STREET CROSS-SECTION INFORMATION:
 CURB HEIGHT(INCHES) =  8.0        STREET HALFWIDTH(FEET) = 38.00
 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =    .020
 OUTSIDE STREET CROSSFALL(DECIMAL) =    .020
 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
 MAXIMUM ALLOWABLE STREET FLOW DEPTH(FEET) =     .91
 STREET PARKWAY CROSSFALL(DECIMAL) =    .020
 *NOTE: STREET-CAPACITY MAY BE EXCEEDED*
 STREETFLOW HYDRAULICS BASED ON MAINLINE Tc :
 STREET HYDRAULICS COMPUTED USING ESTIMATED FLOW(CFS) =  793.06
   ***STREET FLOWING FULL***
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  1.90
   HALFSTREET FLOOD WIDTH(FEET) =   99.56
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.34
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    8.23

 *DEFICIENCY ANALYSIS(BASED ON REPLACEMENT SYSTEM HYDROLOGY):
 *REPLACEMENT PIPE SYSTEM (MANNING'S N = .013):
 ESTIMATED PIPE DIAMETER(INCH) = 120.00    NUMBER OF PIPES =   1
 DEPTH OF FLOW IN 120.0 INCH PIPE IS  96.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  12.69
 PIPE-FLOW(CFS) =    856.99
 PIPEFLOW TRAVEL TIME(MIN.) =   1.79    Tc(MIN.) =  29.09
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.115
 SUBAREA AREA(ACRES) =     .00       SUBAREA RUNOFF(CFS) =     .00
 TOTAL AREA(ACRES) =  487.15         PEAK FLOW RATE(CFS) =    856.99
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 *NOTE: ESTIMATED PEAK FLOW DEFAULTED TO UPSTREAM PEAK FLOW;
        STREET HYDRAULICS NOT COMPUTED*

 *PARALLEL PIPE SYSTEM (MANNING'S N = .013):
 PIPE DIAMETER(INCH) = 114.00    NUMBER OF PIPES =   1

****************************************************************
 FLOW PROCESS FROM NODE    3067.00 TO NODE    3067.00 IS CODE =   1
----------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  29.09
 RAINFALL INTENSITY(INCH/HR) =   2.12
 AREA-AVERAGED Fm(INCH/HR) =    .13
 AREA-AVERAGED Fp(INCH/HR) =    .97
 AREA-AVERAGED Ap =    .13
 EFFECTIVE STREAM AREA(ACRES) =  432.37
 TOTAL STREAM AREA(ACRES) =  487.15
 PEAK FLOW RATE(CFS) AT CONFLUENCE =    856.99

****************************************************************
 FLOW PROCESS FROM NODE    3060.00 TO NODE    3060.50 IS CODE =  2.1
----------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  540.00
 ELEVATION DATA: UPSTREAM(FEET) =    940.00  DOWNSTREAM(FEET) =    930.00
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```
Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]** .20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     8.362
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =   4.469
SUBAREA Tc AND LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
COMMERCIAL                 A        4.76       .98        .10     32    8.36
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =    .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =    .10
SUBAREA RUNOFF(CFS) =      18.73
TOTAL AREA(ACRES) =      4.76    PEAK FLOW RATE(CFS) =      18.73

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M =   .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

****************************************************************************
 FLOW PROCESS FROM NODE    3060.50 TO NODE    3061.00 IS CODE =  6.2
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =  930.00  DOWNSTREAM ELEVATION(FEET) =  926.00
STREET LENGTH(FEET) =   430.00   CURB HEIGHT(INCHES) =  8.0
STREET HALFWIDTH(FEET) = 32.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
INSIDE STREET CROSSFALL(DECIMAL) =   .020
OUTSIDE STREET CROSSFALL(DECIMAL)  =   .020
SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
STREET PARKWAY CROSSFALL(DECIMAL)  =   .020

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      28.64
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =   .56
  HALFSTREET FLOOD WIDTH(FEET) =   20.24
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.34
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.88
STREET FLOW TRAVEL TIME(MIN.) =   2.15   Tc(MIN.) =  10.51
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.897
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A        5.79       .98        .10     32
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =    .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =    .10
SUBAREA AREA(ACRES) =     5.79     SUBAREA RUNOFF(CFS) =    19.80
EFFECTIVE AREA(ACRES) =   10.55     AREA-AVERAGED Fm(INCH/HR) =    .10
AREA-AVERAGED Fp(INCH/HR) =   .98  AREA-AVERAGED Ap =    .10
TOTAL AREA(ACRES) =   10.55        PEAK FLOW RATE(CFS) =      36.07

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M =   .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

  OF SUBAREA STREET FLOW HYDRAULICS:
EPTH(FEET) =  .60   HALFSTREET FLOOD WIDTH(FEET) =  22.20
LOW VELOCITY(FEET/SEC.) =  3.53   DEPTH*VELOCITY(FT*FT/SEC.) =   2.12

****************************************************************************
```

```
 FLOW PROCESS FROM NODE    3061.00 TO NODE    3062.00 IS CODE =  6.2
----------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
======================================================================
 UPSTREAM ELEVATION(FEET) =  926.00  DOWNSTREAM ELEVATION(FEET) =  920.00
 STREET LENGTH(FEET) =   400.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 32.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =   .020
 OUTSIDE STREET CROSSFALL(DECIMAL) =   .020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2.
 STREET PARKWAY CROSSFALL(DECIMAL) =   .020

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      49.78
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =   .62
   HALFSTREET FLOOD WIDTH(FEET) =   22.90
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.58
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.82
 STREET FLOW TRAVEL TIME(MIN.) =   1.46   Tc(MIN.) =  11.96
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.605
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  A       8.68       .98        .10     32
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =   .98
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =   .10
 SUBAREA AREA(ACRES) =    8.68      SUBAREA RUNOFF(CFS) =   27.40
 EFFECTIVE AREA(ACRES) =   19.23    AREA-AVERAGED Fm(INCH/HR) =   .10
 AREA-AVERAGED Fp(INCH/HR) =  .98   AREA-AVERAGED Ap =   .10
 TOTAL AREA(ACRES) =   19.23        PEAK FLOW RATE(CFS) =      60.70

 SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
 5M =   .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) =   .65   HALFSTREET FLOOD WIDTH(FEET) =  24.77
 FLOW VELOCITY(FEET/SEC.) =  4.80   DEPTH*VELOCITY(FT*FT/SEC.) =   3.14

**********************************************************************
 FLOW PROCESS FROM NODE    3062.00 TO NODE    3063.00 IS CODE =  6.2
----------------------------------------------------------------------
 >>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>(STREET TABLE SECTION #  2 USED)<<<<<
======================================================================
 UPSTREAM ELEVATION(FEET) =  920.00  DOWNSTREAM ELEVATION(FEET) =  914.00
 STREET LENGTH(FEET) =   540.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 32.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =   .020
 OUTSIDE STREET CROSSFALL(DECIMAL) =   .020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
 STREET PARKWAY CROSSFALL(DECIMAL) =   .020

 **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      81.60
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 STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
 STREET FLOW DEPTH(FEET) =    .75
 HALFSTREET FLOOD WIDTH(FEET) =    33.35
 AVERAGE FLOW VELOCITY(FEET/SEC.) =     4.54
 PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     3.39
STREET FLOW TRAVEL TIME(MIN.) =  1.98   Tc(MIN.) =  13.94
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.288
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A       14.55       .98        .10    32
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =    .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =    .10
SUBAREA AREA(ACRES) =    14.55     SUBAREA RUNOFF(CFS) =    41.78
EFFECTIVE AREA(ACRES) =    33.78    AREA-AVERAGED Fm(INCH/HR) =    .10
AREA-AVERAGED Fp(INCH/HR) =    .98  AREA-AVERAGED Ap =    .10
TOTAL AREA(ACRES) =    33.78        PEAK FLOW RATE(CFS) =      97.01

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M =  .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) =  .78   HALFSTREET FLOOD WIDTH(FEET) =  37.25
FLOW VELOCITY(FEET/SEC.) =  4.68   DEPTH*VELOCITY(FT*FT/SEC.) =   3.68

****************************************************************************
FLOW PROCESS FROM NODE   3063.00 TO NODE   3064.00 IS CODE =  6.2
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =  914.00  DOWNSTREAM ELEVATION(FEET) =  908.00
STREET LENGTH(FEET) =   500.00   CURB HEIGHT(INCHES) =  8.0
STREET HALFWIDTH(FEET) = 32.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
INSIDE STREET CROSSFALL(DECIMAL) =   .020
OUTSIDE STREET CROSSFALL(DECIMAL) =   .020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
STREET PARKWAY CROSSFALL(DECIMAL) =   .020

 **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     116.60
 ***STREET FLOWING FULL***
 STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
 STREET FLOW DEPTH(FEET) =   .83
 HALFSTREET FLOOD WIDTH(FEET) =   40.01
 AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.69
 PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    3.88
STREET FLOW TRAVEL TIME(MIN.) =   1.78   Tc(MIN.) =  15.72
 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.060
SUBAREA LOSS RATE DATA(AMC  II):
DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A       14.69       .98        .10    32
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =    .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =    .10
SUBAREA AREA(ACRES) =    14.69     SUBAREA RUNOFF(CFS) =    39.17
EFFECTIVE AREA(ACRES) =    48.47    AREA-AVERAGED Fm(INCH/HR) =    .10
AREA-AVERAGED Fp(INCH/HR) =    .98  AREA-AVERAGED Ap =    .10
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TOTAL AREA(ACRES) =    48.47       PEAK FLOW RATE(CFS) =      129.24

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M =   .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) =   .85   HALFSTREET FLOOD WIDTH(FEET) =  41.11
FLOW VELOCITY(FEET/SEC.) =  4.85   DEPTH*VELOCITY(FT*FT/SEC.) =   4.12

****************************************************************************
FLOW PROCESS FROM NODE    3064.00 TO NODE    3065.00 IS CODE =  6.2
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =  908.00  DOWNSTREAM ELEVATION(FEET) =  897.00
STREET LENGTH(FEET) =   840.00   CURB HEIGHT(INCHES) =  8.0
STREET HALFWIDTH(FEET) = 32.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
INSIDE STREET CROSSFALL(DECIMAL) =   .020
OUTSIDE STREET CROSSFALL(DECIMAL) =   .020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
STREET PARKWAY CROSSFALL(DECIMAL) =   .020

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      151.64
  ***STREET FLOWING FULL***
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =   .88
  HALFSTREET FLOOD WIDTH(FEET) =   42.46
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.25
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    4.60
STREET FLOW TRAVEL TIME(MIN.) =   2.67   Tc(MIN.) =  18.39
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.786
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A       18.51      .98        .10     32
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =   .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =   .10
SUBAREA AREA(ACRES) =   18.51      SUBAREA RUNOFF(CFS) =   44.78
EFFECTIVE AREA(ACRES) =   66.98     AREA-AVERAGED Fm(INCH/HR) =   .10
AREA-AVERAGED Fp(INCH/HR) =   .98  AREA-AVERAGED Ap =   .10
TOTAL AREA(ACRES) =   66.98         PEAK FLOW RATE(CFS) =     162.05

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M =   .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) =   .89   HALFSTREET FLOOD WIDTH(FEET) =  43.25
FLOW VELOCITY(FEET/SEC.) =  5.36   DEPTH*VELOCITY(FT*FT/SEC.) =   4.78
*NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
       AND L =  840.0 FT WITH ELEVATION-DROP =  11.0 FT, IS   62.6 CFS,
       WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   3065.00

****************************************************************************
FLOW PROCESS FROM NODE    3065.00 TO NODE    3066.00 IS CODE =  6.3
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

>>>>>(STREET TABLE SECTION # 2 USED)<<<<<

UPSTREAM ELEVATION(FEET) = 897.00 DOWNSTREAM ELEVATION(FEET) = 880.00
STREET LENGTH(FEET) = 900.00 CURB HEIGHT(INCHES) = 8.0
ET HALFWIDTH(FEET) = 32.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) = 10.00
INSIDE STREET CROSSFALL(DECIMAL) = .020
OUTSIDE STREET CROSSFALL(DECIMAL) = .020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF = 2
STREET PARKWAY CROSSFALL(DECIMAL) = .020
MAXIMUM ALLOWABLE STREET FLOW DEPTH(FEET) = .87

**TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 210.60
STREET FLOWING FULL
STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
STREET FLOW DEPTH(FEET) = .91
HALFSTREET FLOOD WIDTH(FEET) = 44.29
AVERAGE FLOW VELOCITY(FEET/SEC.) = 6.57
PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) = 6.00
STREET FLOW TRAVEL TIME(MIN.) = 2.28 Tc(MIN.) = 20.67
100 YEAR RAINFALL INTENSITY(INCH/HR) = 2.597
SUBAREA LOSS RATE DATA(AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN
COMMERCIAL	A	43.15	.98	.10	32

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = .10
SUBAREA AREA(ACRES) = 43.15 SUBAREA RUNOFF(CFS) = 97.06
EFFECTIVE AREA(ACRES) = 110.13 AREA-AVERAGED Fm(INCH/HR) = .10
AREA-AVERAGED Fp(INCH/HR) = .98 AREA-AVERAGED Ap = .10
TOTAL AREA(ACRES) = 110.13 PEAK FLOW RATE(CFS) = 247.72

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M = .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = .96 HALFSTREET FLOOD WIDTH(FEET) = 46.42
FLOW VELOCITY(FEET/SEC.) = 6.90 DEPTH*VELOCITY(FT*FT/SEC.) = 6.59

NOTE: ESTIMATED STREET FLOW DEPTH IS GREATER THAN
THE MAXIMUM ALLOWABLE STREET FLOW DEPTH(FEET) = .87
SIZE PIPE(S) TO SATISFY THE STREET CONSTRAINT AS FOLLOWS:
PIPE SIZED TO MAXIMIZE STREETFLOW AT DOWNSTREAM NODE **
ESTIMATED PIPE DIAMETER(INCH) = 33.00 NUMBER OF PIPES = 1
ASSUME FULL-FLOWING PIPELINE
PIPE-FLOW VELOCITY(FEET/SEC.) = 11.92
PIPE-FLOW(CFS) = 70.84
PIPEFLOW TRAVEL TIME(MIN.) = 1.26 Tc(MIN.) = 19.64
100 YEAR RAINFALL INTENSITY(INCH/HR) = 2.677
SUBAREA AREA(ACRES) = 43.15 SUBAREA RUNOFF(CFS) = 100.18
TOTAL AREA(ACRES) = 110.13 PEAK FLOW RATE(CFS) = 255.69

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M = .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65
STREETFLOW HYDRAULICS BASED ON MAINLINE Tc :
STREET HYDRAULICS COMPUTED USING ESTIMATED FLOW(CFS) = 184.84
STREET FLOWING FULL
STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:

```
 STREET FLOW DEPTH(FEET) =    .88
 HALFSTREET FLOOD WIDTH(FEET) =   42.64
 AVERAGE FLOW VELOCITY(FEET/SEC.) =   6.33
 PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    5.57

****************************************************************************
FLOW PROCESS FROM NODE    3066.00 TO NODE    3067.00 IS CODE =  6.3
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =  880.00  DOWNSTREAM ELEVATION(FEET) =  866.00
STREET LENGTH(FEET) =  1340.00   CURB HEIGHT(INCHES) =  8.0
STREET HALFWIDTH(FEET) = 32.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
INSIDE STREET CROSSFALL(DECIMAL) =    .020
OUTSIDE STREET CROSSFALL(DECIMAL)  =    .020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
STREET PARKWAY CROSSFALL(DECIMAL)  =   .020
MAXIMUM ALLOWABLE STREET FLOW DEPTH(FEET) =    .91

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     324.54
  ***STREET FLOWING FULL***
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  1.13
  HALFSTREET FLOOD WIDTH(FEET) =   55.33
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.00
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    6.80
STREET FLOW TRAVEL TIME(MIN.) =   3.72   Tc(MIN.) =  23.36
 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.413
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A       66.05       .98        .10    32
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =    .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =    .10
SUBAREA AREA(ACRES) =   66.05      SUBAREA RUNOFF(CFS) =  137.62
EFFECTIVE AREA(ACRES) =  176.18    AREA-AVERAGED Fm(INCH/HR) =    .10
AREA-AVERAGED Fp(INCH/HR) =    .98  AREA-AVERAGED Ap =    .10
TOTAL AREA(ACRES) =  176.18        PEAK FLOW RATE(CFS) =     367.08

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
M =   .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

ND OF SUBAREA STREET FLOW HYDRAULICS:
EPTH(FEET) = 1.18   HALFSTREET FLOOD WIDTH(FEET) =  57.59
LOW VELOCITY(FEET/SEC.) =  6.20   DEPTH*VELOCITY(FT*FT/SEC.) =   7.31

NOTE: ESTIMATED STREET FLOW DEPTH IS GREATER THAN
      THE MAXIMUM ALLOWABLE STREET FLOW DEPTH(FEET) =  .91
IZE PIPE(S) TO SATISFY THE STREET CONSTRAINT AS FOLLOWS:
* PIPE SIZED TO CARRY TOTAL UPSTREAM PIPEFLOW **
ESTIMATED PIPE DIAMETER(INCH) =  57.00    NUMBER OF PIPES =   1
SOME FULL-FLOWING PIPELINE
IPE-FLOW VELOCITY(FEET/SEC.) =  12.76
IPE-FLOW(CFS) =    226.34
IPEFLOW TRAVEL TIME(MIN.) =  1.75    Tc(MIN.) =  21.39
 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.544
```

SUBAREA AREA(ACRES) = 66.05 SUBAREA RUNOFF(CFS) = 145.40
TOTAL AREA(ACRES) = 176.18 PEAK FLOW RATE(CFS) = 387.85

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M = .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65
STREETFLOW HYDRAULICS BASED ON MAINLINE Tc :
STREET HYDRAULICS COMPUTED USING ESTIMATED FLOW(CFS) = 161.51
STREET FLOWING FULL
STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
STREET FLOW DEPTH(FEET) = .92
HALFSTREET FLOOD WIDTH(FEET) = 44.65
AVERAGE FLOW VELOCITY(FEET/SEC.) = 4.94
PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) = 4.54
*NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
AND L = 1340.0 FT WITH ELEVATION-DROP = 14.0 FT, IS 193.6 CFS,
WHICH EXCEEDS THE SPECIFIED STREET CAPACITY AT NODE 3067.00

****
FLOW PROCESS FROM NODE 3067.00 TO NODE 3067.00 IS CODE = 1

>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==========
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 21.39
RAINFALL INTENSITY(INCH/HR) = 2.54
AREA-AVERAGED Fm(INCH/HR) = .10
AREA-AVERAGED Fp(INCH/HR) = .98
AREA-AVERAGED Ap = .10
EFFECTIVE STREAM AREA(ACRES) = 176.18
TOTAL STREAM AREA(ACRES) = 176.18
PEAK FLOW RATE(CFS) AT CONFLUENCE = 387.85

** CONFLUENCE DATA **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	856.99	29.09	2.115	.97(.13)	.13	432.4	3410.00
1	804.27	37.70	1.811	.97(.13)	.14	481.6	3404.10
1	764.57	41.02	1.721	.98(.13)	.13	487.1	3400.00
1	844.95	26.69	2.227	.97(.13)	.13	402.5	3050.00
2	387.85	21.39	2.544	.98(.10)	.10	176.2	3060.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	1182.65	26.69	2.227	.97(.12)	.12	578.6	3050.00
2	1176.91	29.09	2.115	.97(.12)	.12	608.5	3410.00
3	1075.89	37.70	1.811	.97(.12)	.13	657.8	3404.10
4	1022.01	41.02	1.721	.98(.12)	.13	663.3	3400.00
5	1166.98	21.39	2.544	.97(.12)	.12	498.7	3060.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 1182.65 Tc(MIN.) = 26.69
EFFECTIVE AREA(ACRES) = 578.63 AREA-AVERAGED Fm(INCH/HR) = .12
AREA-AVERAGED Fp(INCH/HR) = .98 AREA-AVERAGED Ap = .12
TOTAL AREA(ACRES) = 663.33

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3160 - 3161 tributal area

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
OMMERCIAL	A	3.49	.98	.10	32	12.13

U REA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = .98
UbAREA AVERAGE PERVIOUS AREA FRACTION, Ap = .10
UBAREA RUNOFF(CFS) = 10.92
OTAL AREA(ACRES) = 3.49 PEAK FLOW RATE(CFS) = 10.92

UBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
M = .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

****
LOW PROCESS FROM NODE 3161.00 TO NODE 3162.00 IS CODE = 6.2

>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>(STREET TABLE SECTION # 2 USED)<<<<<
==========
?STREAM ELEVATION(FEET) = 864.00 DOWNSTREAM ELEVATION(FEET) = 862.00
TREET LENGTH(FEET) = 200.00 CURB HEIGHT(INCHES) = 8.0
TREET HALFWIDTH(FEET) = 32.00

ISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) = 10.00
NSIDE STREET CROSSFALL(DECIMAL) = .020
UTSIDE STREET CROSSFALL(DECIMAL) = .020

?ECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF = 2
TREET PARKWAY CROSSFALL(DECIMAL) = .020

RAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 16.09
STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
STREET FLOW DEPTH(FEET) = .48
HALFSTREET FLOOD WIDTH(FEET) = 15.87
AVERAGE FLOW VELOCITY(FEET/SEC.) = 2.97
PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) = 1.41
'REET FLOW TRAVEL TIME(MIN.) = 1.12 Tc(MIN.) = 13.26
100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.390
)BAREA LOSS RATE DATA(AMC II):

)EVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN
)MMERCIAL	A	3.49	.98	.10	32

)BAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = .98
)BAREA AVERAGE PERVIOUS AREA FRACTION, Ap = .10
)BAREA AREA(ACRES) = 3.49 SUBAREA RUNOFF(CFS) = 10.34
'FECTIVE AREA(ACRES) = 6.98 AREA-AVERAGED Fm(INCH/HR) = .10
.EA-AVERAGED Fp(INCH/HR) = .98 AREA-AVERAGED Ap = .10
'TAL AREA(ACRES) = 6.98 PEAK FLOW RATE(CFS) = 20.68

'BAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
= .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

D OF SUBAREA STREET FLOW HYDRAULICS:
PTH(FEET) = .51 HALFSTREET FLOOD WIDTH(FEET) = 17.51
.OW VELOCITY(FEET/SEC.) = 3.18 DEPTH*VELOCITY(FT*FT/SEC.) = 1.62

****
.OW PROCESS FROM NODE 3162.00 TO NODE 3163.00 IS CODE = 6.2

>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>(STREET TABLE SECTION # 2 USED)<<<<<
==========

```
 UPSTREAM ELEVATION(FEET) =  862.00  DOWNSTREAM ELEVATION(FEET) =  860.00
 STREET LENGTH(FEET) =   220.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 32.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =   .020
 OUTSIDE STREET CROSSFALL(DECIMAL) =   .020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
 STREET PARKWAY CROSSFALL(DECIMAL) =   .020

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      25.60
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =   .55
   HALFSTREET FLOOD WIDTH(FEET) =   19.46
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.22
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.76
STREET FLOW TRAVEL TIME(MIN.) =   1.14   Tc(MIN.) =  14.39
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.226
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A        3.49       .98        .10     32
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =   .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =   .10
SUBAREA AREA(ACRES) =    3.49      SUBAREA RUNOFF(CFS) =    9.83
EFFECTIVE AREA(ACRES) =   10.47    AREA-AVERAGED Fm(INCH/HR) =   .10
AREA-AVERAGED Fp(INCH/HR) =   .97  AREA-AVERAGED Ap =   .10
TOTAL AREA(ACRES) =   10.47        PEAK FLOW RATE(CFS) =   29.48

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M =  .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) =  .57   HALFSTREET FLOOD WIDTH(FEET) =  20.63
FLOW VELOCITY(FEET/SEC.) =  3.31   DEPTH*VELOCITY(FT*FT/SEC.) =   1.89

****************************************************************************
FLOW PROCESS FROM NODE    3163.00 TO NODE    3164.00 IS CODE =  6.2
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =  860.00  DOWNSTREAM ELEVATION(FEET) =  852.00
STREET LENGTH(FEET) =   600.00   CURB HEIGHT(INCHES) =  8.0
STREET HALFWIDTH(FEET) = 32.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
INSIDE STREET CROSSFALL(DECIMAL) =   .020
OUTSIDE STREET CROSSFALL(DECIMAL) =   .020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
STREET PARKWAY CROSSFALL(DECIMAL) =   .020

   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      36.52
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =   .57
  HALFSTREET FLOOD WIDTH(FEET) =   20.79
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.05
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.32
```

```
STREET FLOW TRAVEL TIME(MIN.) =   2.47   Tc(MIN.) =  16.87
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.934
SUBAREA LOSS RATE DATA(AMC  II):
I  ELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A       5.51       .98        .10    32
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =    .98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =    .10
SUBAREA AREA(ACRES) =     5.51      SUBAREA RUNOFF(CFS) =    14.06
EFFECTIVE AREA(ACRES) =   15.98     AREA-AVERAGED Fm(INCH/HR) =    .10
AREA-AVERAGED Fp(INCH/HR) =   .98   AREA-AVERAGED Ap =    .10
TOTAL AREA(ACRES) =   15.98         PEAK FLOW RATE(CFS) =      40.79

SUBAREA AREA-AVERAGED RAINFALL DEPTH(INCH):
5M =   .50; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) =  .59   HALFSTREET FLOOD WIDTH(FEET) =  21.73
FLOW VELOCITY(FEET/SEC.) =  4.15   DEPTH*VELOCITY(FT*FT/SEC.) =   2.46

****************************************************************************
FLOW PROCESS FROM NODE   3164.00 TO NODE   3164.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TI  OF CONCENTRATION(MIN.) =  16.87
RAINFALL INTENSITY(INCH/HR) =   2.93
AREA-AVERAGED Fm(INCH/HR) =   .10
AREA-AVERAGED Fp(INCH/HR) =   .98
AREA-AVERAGED Ap =   .10
EFFECTIVE STREAM AREA(ACRES) =   15.98
TOTAL STREAM AREA(ACRES) =   15.98
PEAK FLOW RATE(CFS) AT CONFLUENCE =     40.79
** CONFLUENCE DATA **
STREAM       Q          Tc        AREA       HEADWATER
NUMBER     (CFS)      (MIN.)    (ACRES)       NODE
   1      1182.65     41.95      663.33      3400.00
   2        40.79     16.87       15.98      3160.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
UNIT-HYDROGRAPH DATA:
RAINFALL(INCH): 5M=   .50;30M= 1.02;1H= 1.34;3H= 2.35;6H= 3.34;24H= 6.65
S-GRAPH: VALLEY(DEV.)=100.0%;VALLEY(UNDEV.)/DESERT=    .0%
         MOUNTAIN=    .0%;FOOTHILL=    .0%;DESERT(UNDEV.)=    .0%
Tc(HR) =   .70; LAG(HR) =   .56; Fm(INCH/HR) =  .12; Ybar =  .15
USED SIERRA MADRE DEPTH-AREA CURVES WITH AMC  II CONDITION.
UNIT-INTERVAL(MIN) =  5.00    TOTAL AREA(ACRES) =     679.31
LONGEST FLOWPATH FROM NODE   3400.00 TO NODE   3164.00 = 13220.00 FEET.
TIME OF PEAK FLOW(HR) = 16.58  RUNOFF VOLUME(AF) =      323.78
PEAK FLOW RATE(CFS) =   1027.07
  'UPSTREAM NODE PEAK FLOW RATE(CFS) =   1182.65)
P.  K FLOW RATE(CFS) USED =   1182.65

****************************************************************************
FLOW PROCESS FROM NODE   3164.00 TO NODE   3165.00 IS CODE =  3.1
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
LEVATION DATA: UPSTREAM(FEET) =   841.00  DOWNSTREAM(FEET) =   837.00
L( LENGTH(FEET) =  1200.00   MANNING'S N =  .013
EPTH OF FLOW IN 132.0 INCH PIPE IS 106.5 INCHES
IPE-FLOW VELOCITY(FEET/SEC.) =  14.39
STIMATED PIPE DIAMETER(INCH) = 132.00    NUMBER OF PIPES =   1
IPE-FLOW(CFS) =   1182.65
IPE TRAVEL TIME(MIN.) =   1.39    Tc(MIN.) =  43.34
**********************************************************************
LOW PROCESS FROM NODE   3165.00 TO NODE   3165.00 IS CODE = 15.1
----------------------------------------------------------------------
>>>>DEFINE MEMORY BANK # 1 <<<<<
==========================================================================
EAK FLOWRATE TABLE FILE NAME: A:\ont1ampd.DNA
EMORY BANK #  1 DEFINED AS FOLLOWS:
EAK FLOW RATE(CFS) =      2981.49    Tc(MIN.) =  61.41
REA-AVERAGED Fm(INCH/HR) =   .37    Ybar =  .38
OTAL AREA(ACRES) =     2960.41
ONGEST FLOWPATH FROM NODE   2200.00 TO NODE   3165.00 = 31014.00 FEET.
**********************************************************************
FLOW PROCESS FROM NODE   3165.00 TO NODE   3165.00 IS CODE =  11
----------------------------------------------------------------------
>>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
==========================================================================
```

43.34 - 26.69 = 16.69

```
*  MAIN STREAM CONFLUENCE DATA **
PEAK FLOW RATE(CFS) =      1182.65    Tc(MIN.) =  43.34
AREA-AVERAGED Fm(INCH/HR) =   .12    Ybar =  .15
TOTAL AREA(ACRES) =      679.31
LONGEST FLOWPATH FROM NODE   3400.00 TO NODE   3165.00 = 14420.00 FEET.
```

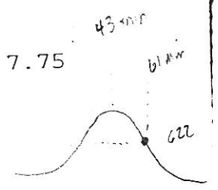
pipe

```
** MEMORY BANK #  1 CONFLUENCE DATA **
PEAK FLOW RATE(CFS) =      2981.49    Tc(MIN.) =  61.41
AREA-AVERAGED Fm(INCH/HR) =   .37    Ybar =  .38
TOTAL AREA(ACRES) =     2960.41
LONGEST FLOWPATH FROM NODE   2200.00 TO NODE   3165.00 = 31014.00 FEET.
```

Channel

```
COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
UNIT-HYDROGRAPH DATA:
RAINFALL(INCH): 5M=  .51;30M= 1.05;1H= 1.38;3H= 2.49;6H= 3.61;24H= 7.75
S-GRAPH: VALLEY(DEV.)=100.0%;VALLEY(UNDEV.)/DESERT=   .0%
         MOUNTAIN=   .0%;FOOTHILL=   .0%;DESERT(UNDEV.)=   .0%
Tc(HR) = 1.02; LAG(HR) =  .82; Fm(INCH/HR) =  .33; Ybar =  .34
USED SIERRA MADRE DEPTH-AREA CURVES WITH AMC  II CONDITION.
UNIT-INTERVAL(MIN) =  5.00   TOTAL AREA(ACRES) =   3639.72
LONGEST FLOWPATH FROM NODE   2200.00 TO NODE   3165.00 = 31014.00 FEET.
TIME OF PEAK FLOW(HR) = 16.83  RUNOFF VOLUME(AF) =    1595.15
PEAK FLOW RATE(CFS) =    3602.96
```

PEAK



3603 - 2981 = 622/1182 = 53%

Tc = 61.40

```
**********************************************************************
FLOW PROCESS FROM NODE   3165.00 TO NODE   3070.00 IS CODE =  5.1
----------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (NEW ELEMENT)<<<<<
==========================================================================
ELEVATION DATA: UPSTREAM(FEET) =   837.00  DOWNSTREAM(FEET) =   828.00
CHANNEL LENGTH THRU SUBAREA(FEET) =   860.00   CHANNEL SLOPE =   .0105
```

```
 BASE(FEET) =    30.00    "Z" FACTOR =  .000
'S' FACTOR =    .015    MAXIMUM DEPTH(FEET) =    8.00
 FLOW THRU SUBAREA(CFS) =    3602.96
LOCITY(FEET/SEC) =  24.32    FLOW DEPTH(FEET) =    4.94
T E(MIN.) =     .59    Tc(MIN.) =  61.99

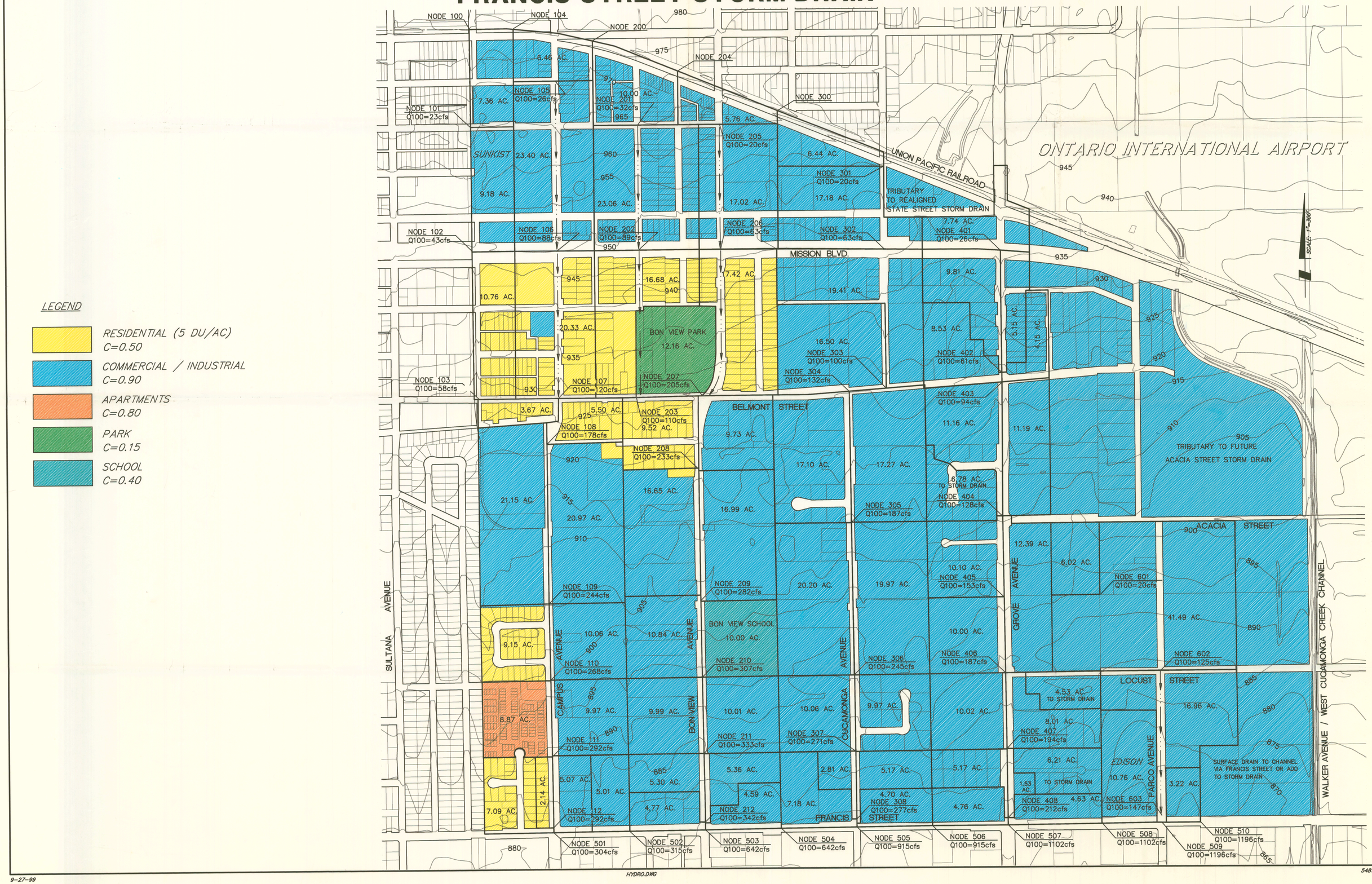
****************************************************************
OCESS FROM NODE    3070.00 TO NODE    3070.00 IS CODE =  8.1
----------------------------------------------------------------
DITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
================================================================
E Tc(MIN) =  61.99
EAR RAINFALL INTENSITY(INCH/HR) =  1.343
 LOSS RATE DATA(AMC  II):
EMENT TYPE/       SCS SOIL    AREA      Fp          Ap       SCS
ND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)   CN
AL                   A      116.10       .98         .10    32
AL                   B       24.00       .75         .10    56
 AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =    .94
 AVERAGE PERVIOUS AREA FRACTION, Ap =    .10
ROGRAPH DATA:
(INCH): 5M=   .51;30M= 1.05;1H= 1.38;3H= 2.48;6H= 3.60;24H= 7.71
 VALLEY(DEV.)=100.0%;VALLEY(UNDEV.)/DESERT=    .0%
 MOUNTAIN=    .0%;FOOTHILL=    .0%;DESERT(UNDEV.)=    .0%
 1.03; LAG(HR) =  .83; Fm(INCH/HR) =  .32; Ybar =  .33
RRA MADRE DEPTH-AREA CURVES WITH AMC  II CONDITION.
ERVAL(MIN) =  5.00    TOTAL AREA(ACRES) =   3779.82
FLOWPATH FROM NODE    2200.00 TO NODE    3070.00 = 31874.00 FEET.
PEAK FLOW(HR) = 16.83  RUNOFF VOLUME(AF) =    1664.52
L ACRES) =  3779.82        PEAK FLOW RATE(CFS) =    3699.70

AREA-AVERAGED RAINFALL DEPTH(INCH):
0; 30M = 1.02; 1HR = 1.34; 3HR = 2.35; 6HR = 3.34; 24HR = 6.65
================================================================
TUDY SUMMARY:
EA(ACRES)      =   3779.82  TC(MIN.) =     61.99
RAGED Fm(INCH/HR)=   .32    Ybar =    .33
W RATE(CFS)    =   3699.70
================================================================
================================================================
ATIONAL METHOD ANALYSIS
```

NEED 2914 → 3069

3069 → 3165

EXHIBIT "A"
HYDROLOGY MAP
FOR
FRANCIS STREET STORM DRAIN



9-27-99

HYDRO.DWG

54810.00

Appendix D

Table 5-1

Existing Regional Conservation Basin Parameters[1]

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
								Maximum Conservation Storage[2]			Rule Curves Apr 16 - Oct 15			Rule Curves Oct 16 - Apr 15			Annual Recharge Estimates[3]					Control Element Settings		
Basins	Owner	Bottom Elevation (ft MSL)	Spillway Elevation (ft MSL)	Maximum Intake Capacity from Channel (cfs)	Storage Volume at Spillway Elevation (af)	Typical Percolation Rate (ft/day)	Recharge Capacity (cfs)	Maximum Operation Depth (ft)	Maximum Operating Elevation (ft MSL)	Storage Volume at Maximum Operating Depth (af)	Elevation (ft MSL)	Storage (af)	Percent Full	Elevation (ft MSL)	Storage (af)	Percent Full	Storm Water (af/yr)	Supplemental Water (af/yr)	Recycled Water (af/yr)	Control Element	Operator	First Storm	Non-Significant Storm	Significant Storm
San Antonio Channel - CB59																				San Antonio Channel Rubber Dam	Rubber dam operated from adjacent control building or SCADA	Deflated	Deflated	Deflated
College Heights West (MZ1)	CBWCD	1,224.0	1,243.0	162.3	87.8	2.5	15	10.0	1,234.0	39.4	NA	NA	NA	NA	NA	NA	50	0	0	San Antonio Channel to College Heights West	Automated Sluice Gate	Closed	Closed	Closed[5]
College Heights East (MZ1)	CBWCD	1,224.0	1,243.0	161.4	83.0	2.5		10.0	1,234.0	33.4	NA	NA	NA	NA	NA	NA				San Antonio Channel to College Heights East	Automated Sluice Gate	Closed	Open	Closed[5]
Montclair 1 (MZ1)	CBWCD	1,099.0	1,127.2	100.0	117.0	1.5	40	28.0	1,127.0	117.0	1,127.2	134.0	100%	1,127.2	134.0	100%	340	2,331	668	San Antonio Channel to Montclair 1	Automated Sluice Gate	Closed	Open	Open
Montclair 2 (MZ1)	CBWCD	1,070.0	1,102.0	-	308.0	1.5		28.0	1,098.0	258.0 [4]	1,098.0	258.0	100%	1,087.0	132.0	51%	370	3,682	1,013	Montclair 1 to Montclair 2	Manual Sluice Gate	Open	Open	Open
Montclair 3 (MZ1)	CBWCD	1,034.0	1,054.0	-	33.0	1.5		20.0	1,054.0	33.0	1,054.0	33.0	100%	1,034.0	0.0	0%	160	1,317	369	Montclair 2 to Montclair 3	Manual Sluice Gate	Open	Open	Open
Montclair 4 (MZ1)	CBWCD	1,010.0	1,037.0	-	111.0	1.5		27.0	1,037.0	111.0	1,037.0	111.0	100%	1,010.0	0.0	0%	250	1,697	487	Montclair 3 to Montclair 4 Montclair 4 to San Antonio Creek	Passive Overflow Passive Overflow	NA NA	NA NA	NA NA
Brooks (MZ1)[5]	CBWCD	860.0	923.0	112.1	200.0	1.5	5	29.0	875/893 [6]	185.0 [6]	888.0	180.0	90%	875.0	65.0	13%	1,710	3,724	1,359	San Antonio Channel to Brooks Basin	Automated Sluice Gate	Closed	Open	Varies[7]
West Cucamonga Channel																								
Ely 1 (MZ2)	SBCFCD	823.0	835.0	NA	85.0	0.5	5	5.0	828.0	22.0	828.0	22.0	26%	828.0	22.0	26%	1,570	3,167	1,184	West Cucamonga Channel to Ely 1 Basin	Manual Sluice Gate	Open	Open	Open
Ely 2 (MZ2)	SBCFCD	825.0	835.0	-	96.0	0.5		3.0	828.0	25.0	828.0	25.0	26%	828.0	25.0	26%				Ely 1 Basin to Ely 2 Basin	Manual Sluice Gate	Open	Open	Open
Ely 3 Cells 1 (MZ2)[8]	CBWCD	820.0	835.0	-	136.0	0.5		3.8	823.8	12.0	823.8	11.8	100%	823.8	11.8	100%				Ely 2 Basin to Ely 3 Basin to Cell 1	Manual Sluice Gate	Open	Open	Open
Ely 3 Cells 2 (MZ2)[8]	CBWCD	820.0	835.0	-		0.5		3.8	823.8	9.0	823.8	8.7	100%	823.8	8.7	100%				Ely 2 Basin to Ely 3 Basin to Cell 2	Manual Sluice Gate	Open	Open	Open
Ely 3 Cells 3 (MZ2)[8]	CBWCD	820.0	835.0	-		0.5		3.8	823.8	9.0	823.8	9.1	100%	823.8	9.1	100%				Ely 2 Basin to Ely 3 Basin to Cell 3 Ely 3 to West Cucamonga Channel	Manual Sluice Gate Automated Sluice Gate	Open Closed	Open Closed	Open Open
Riverside Drive Drain																								
Grove (MZ2)	CBWCD	742.5	767.3	NA	305.5	0.25	NA	5.0	747.5	52.0	742.9	0.0	0%	747.5	52.0	100%	NA	NA	NA	Grove Basin to Grove Ave.	Automated Sluice Gate	Closed	Closed	Open
Cucamonga/Deer Cr Channels - CB11																				Cucamonga Channel Rubber Dam	Rubber dam operated from adjacent control building or SCADA	Deflated	Inflated	Deflated
Turner 1 (MZ2)	CBWCD	965.0	1,000.0	255.0 182.7	266.0	0.5	6	13.0	978.0	56.0	981.0	80.0	30%	978.0	56.0	21%	1,240	1,098	584	Cucamonga Channel Inlet to Turner Basin 1 Deer Creek Channel Drop Inlet (48" pipe) to Turner Basin 1	Automated Sluice Gate Automated Sluice Gate	Closed Closed	Open Closed	Open Closed
Turner 2 (MZ2)	SBCFCD	968.0	990.0	-	52.0	0.5		10.0	978.0	16.0	978.0	16.0	31%	978.0	16.0	31%				Turner Basin 1 to Turner Basin 2 (42" pipe)	Manual Sluice Gate	Closed[9]	Closed[9]	Open
Turner 3 (MZ2)	SBCFCD	966.0	986.5	-	120.0	0.5		12.0	978.0	60.0	978.0	59.6	50%	978.0	59.6	39%	640	937	394	Turner Basin 4 to Turner Basin 3 (42" pipe)	Manual Sluice Gate	Open	Open	Closed
Turner 4 (MZ2)	SBCFCD	961.0	987.0 [10]	224.9	50.0	0.5		17.0	978.0	25.0	978.0	25.0	39%	978.0	25.0	50%				Deer Creek Drop Inlet (48" pipe) to Turner Basin 4	Automated Sluice Gate	Closed	Open	Closed
Etiwanda Channel - CB14																								
Victoria North (MZ2)	SBCFCD	1,313.0	1,318.0	100.0	28.5	1.5	6	3.0	1,316.0	19.0	1,317.5	23.7	67%	1,317.5	23.7	67%	2,090	2,365	1,114	San Sevaine Channel Outlet/Inlet to Victoria Basin North	Automated Sluice Gate	Closed	Open	Closed
Victoria South (MZ2)[11]	SBCFCD	1,309.0	1,318.0	-	47.1	1.5		7.0	1,316.0	31.8	1,317.5	43.2	84%	1,317.5	43.2	84%				Victoria Basin North to Victoria Basin South Victoria Basin South to San Sevaine Channel	Manual Sluice Gate Automated Sluice Gate	Open Closed	Open Closed	Open Closed
Etiwanda Conservation Ponds (MZ3)	SBCFCD	1,010.0	1,048.0	NA	120.0	1.0	NA	11.0	1,048.0	120.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DeClez Channel																				DeClez Channel Rubber Dam DeClez Channel Outlet/Inlet to Feeder Channel[13] Feeder Channel to RP3 Junction Structure Feeder Channel Flow Control Feeder Channel Outlet to DeClez Channel	Rubber dam operated from adjacent control building or SCADA Automated Sluice Gate Manual Sluice Gate Manual Sluice Gate Manual Sluice Gate	Deflated Closed Closed[14] Closed[15] Closed	Inflated Open Closed[14] Closed[15] Closed	Deflated Open Closed[14] Closed[15] Closed
RP3 Cell 1a (MZ3)	IEUA	948.0	952.0	-	20.0	2.5	7	2.0	950.0	10.0	952.0	20.0	100%	952.0	20.0	100%	1,330	6,562	1,973	Jurupa Basin to RP3 Cell 1a RP3 Cell 1a to Junction Structure	Automated Valve Manual Sluice Gate	NA Open	NA Open	NA Open
RP3 Cell 1b (MZ3)	IEUA	948.0	952.0	-	13.2	2.5		2.0	950.0	6.3	952.0	13.2	100%	952.0	13.2	100%				RP3 Cell 1b to Junction Structure	Manual Sluice Gate	Open	Open	Open
RP3 Cell 2 (MZ3)	IEUA	949.0	955.0	-	48.1	2.5		4.0	953.0	31.4	949.0	0.0	0%	955.0	48.1	100%				Feeder Channel to RP3 Cell 2	Manual Sluice Gate	Open	Open	Open
RP3 Cell 3a (MZ3)	IEUA	941.0	946.0	-	12.9	2.5		3.0	944.0	7.4	945.0	10.3	80%	945.0	10.3	80%				Feeder Channel to RP3 Cell 3a	Manual Sluice Gate	Open	Open	Open
RP3 Cell 3b (MZ3)	IEUA	941.0	946.0	-	13.2	2.5		3.0	944.0	6.3	945.0	10.6	80%	945.0	10.6	80%				Feeder Channel to RP3 Cell 3b	Manual Sluice Gate	Open	Open	Open
RP3 Cell 4a (MZ3)	IEUA	937.0	942.0	-	13.1	2.5		3.0	940.0	9.6	941.0	10.5	80%	941.0	10.5	80%				Feeder Channel to RP3 Cell 4a	Manual Sluice Gate	Open	Closed	Closed
RP3 Cell 4b (MZ3)	IEUA	937.0	942.0	-	15.1	2.5		3.0	940.0	7.3	941.0	12.1	80%	941.0	12.1	80%				Feeder Channel to RP3 Cell 4b	Manual Sluice Gate	Open	Closed	Closed

Notes:

[1] Recharge Basin Operating Parameters represent the most recent available data reported in either the March 2006 Chino Basin Recharge Facilities Operation Procedures prepared for the Groundwater Recharge Coordinating Committee by WEI, the August 2001 Recharge Master Plan Phase II Report prepared for Chino Basin Watermaster by WEI and Black & Veatch, the January 1998 Chino Basin Recharge Master Plan prepared for CBWCD and Chino Basin Watermaster by WEI, SBCFCD Facility Drawings, or SBCFCD Zone 1 Project Systems Inventory.

[2] Water level and storage generally associated with the maximum storage with one foot of freeboard.

[3] Recharge estimates post Chino Basin Facilities Improvement Project.

[4] Open when San Antonio Dam releases and water quality is acceptable.

[5] Exception to the rule for 7-day perc out due to basin geometry. Maximum Inlet Capacity from West State Street is 96.24 cfs.

[6] Brooks Street Basin has a desired maximum operation elevation of 893 feet MSL. Groundwater monitoring is being done in piezometers adjacent this basin to determine slope stability. Pending evaluation of this monitoring data, 875 feet MSL will be the maximum operating water surface elevation for supplemental recharge operations. Storm water can be retained in Brooks Street Basin in excess of 875 feet MSL provided that no additional supplemental water will be discharged into the basin until the water surface elevation falls below 875 feet MSL.

[7] Generally, gate should be open to capture storm water from San Antonio Creek. Gate SAC-BRK-A must be closed if water surface elevation in Brooks Street is greater than the inlet elevation.

[8] The storage shown for Ely 3 Maximum Conservation Storage and Rule Curves is based on the storage at the top of internal berms, minus 1.0 foot.

[9] Closed until Turner 1 is full.

[10] Only possible if Deer Creek gate DRC-TR4-A is shut and local flow fills basins.

[11] Maximum Inlet Capacity from Etiwanda Channel is 156.2 cfs.

[12] Open if Banana Basin is full.

[13] Maximum Intake Capacity from Declez Channel to RP3 Diversion is 192.0 cfs.

[14] Changed from March 2006 document per personal communication from Andy Campbell. Adjusted Rule Curve elevations based on capacity curves in March 2006 document.

[15] Closed until Cell 3 is full.

Table 6-3
Supplemental Water Recharge Capacity Estimates[1]

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	Supplemental Water Recharge																						
	Operational Availability for Supplemental Water Recharge												Average Recharge Rate[2]	Supplemental Water Recharge Capacity	Turn Out Capacity				Theoretical Maximum Imported Water Recharge Capacity				
	Quarter 3			Quarter 4			Quarter 1			Quarter 2													
Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			Turn Out Name	Max Discharge Rate	Useful Discharge Rate	Turn Out Limited[3]?	Annual	Q3	Q4	Q1	Q2
													(cfs)	(acre-ft/yr)		(cfs)	(cfs)		(acre-ft/Qtr)				
Brooks Street Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474				No	2,474	652	794	281	746
College Heights Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	15	7,421				No	7,421	1,957	2,383	843	2,238
Montclair Basin 1	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Montclair Basin 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77			OC59	300	300						
Montclair Basin 3	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	40	19,789				No	19,789	5,219	6,355	2,247	5,968
Montclair Basin 4	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Seventh and Eighth Street Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	CB20	30	*30*	No	2,474	652	794	281	746
Upland Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	20	9,895	OC59	80	80	No	9,895	2,610	3,177	1,124	2,984
Subtotal Management Zone 1														***42,052***					***42,052***	***11,091***	***13,504***	***4,775***	***12,682***
Ely Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	CB20	30	*30*	No	2,474	652	794	281	746
Etiwanda Spreading Area (Joint Use of Etiwanda Debris Basin)	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	7	3,463	CB14	30	*30*	No	3,463	913	1,112	393	1,044
Hickory Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	CB18	30	30	Yes	2,061	544	662	234	622
Lower Day Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	9	4,453	CB15	30	20	No	4,453	1,174	1,430	506	1,343
San Sevaine No. 1	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
San Sevaine No. 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
San Sevaine No. 3	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	50	24,736	CB13	30	23	Yes	11,379	3,001	3,654	1,292	3,432
San Sevaine Nos. 4 and 5	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Turner Basins Nos. 1 and 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Turner Basins Nos. 3 and 4	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	3	1,484	CB11	40	9	No	1,484	391	477	169	448
Victoria Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	6	2,968	CB14	30	*30*	No	2,968	783	953	337	895
Subtotal Management Zone 2														***42,052***					***28,282***	***7,459***	***9,082***	***3,211***	***8,529***
Banana Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474					2,061	544	662	234	622
Declez Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	6	2,968	CB18	30	30	Yes	2,474	652	794	281	746
IEUA RP3 Ponds	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	20	9,895					8,245	2,175	2,648	936	2,487
Subtotal Management Zone 3														***15,337***					***12,780***	***3,371***	***4,104***	***1,451***	***3,854***
Total														**99,440**					**83,114**	**21,920**	**26,690**	**9,438**	**25,066**

1 -- Historical recharge estimates provided by IEUA. Recharge basins not optimized for storm water recharge; actual recharge performance could be improved.
2 -- Per Andy Campbell of IEUA, August 2007
3 -- Turn Out Capacity for the San Sevaine Basins is 30 cfs but is limited to 23 cfs due to operational considerations on the Rialto Feeder; 23 cfs assumed.

Appendix E

Attachment 4
Budget

The City is pursuing multiple state funding sources that include this program, Proposition 1E SWFM, and Proposition 84, IRWM funding. The budget is presented meets or exceeds matching requirements for each program as follows:

1. Proposition 1E, SWFM-the budget includes 50% local matching funds as required by the SWFM grant program
2. Proposition 84, IRWM-the IRWM grant program only requires 25% local matching funds; however, to remain consistent with the SWFM grant requirements, 50% local matching funds will be included

A breakdown of the match amounts are presented below:

Category	IRWM Grant	50% IRWM Match	SWFM Grant	50% SWFM Match	Total Match
Admin	$ 11,538	$ 11,538	$ 116,462	$ 116,462	$ 128,000
Land Acquisition	$ -	$ -	$ -	$ -	$ -
Engineering	$ 51,923	$ 51,923	$ 524,077	$ 524,077	$ 576,000
Construction	$ 576,923	$ 576,923	$ 5,823,077	$5,823,077	$6,400,000
Env. Compl. Mit, and Enh.	$ 11,538	$ 11,538	$ 116,462	$ 116,462	$ 128,000
Construction Admin	$ 40,385	$ 40,385	$ 407,615	$ 407,615	$ 448,000
Other	$ -	$ -	$ -	$ -	$ -
Construction Contingencies	$ 57,692	$ 57,692	$ 582,308	$ 582,308	$ 640,000
Total:	**$ 750,000**	**$ 750,000**	**$7,570,000**	**$7,570,000**	**$8,320,000**

The blended match requirements result in an overall match of 50% as shown on Table 5.

The City has submitted an application to Santa Ana Watershed Project Authority (SAWPA) for inclusion in the region's IRWM application to the state. The City project has been identified to receive $750,000 of funding in the IRWM program. Those amounts are included in the budget plan shown on Table 5 within column c. If the City is not successful in acquiring those funds, local funds will replace those budget amounts overall increasing the City's match funding percentage to 50% of the amount requested for the SWFM program.

Table 5 - Project Budget

Project: Francis Street Storm Drain and Ely Basin Flood Control and Aquifer Recharge Project

	Budget Category[2.]	(a) Requested Grant Funding	(b) Non-State Share[1.] (Funding Match)	(c) Other State Funds Being Used	(d) Total	(e) % Funding Match[3.]
(a)	Direct Project Administration Costs	$ 116,462	$ 128,000	$ 11,538	$ 256,000	50%
(b)	Land Purchase/Easement	$ -	$ -	$ -	$ -	-
(c)	Planning/Design/Engineering/ Environmental Documentation	$ 524,077	$ 576,000	$ 51,923	$ 1,152,000	50%
(d)	Construction/Implementation	$ 5,823,077	$ 6,400,000	$ 576,923	$ 12,800,000	50%
(e)	Environmental Compliance/ Mitigation/Enhancement	$ 116,462	$ 128,000	$ 11,538	$ 256,000	50%
(f)	Construction Administration	$ 407,615	$ 448,000	$ 40,385	$ 896,000	50%
(g)	Other Costs	$ -	$ -	$ -	$ -	-
(h)	Construction/Implementation Contingency	$ 582,308	$ 640,000	$ 57,692	$ 1,280,000	50%
(i)	**Grand Total**	**$ 7,570,000**	**$ 8,320,000**	**$ 750,000**	**$ 16,640,000**	**50%**

Notes:

1.) The City of Ontario will use development impact fees (DIF) to pay for design and construction, which will be paid back by the County of San Bernardino after 2025.

2.) Based on historic City projects.

- (a) Estimated at 2% of Total Construction Cost
- (b) Not Applicable
- (c) Estimated at 9% of Total Construction Cost
- (d) See Attachment X for detailed Construction Costs
- (e) Estimated at 2% of Total Construction Cost
- (f) Estimated at 7% of Total Construction Cost
- (g) Not Applicable
- (h) Estimated at 10% of Total Construction Cost
- (i) Sum row (a) thru (h) for each column

3.) Match Funds are further defined on the enclosed Attachment 4 opening paragraph.

Appendix F

Attachment 5
Schedule

Francis Street Storm Drain and Ely Basin Flood Control and Aquifer Recharge Project

ID	Task Name	Duration	Start	Finish
1	**Execution of Grant Agreement**	**0 days**	**Thu 8/15/13**	**Thu 8/15/13**
2	**Task 1 - Project Administration**	**380 days**	**Thu 8/15/13**	**Wed 1/28/15**
3	**Task 2 - Labor Compliance**	**380 days**	**Thu 8/15/13**	**Wed 1/28/15**
4	**Task 3 - Reporting**	**380 days**	**Thu 8/15/13**	**Wed 1/28/15**
5	**Task 4 - Assessment and Evaluation**	**120 days**	**Thu 8/15/13**	**Wed 1/29/14**
6	Assessment and Evaluation	30 days	Thu 8/15/13	Wed 9/25/13
7	Hydrology and Hydraulics	90 days	Thu 9/26/13	Wed 1/29/14
8	**Task 5 - Project Design and Engineering**	**165 days**	**Thu 8/15/13**	**Wed 4/2/14**
9	Records Research	30 days	Thu 8/15/13	Wed 9/25/13
10	Design Surveys	20 days	Thu 9/26/13	Wed 10/23/13
11	Geotechnical Investigation	60 days	Thu 9/26/13	Wed 12/18/13
12	Base Construction Drawings	20 days	Thu 10/24/13	Wed 11/20/13
13	Preliminary Design	30 days	Thu 12/19/13	Wed 1/29/14
14	Coordination with Agencies	15 days	Thu 1/30/14	Wed 2/19/14
15	90% and Final Design	30 days	Thu 2/20/14	Wed 4/2/14
16	**Task 6 - Environmental Documentation**	**150 days**	**Thu 8/15/13**	**Wed 3/12/14**
17	Initial Study	30 days	Thu 8/15/13	Wed 9/25/13
18	Draft EIR	60 days	Thu 9/26/13	Wed 12/18/13
19	Appeal	60 days	Thu 12/19/13	Wed 3/12/14
20	Adoption	0 days	Wed 3/12/14	Wed 3/12/14
21	**Task 7 - Permitting**	**80 days**	**Thu 8/15/13**	**Wed 12/4/13**
22	San Bernardino County Flood Control District (SBCFCD)	80 days	Thu 8/15/13	Wed 12/4/13
23	Inland Empire Utilities Agency (IEUA)	80 days	Thu 8/15/13	Wed 12/4/13
24	Regional Water Quality Control Board (RWQCB)	80 days	Thu 8/15/13	Wed 12/4/13
25	**Task 8 - Construction Contracting**	**55 days**	**Thu 4/3/14**	**Wed 6/18/14**
26	Bidding	45 days	Thu 4/3/14	Wed 6/4/14
27	Construction Contract Execution	10 days	Thu 6/5/14	Wed 6/18/14
28	**Task 9 - Construction**	**160 days**	**Thu 6/19/14**	**Wed 1/28/15**
29	Mobilization and Site Preparation	10 days	Thu 6/19/14	Wed 7/2/14
30	Storm Water Conveyance Facilities	150 days	Thu 7/3/14	Wed 1/28/15
31	Basin Earthwork	60 days	Thu 7/3/14	Wed 9/24/14
32	Basin Monitoring Systems	30 days	Thu 9/25/14	Wed 11/5/14
33	Performance Testing and Demobilization	160 days	Thu 6/19/14	Wed 1/28/15
34	**Task 10 - Environmental Compliance / Mitigation / Enhancement**	**160 days**	**Thu 6/19/14**	**Wed 1/28/15**
35	**Task 11 - Construction Administration**	**160 days**	**Thu 6/19/14**	**Wed 1/28/15**

Project: Att05_SWF_Schedule_02of02
Date: Fri 7/12/13

Task | Milestone | External Tasks
Split | Summary | External Milestone
Progress | Project Summary | Deadline

Note: Project kick-off will occur immediately following execution of grant agreement.