APPENDIX E
Human Health Risk Assessment

KAISER PERMANENTE DOWNEY MEDICAL CENTER
HEALTH RISK ASSESSMENT

A. INTRODUCTION--HAZARDOUS WASTE AND PUBLIC SAFETY.

The proposed Kaiser Permanente Downey Medical Center will use and store a variety of hazardous materials which will produce hazardous wastes on the Project site. In comparison to many industrial facilities, however, the Kaiser Permanente Downey Medical Center will generate relatively small quantities of hazardous waste, which will be handled and disposed of in accordance with Kaiser's internal policies and procedures and state and federal law.

Hazardous materials pose a risk to worker and public health whenever these substances are used or stored. The risk to human health and the environment posed by hazardous materials is determined by the probability of exposure and the potential severity of harm resulting from such exposure, measured against the beneficial value from the particular use. Potential exposure of the public or the environment to hazardous materials could result from the Project from the following activities: (1) the improper handling or use of hazardous materials during hospital operations, (2) failure of storage containment systems, (3) improper disposal methods, (4) transportation accidents, and (5) fire, explosion or other emergencies.

The types and varieties of hazardous waste Kaiser produces are significant enough to require compliance with hazardous waste regulations, some of which are listed below.

Basic compliance requirements for hazardous waste generators include:

- Responsibility to characterize wastes
- Obtaining an EPA identification number
- Managing hazardous waste on-site in compliance with the DTSC regulations
- Obtaining hazardous waste treatment permits as necessary
- Selecting appropriate off-site treatment and disposal facilities
- Preparing hazardous wastes for shipment
- Making reasonable efforts to minimize waste generation

The cornerstone of Kaiser's hazardous waste management program is the ability of facility personnel to properly identify all wastes that are generated, treated, stored, or disposed. Once identified, a "*Hazardous Waste Determination*" of each wastestream is required by law. Hazardous waste determinations are made:

(1) Through detailed chemical and physical analysis of a representative sample of the wastestream; and/or

(2) Through the application of process and material knowledge (which normally includes

review of the Material Safety Data Sheet (MSDS) using existing published or documented waste analysis data or studies conducted on hazardous wastes generated by similar processes).

Infectious and biohazardous waste is identified and managed by Kaiser employees in accordance with its Infectious/Biohazardous Waste Management Program attached hereto as Appendix *

B. DEFINITION OF HAZARDOUS WASTE

A "waste" is any "discarded" hazardous material of any form that is characteristically hazardous (i.e., toxic, reactive, ignitable, or corrosive) or listed in 40 CFR 261 and has not been excluded by federal regulations from classification as a hazardous waste. For purposes of this analysis, "discarded" includes materials which are (1) recycled or (2) relinquished (i.e., thrown away, burned/incinerated, or stored before throwing away). To determine if a "waste" is a "hazardous waste", generators are obligated to determine if the waste is (1) *listed* or (2) *characteristic*. "*Listed wastes*" are wastes that contain specific chemicals known to be hazardous. "*Characteristic wastes*" are wastes with a known hazardous property. As the state's regulations were amended in 1991 to include all federally listed hazardous wastes, it is generally not necessary to consult EPA Regulations when making hazardous waste determinations.

Listed Wastes

"Listed" wastes are contained 22 CCR 66261.30 - 66261.34 and 66261.126, included here as Appendix 2A. Note that there are four lists of hazardous waste, each designated by a different letter: K-wastes, F-wastes, P-wastes, and U-wastes.

- K-wastes: K-wastes are generated from specific production processes and hence are called "hazardous wastes from specific sources". An example of a K-waste is K073, "chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using anodes in chlorine production." There are few, if any, K-wastes currently being generated in hospitals, labs, or other health care facilities.

- F-wastes: F-wastes do not include a description of the production process generating the waste. For this reason, F-wastes are considered wastes from "non-specific sources". An example of an F-waste frequently associated with medical facilities is F003 which includes a number of spent halogenated solvents such as xylene, acetone, and methanol.

- P-and U-wastes: P- and U-listed wastes refer to particular commercial chemical products, off-specification species of those products (i.e., a bad batch), and container and spill residues thereof. P-listed wastes are often called "acutely hazardous wastes". Examples of P- and U-wastes that may be generated at Kaiser Permanente include P042 (epinephrine) and U122 (formaldehyde).

- Appendix X wastes: This subdivision sets forth a list of chemicals which create a presumption that a waste is a hazardous waste. If a waste consists of or contains a chemical listed in this subdivision, the waste is not a hazardous waste pursuant to the procedures set

forth in section 66262.11. The hazardous characteristics which serve as a basis for listing the chemicals are indicated in the list as follows: (X) toxic, (C) corrosive. (I) ignitable and (R) reactive.

Two items of note about P- and U-listed wastes:

(1) They are only applicable to the listed chemical product in an essentially *pure form* or where the chemical product is the *sole active ingredient*; and

(2) They are only applicable when the chemicals are unused products.

With respect to (2) above, the used chemical is necessarily a non-hazardous waste. For example, it may exhibit any one or more of the hazardous waste characteristics described below.

Characteristic Wastes

In addition to the four lists of hazardous wastes described above, California classifies a waste as hazardous if it exhibits any one or more of the following "characteristics": ignitability, corrosivity, reactivity or toxicity. A detailed description of each of these characteristics is contained in 22 CCR 66261.20 - 66261.24.

- Toxicity: A waste exhibits the toxicity characteristic if it exceeds specified concentrations of certain metals and organic compounds or stated criteria in several biological tests;

- Reactivity: Reactive wastes are unstable and capable of readily undergoing violent change, often in the presence of water. Few standard test measures exist for this characteristic;

- Ignitability: Ignitable is generally associated with wastes having a flash point of less than 140 degrees Fahrenheit, ignitable compressed gases, and certain oxidizers; and

- Corrosivity: Corrosive wastes exhibit a pH $\leq$ 2 or $\geq$ 12.5 or corrode steel at a specified rate.

Materials which are not considered hazardous waste:

The following materials are not considered hazardous waste and are therefore not subject to hazardous waste generator requirements.

- Samples of waste which are collected for the sole purpose of testing to determine characteristics or composition.

- Chlorofluorocarbons that are removed from cooling systems and are reclaimed for reuse. (1)

- Materials which are not reclaimed prior to being used or reused:

- as an ingredient in an industrial process;
- as a safe and effective substitute for commercial products, or;
- as a substitute for raw material feedstock in the original processes from which it was generated. (1)

- A material which would not be classified as a federal hazardous waste and is recycled and used at the site where the material was generated. (1)

- A material which is a "product" and has been processed from a hazardous waste and:
  1. Does not contain constituents other than those for which the material is being recycled which renders it hazardous, and;
  2. The product is used, or distributed or sold for use, in a manner for which the product is commonly used. (1)

- A fuel which is removed from a fuel tank, is either contaminated with water or by nonhazardous debris of not more than 2% by weight, and is transferred to, and processed into a fuel. (1)

(1) In order for the recyclable materials described above to be excluded from classification as a waste:

1. Containers or tanks containing the materials must be labeled, marked, and placarded in accordance with generator requirements but use the words "Excluded Recyclable Material" instead of "Hazardous Waste."
2. The business location must maintain a business plan meeting the requirements of section 25504 of the health and safety code (including emergency response plans).
3. The material shall be stored and handled in accordance with all local ordinances and codes.

B. TYPES OF HAZARDOUS WASTE STREAMS

The proposed Downey Medical Center will generate several generic types of hazardous waste streams: medical (biohazardous) waste, radiological waste, and hazardous chemical waste.

Medical Waste.

Medical waste includes biologically hazardous waste is generally defined as waste capable of producing infectious disease and includes human blood, blood products, and body fluids, pathological waste, sharps waste, waste cultures and stocks, and certain mixed wastes. Medical waste generated on the Project site refers to the following materials: (1) infectious waste that can be sterilized onsite such as used bandages and contaminated paper, (2) "special" waste which cannot be rendered non-hazardous by sterilization, including human or animal surgery specimens, tissues, or body parts removed during surgery, autopsy, or other medical procedures., chemotherapy residuals on gloves, tubing, and syringes, and pathology tissues containing formaldehyde; and (3) "sharps waste", which is any discarded medical device that was used in patient care, medical research, or an industrial laboratory and is capable of puncturing or cutting

the skin, such as needles; syringes with needles attached; trocars; pipettes; scalpel blades; blood vials; broken or unbroken glassware that has been in contact with infectious agents, including serum culture bottles, slides, and cover slips, and (4) waste cultures and stocks, which are wastes from the production of bacteria, viruses, spores, discarded live and attenuated vaccines used in human health care or research, and culture dishes and devices used to transfer, inoculate, and mix cultures.. All infectious and "special" medical wastes on the site would be collected at the source, placed in labeled red bags and transported in leakproof containers to a secure holding area. Contaminated needle sharps would be collected at the source in sealed, labeled hard shell containers.

A steam sterilizer unit would be provided at the proposed medical center to disinfect infectious waste (i.e., contaminated paper, used bandages, etc.). The sterilization process consists of steam sterilizing the infectious waste at 250 degrees Fahrenheit for 45 minutes. Once the waste has been processed, it is no longer infectious and is disposed of as general waste in a landfill. Steam for the process condenses into sterile water, which is cooled then discharged into the sanitary sewer system. The special medical wastes that cannot be sterilized and the contaminated sharps would be removed from the site by a licensed bio-hazardous waste hauler and taken to an appropriate facility for incineration. These materials would be contained onsite in a locked and monitored holding area while awaiting removal.

Radiological Waste

Radiological waste refers to waste products contaminated by radiological material. These radioactive waste materials consist primarily of radioactive implants used in nuclear medicine that have been removed from a patient's body. All radioactive waste would be collected at the source and contained in a lead-lined vault until it has decayed (reached its half-life) and is rendered safe for sanitary landfill disposal. Monitoring equipment would be used to detect radioactive materials in waste products.

Chemical Waste

Chemical hazardous waste includes toxic chemicals such as formaldehyde, xylene, alcohols and reagents. Waste amounts of toxic chemicals generated at the site would be collected, labeled and stored in a specialized hazardous waste storage area for a maximum of 90 days. All hazardous chemical waste would be removed from the site by a licensed hazardous waste hauler and taken to an appropriate facility for disposal (i.e, neutralization, incineration, etc.). Spent X-ray developer would be collected, labeled and removed by Kaiser for recycling.

The use of hazardous materials on the project site could pose a potential risk to staff and patrons of the hospital, the surrounding community and the immediate environment. Impacts could result from the handling, storage, transport and disposal of hazardous materials on the site. In assessing the risks associated with hazardous wastes, the level of risk is determined in part by the acceptability of the activity relative to its perceived benefits. The proposed Kaiser Permanente Downey Medical Center would be required to comply with all federal, state and local regulations pertaining to the use, storage, disposal and transport of hazardous materials on the site.

Appropriate internal Kaiser safeguards and monitoring and audit systems will be implemented by Kaiser to minimize the risks associated with the use of hazardous materials on the Project site.

Mixed Waste.
Mixed Waste is a mixture of infectious/biohazardous waste and other wastes. Mixed waste is infectious/biohazardous waste, except that (a) a mixture of infectious/biohazardous waste and hazardous waste is hazardous waste and (b) a mixture of infectious/biohazardous waste and radioactive waste is radioactive waste.

C. USE OF HAZARDOUS MATERIALS AT THE KAISER PERMANENTE DOWNEY MEDICAL CENTER.

Hazardous materials will be utilized in the following departments at the proposed Kaiser Permanente Downey Medical Center:

Central Supply

The Central Supply department would provide for sterilization of medical instruments and equipment, using a highly toxic gas, ethylene oxide (Eto). The Eto units in the proposed hospital would be enclosed in a specialized room away from the main corridors and patient rooms, and equipped with sensors to detect any escape of Eto into the work room. The Eto units would release the spent gas into vents which are equipped with chemical scrubbers that reduce the concentration of Eto to non-toxic levels. Eto is a strictly regulated gas, controlled by the State and local air quality management districts. The state requires that facilities utilizing 25-600 pounds per year of Eto maintain a 99% emission control rate. For facilities using greater than 600 lbs per year, an emission control of 99.9 percent must be maintained.

Laboratories

The hospital laboratory would use certain hazardous materials. These materials include alcohols, xylenes, formaldehydes, stains and reagents. Acids are also used in the lab, including nitric acid, hydorcholoric acid and glacial acetic acid. Bases also inclue sodium hydrozide and ammonium hydroxide. These materials are generally stored in small qualities, according to legal regulations.

Central Plant, Engineering.

The Central Plan would contain one or more underground tanks to store diesel fuel. These underground tanks would be monitored by a detection system to indicate any leakage. In addition, other flammable, combustible and volatile materials would be used to operate and maintain engineering equipment throughout the hospital.

Other Departments:

Hazardous materials include formaldehyde, flammable liquids, paints, solvents, pesticides and detergents which would be in other departments. Photographic developer and fixer would also

be used in radiology and ophthalmology for developing X-rays and other film. The used photographic developer would be recycled for silver content by Kaiser.

D. DEFINITION OF SIGNIFICANT IMPACTS

Kaiser Permanente has developed many internal procedures to minimize waste, prevent pollution, and conserve natural resources, governed by Kaiser's national Environmental Stewardship Council. In California, Kaiser's operations leaders sponsor efforts to minimize solid, bio-hazardous, and chemical wastes. The average performance for reducing bio-hazardous (regulated medical) waste for KP medical centers is 30%, a significant reduction in the volume and toxicity of waste streams. Chemical wastes are minimized through programs to centralize and standardize the use of hazardous chemicals, to use less hazardous alternatives when appropriate, to recycle chemical wastes such as xylene and alcohol when possible, and to dispose of wastes in an environmentally responsible manner. Kaiser attempts to reduce, reuse, and recycle all waste streams wherever feasible, limiting significant impacts on the public and the environment.

Kaiser Permanete employees responsible for the handling of hazardous wastes are trained in accordance with the standards set forth in the Kaiser Permanente California Hazardous Waste Guidance Manual attached hereto as Appendix *. This guidance document is designed to help Kaiser Permanente employees who are involved in the management of hazardous waste understand and comply with California hazardous waste requirements relevant to the positions in which they are employed. Sample forms, procedures, and plans are included in the Guidance Manual.

Kaiser Permanente also has an aggressive audit program. Kaiser's National Environmental, Health and Safety (NEH&S) Audit Program is a governance tool used to assess and communicate environmental, health and safety compliance status with the ultimate purposes of assuring management that Kaiser's waste management and treatment program maximizes the impact on its employee, members, the public and the environment. The audit program will evaluate the compliance programs and the environmental health and safety management systems of the Kaiser Permanente Downey Medical Center.

The Hazardous Waste audit protocol will evaluate the Kaiser Permanente Downey Medical Center's program for completeness with the current regulatory and environmental compliance obligations. Topics audited in the Hazardous Waste program include an evaluation of program management procedures, employee training and knowledge, records retention, waste storage area management and security, waste classification, waste handling, waste containerization and labeling, transporter and disposal site selection and management and waste activities reporting.

The Medical Waste audit protocol evaluates the Kaiser Permanente Downey Medical Center's program for proper management of infectious, biohazardous and chemotherapy drug related wastes. The audit protocol evaluates proper usage of solid waste and medical wastes (redbag) containers, proper disposal of trace and bulk quantities of chemotherapy wastes and employee knowledge.

The audit scope is standardized, which allows for all audits to be conducted in a consistent manner and the audit results are quantified to allow for benchmarking. The audit results are reported annually to the Kaiser Permanente Board of Directors.

For the purposes of this EIR, a hazardous waste impact is considered material and significant if it would expose staff, patients, visitors or neighboring residents to a significant health risk associated with the storage, use, transportation or disposal of hazardous waste on the site.

The use of hazardous materials and the disposal of hazardous waste at the project site represents a potentially significant impact which would be reduced to a less than significant level by the implementation of Kaiser's internal procedures described herein, and conformance with existing Federal, State and local requirements regulating hazardous materials and waste on the Project site.

Appendix *

Kaiser Permanente Infectious/ Biohazardous Waste Management Program

I. PURPOSE:

These guidelines outline the program elements of an infectious/ biohazardous waste management program, including federal regulatory requirements. State and local requirements for infectious/biohazardous waste programs should be reviewed for applicability and incorporated, as necessary.

II. COVERAGE:

All Kaiser Permanente employees and physicians who handle, manage, or dispose of infectious/ biohazardous waste.

III. DEFINITIONS:

Germ Theory: Disease transmission theories, including an understanding of the distinction between the health risks associated with infectious/ biohazardous waste management and the concept of Universal Precautions. *See* Rutala and Mayhall, "SHEA Position Paper: Medical Waste" (Jan. 1992) and APIC, "Why Infection Control?," which are attached to these Guidelines as Exhibits 1 and 2.

Hazardous waste: A waste that is characteristically hazardous (i.e., toxic, reactive, ignitable, or corrosive) or listed in 40 CFR 261 and has not been excluded by federal regulations from classification as a hazardous waste.

Human blood, blood products, body fluids: Discarded free-flowing human blood and blood products (e.g., plasma, serum), any free-flowing body secretion containing blood components (e.g., pleural, peritoneal, amniotic fluids), and any other fluid visibly contaminated with blood. (Note: Human excretions (e.g., urine, stool) are specifically excluded because they have accepted means of disposal.)

Infectious/Biohazardous Waste: Waste that includes human blood, blood products, and body fluids, pathological waste, sharps waste, waste cultures and stocks, and certain mixed wastes.

Mixed waste: A mixture of infectious/biohazardous waste and other wastes. Mixed waste is infectious/biohazardous waste, except that (a) a mixture of infectious/biohazardous waste and hazardous waste is hazardous waste and (b) a mixture of infectious/biohazardous waste and radioactive waste is radioactive waste.

Pathological waste: Human or animal surgery specimens, tissues, or body parts removed during surgery, autopsy, or other medical procedures.

Sharps waste: Any discarded medical device that was used in patient care, medical research, or an industrial laboratory and is capable of puncturing or cutting the skin. Examples include: needles; syringes with needles attached; trocars; pipettes; scalpel blades; blood vials; broken or unbroken glassware that has been in contact with infectious agents, including serum culture bottles, slides, and cover slips.

Waste cultures and stocks: Wastes from the production of bacteria, viruses, spores, discarded live and attenuated vaccines used in human health care or research, and culture dishes and devices used to transfer, inoculate, and mix cultures.

IV. GUIDELINES:

The following program elements outline federal regulatory requirements for infectious/biohazardous waste management programs, including federal OSHA's Bloodborne Pathogen Standard (29 C.F.R. section 1910.1030) and DOT's applicable Hazardous Materials Regulations (49 C.F.R. sections 173.134(b)(3), 173.197(a)), and sound management practices:

1. **Procedures and plans**:
   a) Service Area(s)/Local Market(s) should consider developing a written program which formally describes the procedures, plans, and requirements related to the following:

      - Roles and responsibilities;
      - Containment and storage of infectious/biohazardous waste;
      - Lifting and handling waste materials;
      - Conducting infectious/biohazardous waste self audits;
      - Infectious/biohazardous tracking form management, as applicable;
      - On-site/off-site treatment and disposal methods, as applicable;
      - Infectious/biohazardous waste labeling, and packaging;
      - Spill management of infectious/biohazardous waste;
      - Infectious/biohazardous waste management training;
      - Exchange of information with contractors and contractor employees; and
      - Permit application and management, as applicable.

2. **Roles and responsibilities:**
   a) Roles and responsibilities relative to implementing and maintaining an infectious/ biohazardous waste program should be understood by affected employees, including facility administration, clinical department supervisors, employees, and all relevant departments.

   b) Roles and responsibilities relative to contractor compliance with infectious/biohazardous waste program requirements should be clearly defined and understood by relevant management and contractors. (See your local EH&S professional for a copy of KP's sample policy and procedure on contractor safety.)

3. **Operations Elements:**

a) *Labeling*

Employees involved in the generation of infectious/biohazardous waste must be provided, where necessary, with appropriately labeled containers for storage and disposal of infectious/biohazardous waste. These containers must meet the following requirements:

- Warning labels affixed to containers of infectious/biohazardous waste must include the biohazard symbol with the word "BIOHAZARD";
- Labels must be fluorescent orange or orange-red or predominantly so, with lettering and symbols in a contrasting color; and
- Labels must be affixed as close as feasible to the container by string, wire, adhesive or other method that prevents their loss and unintentional removal.

- Red bags or red containers may be substituted for labels.

Individual containers of infectious/biohazardous waste that are placed in a labeled container during storage, transport, shipment or disposal are exempted from the labeling requirements.

b) *Packaging*

Appropriate packaging must be provided for infectious/biohazardous waste. Infectious/biohazardous waste must be placed in appropriate containers which meet the following requirements:

Sharps containers

- Closeable
- Puncture resistant
- Leakproof on sides and bottom

Other infectious/biohazardous waste containers

- Closeable
- Constructed to contain all contents and prevent leakage of fluids during handling, storage, transport or shipping
- Closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport or shipping

Containers used for off-site shipment

- Rigid
- Leak resistant
- Impervious to moisture

Containers used for off-site shipment, continued:

- Of sufficient strength to prevent tearing or bursting under normal conditions of use and handling
- Sealed to prevent leakage during transport
- Puncture resistant for sharps and sharps with residual fluids
- Break-resistant and tightly lidded or stopped for fluids in quantities greater than 20 cubic centimeters

Appendix *

Kaiser Permanente California Hazardous Waste Guidance Manual

Western Service Hub EH&S Environmental, Health & Safety

California Hazardous Waste Guidance Manual

KAISER PERMANENTE®

Western Environmental, Health & Safety Service Hub

Acknowledgements

This manual represents the collaborative efforts of:

The National Environmental, Health, and Safety Department,

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and

The Western Environmental, Health and Safety Service Hub

This document is not a replacement for current U.S. Environmental Protection Agency (EPA) or state regulations. Be sure to contact Barry Foose of the Western Environmental Health and Safety Service Hub, at 626-564-3256, or 8-338-3256, for further assistance.

Table of Contents

About This Manual

This guidance document is designed to help Kaiser Permanente employees who are involved in the management of hazardous waste understand and comply with California hazardous waste requirements relevant to the positions in which they are employed. Sample forms, procedures, and plans are included to further reduce the time and effort spent in understanding the applicable requirements.

The information presented here may be used as a starting point for facilities to develop compliance programs with hazardous waste management requirements or as reference material to an already well-defined and mature waste program. Specific guidance document objectives include:

- Facilitating the hazardous waste identification process by providing simple tools for waste characterization and a comprehensive data base of common hazardous wastes that may be generated in your facility.

- Assisting the facility in obtaining an U.S. EPA or state hazardous waste Identification Number, if applicable.

- Describing requirements for managing hazardous waste on site, including compliance with accumulation and storage standards, release prevention and contingency planning, inspection, training, recordkeeping, and reporting requirements.

- Providing instruction for compliance with state and federal (DOT) requirements for manifesting hazardous waste off-site.

While the text is numbered and ordered in a logical fashion (i.e., waste determination comes before obtaining an EPA identification number, etc.), both chapters and appendices can be referenced as "stand-alone" items to meet your specific program needs. Nevertheless, the recommended approach to use this guidance document is as follows:

- First, read the introductory material in Chapter 1. Chapter 1 and this section ("About This Manual") will briefly explain the basic state hazardous waste management requirements and direct the reader to specific information of interest in the handbook.

- Second, review Chapter Two and the criteria for determining whether hazardous wastes are being generated at your facility. Follow the step-by-step approach presented there to make hazardous waste determinations for your facility.

- Third, review Chapter Three to determine hazardous waste exclusions and exceptions that may be applicable to your facility.

- Fourth, review Chapter Four if you need a state or federal hazardous waste Identification Number for a facility and have not yet acquired one.

- Fifth, study your facility's approach to managing its hazardous waste on-site and make sure that you are following the requirements specified in Chapter Five. This includes shipping accumulated wastes off-site within specific time limits and understanding accumulation rules. Review your containers, labels, and accumulation areas to make sure they comply with the standards. You may need an emergency response plan and training program.

- Sixth, if your facility is treating hazardous waste on-site, it must have a treatment permit. Review Chapter Six for "tiered permitting" treatment requirements.

- Seventh, follow the instructions in Chapter Seven for completing hazardous waste manifests and land disposal restriction notifications, as well as meeting Department of Transportation and Biennial Reporting requirements.

- Eighth, review the summary of waste minimization requirements described in Chapter Eight.

- Ninth, review the recordkeeping and reporting summary presented in Chapter Nine to ensure all hazardous waste administrative requirements are being met.

- And lastly, review the self-audit checklist in Chapter Ten to facilitate management of your hazardous waste program.

Note that Chapter Eleven is reserved for future use. It is intended to be used by the Region to maintain notes and program updates relative to hazardous waste.

Glossary of Key Terms

Accumulation: The short term storage of hazardous waste by generators. Accumulation may either occur at the point of generation or in a designated, remote accumulation area.

Acutely Hazardous Waste: Hazardous wastes which appear on EPA's "P-list".

CFR: Code of Federal Regulations

Characteristic Waste: A waste that demonstrates one or more of the following hazardous waste characteristics: Toxicity, Reactivity, Ignitability, Corrosivity.

Container: Any device that is portable and in which a material can be stored, handled, treated, transported, recycled, or disposed.

Contingency Plan: A document setting out an organized, planned, and coordinated course of action to be followed in case of a fire, explosion, or release of hazardous waste which could threaten human health or the environment.

Corrosivity: Corrosive wastes exhibit a pH ≤ 2 or ≥ 12.5 or corrode steel at a specified rate.

Disposal: The discharge, deposit, injection, dumping, spilling, leaking, or placing of any hazardous waste into or on any land or water so that such waste may enter the environment or be emitted into the air or discharged into any waters.

DOT: Department of Transportation

EPA: Environmental Protection Agency.

EPA Identification Number: The number assigned by EPA to each generator, transporter, and TSDF (Treatment, Storage, and Disposal Facility.)

Extremely Hazardous Wastes: Wastes which are particularly hazardous by virtue of their toxicity or reactivity with water. Special handling and other regulatory requirements apply. Extremely hazardous wastes are designated with an asterisk in Appendix X of 22 CCR 66261.126 or may be identified by criteria found in 22 CCR 66261.110 and 66261.113. An example of an extremely hazardous waste at Kaiser Permanente is mercuric chloride.

Facility: All contiguous land and structures used for treatment, storing, or disposing of hazardous waste. In this text, sometimes used in place of "generator".

Federal or RCRA Hazardous Waste: A hazardous waste which has not been excluded from federal regulation and exhibits a characteristic as defined in 40 CFR 261, Subpart C or is "listed" in 40 CFR 261, Subpart D.

Generator: Any person (which includes any individual, trust, firm, corporation, partnership, or association, among others) whose act or process produces hazardous waste.

Hazardous Waste: For the purposes of this document, a waste which is listed in 22 CCR66261.31 et.seq. or is characteristically hazardous, and has not been excluded from classification as a hazardous waste.

Ignitability: Ignitable is generally associated with wastes having a flash point of less than 140 degrees Fahrenheit, ignitable compressed gases, and certain oxidizers.

Incompatible Materials: Materials and or wastes which, when mixed, have harmful consequences (fire, explosion, heat, off-gassing, etc.).

LC_{50} or Lethal Concentration: The concentration of a material which is expected to kill 50 percent of a group of test animals when administered as a single exposure.

LD_{50} or Lethal Dose: The dose which is required to produce death in 50 percent of the exposed species.

LDR Land Disposal Restrictions: EPA imposed restrictions to prevent activities that involve placing untreated waste in or on the land if a better treatment or immobilization alternative exists.

Listed Hazardous Wastes: Hazardous wastes which have been assigned a specific EPA Hazardous Waste Number and appear in 40 CFR 261 as well as 22 CCR 66261.31 *et.seq.*

Manifest: A multi-copy shipping document (DOHS 8022/) designed to ensure that shipments of hazardous waste can be tracked from their point-of-generation to their final destination.

Operator: The person responsible for overall operation of a facility.

Owner: The person who owns a facility or part of a facility.

POTW, Publicly Owned Treatment Works: Any device or system used in the treatment of municipal sewage or industrial wastes of a liquid nature which is owned by a State or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW.

RCRA: Resource Conservation and Recovery Act: Passed in 1976, this Act directed the EPA to develop and implement a program to protect human health and the environment from improper hazardous waste management practices.

Reactivity: Reactive wastes are unstable and capable of readily undergoing violent change, often in the presence of water. Few standard test measures exist for this characteristic.

Recycled: A material which is used, re-used, or reclaimed (processed to recover a usable product, or regenerated).

Release: Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing, of any chemical substance, including hazardous waste, into the environment.

Satellite Accumulation: Point-of-generation accumulation of hazardous waste under the direct control of the operator is commonly called "satellite accumulation".

Soluble Threshold Limit Concentration (STLC): A regulatory level established by California regulators for persistent and bioaccumulative toxic substances as defined in 22 CCR 66261.24(a)(2). STLC analysis utilizes an extraction method called the Waste Extraction Test (WET) which closely approximates the TCLP.

Special Wastes: Hazardous wastes which meet certain criteria which allow it to be managed or disposed in a manner less stringent than other hazardous wastes. The criteria a waste must meet to qualify as a special waste are contained in 22 CCR 66261.122.

Storage: The holding of hazardous waste for longer periods of time than allowed for accumulation, at the end of which the hazardous waste is treated, disposed, or stored elsewhere.

Surplus Material: "Surplus Material" is raw material or commercial product obtained by a person who intended to use or sell it, but who no longer needs it, and who transfers ownership of it to another person for use in a manner for which the material is commonly used. Recycled surplus material is not subject to regulation as a hazardous waste.

Scrap Metal: "Scrap Metal" includes manufactured, solid metal objects and products as well as metal workings (cuttings, shavings, etc.) and solid metal residues of metal production. Recycled scrap metal is not subject to regulation as a hazardous waste.

Tank: A stationary receptacle designed to contain an accumulation of hazardous waste, which is constructed primarily of non-earthen materials.

Tiered Permitting: A non-federally mandated, streamlined permitting process, for treating hazardous waste.

Total Threshold Limit Concentration (TTLC): A regulatory level established by California regulators for persistent and bioaccumulative toxic substances as defined in 22 CCR 66261.24(a)(2). The TTLC method (atomic absorption for metals and organic spectroscopy for organics) should be performed before the STLC analysis as it is less expensive and will help identify those species which should be subsequently examined for STLC.

Toxicity: A waste exhibits the toxicity characteristic if it exceeds specified concentrations of certain metals and organic compounds or stated criteria in several biological tests.

Toxicity Characteristic Leaching Procedure (TCLP): A test method used by EPA to determine if an extract of a waste contains any toxic metals or organic substances in excess of those concentrations listed in Table 1 of 22 CCR 66261.24(a)(i).

Treatment: Any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste.

TSDF: Treatment, Storage, and Disposal Facility: A RCRA permitted facility, that conducts treatment, storage, or disposal of hazardous waste as each term is defined above.

Waste: A discarded material, of any form, that is not specifically excluded from Regulation. For the purposes of this text, "discarded" includes materials which are (1) recycled or (2) relinquished (i.e., thrown away, burned/incinerated, or stored before throwing away).

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA) which directed the Environmental Protection Agency (EPA) to develop and implement a program to protect human health and the environment from improper hazardous waste management practices. The program is designed to control the management of hazardous waste from generation to disposal (commonly called "cradle-to-grave" responsibility). Key program elements include waste identification, accumulation, transportation, storage, treatment, and disposal.

In 1992, California received formal authorization to implement most RCRA provisions after many years of interim authority. California has merged its RCRA authority into ongoing implementation of the state's Hazardous Waste Control Law (HWCL), which was initially adopted in 1972 and modified repeatedly in the intervening two decades.

The California Department of Toxic Substances (DTSC) is the state's lead agency in implementing HWCL and RCRA provisions, but allows county health departments to implement many HWCL provisions.

In comparison to many industrial facilities, Kaiser Permanente generates relatively small quantities of hazardous wastes. Nevertheless, the types and varieties of waste we produce are significant enough to require compliance with hazardous waste regulations, some of which are listed below.

Basic compliance requirements for hazardous waste generators include:

- Responsibility to characterize wastes
- Obtaining an EPA identification number
- Managing hazardous waste on-site in compliance with the DTSC regulations
- Obtaining hazardous waste treatment permits as necessary
- Selecting appropriate off-site treatment and disposal facilities
- Preparing hazardous wastes for shipment
- Making reasonable efforts to minimize waste generation

More specific hazardous waste generator requirements are outlined in Figure 1.1.

Figure 1.1 Summary of Hazardous Waste Generator Requirements

- Determine and record which of the facility's wastes are "hazardous waste"
- Obtain an EPA Identification Number for hazardous waste generators
- Accumulate no more than 55 gallons of hazardous waste (or one quart of acutely hazardous waste or extremely hazardous waste) at or near the point-of- generation. Observe prescribed satellite accumulation area requirements.
- Store waste on-site for 90 days or less and adhere to the following requirements:
  1. Observe prescribed container & tank requirements.
  2. Observe prescribed preparedness and prevention requirements.
  3. Observe prescribed Contingency Plan requirements.
  4. Observe prescribed personnel training requirements.
  5. Observe prescribed land disposal requirements.
  6. Observe prescribed security requirements.
- Observe permitting requirements for hazardous waste treatment activities.
- Prepare a manifest (DOHS 8022/CAD058236591) and land disposal notification for hazardous waste that is transported off-site.
- Observe packaging, labeling, marking, and placarding requirements as prescribed by DOT regulations.
- Offer hazardous waste only to transporters and T.S.D.F.s with EPA Identification numbers.
- Complete recordkeeping and reporting requirements to include Biennial Report.

The remainder of this guidance document is designed to assist Kaiser Permanente employees involved in the management of hazardous waste to understand and comply with California hazardous waste requirements relevant to the positions in which they are employed. While the text is numbered and ordered in a logical fashion (i.e., waste determination comes before obtaining an EPA Identification Number etc.), both chapters and appendices can be referenced as "stand-alone" items to meet your specific program needs. For further assistance regarding hazardous waste management, contact your Regional EH&S Department.

Chapter 2. Hazardous Waste Determinations

This Chapter provides a comprehensive overview of how to determine which wastes generated at your facility are regulated by state and federal hazardous waste standards. First, an overview of wastestream determinations and a description of the two fundamental types of hazardous waste ("listed" and "characteristic") are presented. Then a model is introduced to facilitate the hazardous waste identification process.

Overview

The cornerstone of any hazardous waste management program is the ability of facility personnel to properly identify all wastes that are generated, treated, stored, or disposed. Once identified, a "*Hazardous Waste Determination*" of each wastestream is required by law. Hazardous waste determinations are made:

(3)	Through detailed chemical and physical analysis of a representative sample of the wastestream; and/or
(4)	Through the application of process and material knowledge (which normally includes review of the Material Safety Data Sheet (MSDS) using existing published or documented waste analysis data or studies conducted on hazardous wastes generated by similar processes).

What is a Hazardous Waste?

A "waste" is any "discarded" material of any form that is not specifically excluded from regulation. For our purposes, "discarded" includes materials which are (1) recycled or (2) relinquished (i.e., thrown away, burned/incinerated, or stored before throwing away).

To determine if a "waste" is a "hazardous waste", generators are obligated to determine if the waste is (1) *listed* or (2) *characteristic*. "*Listed wastes*" are wastes that contain specific chemicals known to be hazardous. "*Characteristic wastes*" are wastes with a known hazardous property.

As the state's regulations were amended in 1991 to include all federally listed hazardous wastes, it is generally not necessary to consult EPA Regulations when making hazardous waste determinations.

Listed Wastes

"Listed" wastes are contained 22 CCR 66261.30 - 66261.34 and 66261.126, included here as Appendix 2A. Note that there are four lists of hazardous waste, each designated by a different letter: K-wastes, F-wastes, P-wastes, and U-wastes.

- K-wastes: K-wastes are generated from specific production processes and hence are called "hazardous wastes from specific sources". An example of a K-waste is K073, "chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using anodes in chlorine production." Now that's specific! There are few, if any, K-wastes currently being generated in hospitals, labs, or other health care facilities.

- F-wastes: F-wastes do not include a description of the production process generating the waste. For this reason, F-wastes are considered wastes from "non-specific sources". An example of an F-waste frequently associated with medical facilities is F003 which includes a number of spent halogenated solvents such as xylene, acetone, and methanol.

- P-and U-wastes: P- and U-listed wastes refer to particular commercial chemical products, off-specification species of those products (i.e., a bad batch!), and container and spill residues thereof. P-listed wastes are often called "acutely hazardous wastes". Examples of P- and U-wastes that may be generated at Kaiser Permanente include P042 (epinephrine) and U122 (formaldehyde).
- Appendix X wastes: This subdivision sets forth a list of chemicals which create a presumption that a waste is a hazardous waste. If a waste consists of or contains a chemical listed in this subdivision, the waste is not a hazardous waste pursuant to the procedures set forth in section 66262.11. The hazardous characteristics which serve as a basis for listing the chemicals are indicated in the list as follows: (X) toxic, (C) corrosive. (I) ignitable and (R) reactive. A chemical denoted with an asterisk is presumed to be an extremely hazardous waste unless it does not exhibit any of the criteria set forth in section 66261.110 and section 66261.113. Trademark chemical names are indicated by all capital letters.

Two items of note about P- and U-listed wastes:

(1) They are only applicable to the listed chemical product in an essentially *pure form* or where the chemical product is the *sole active ingredient*; and

(2) They are only applicable when the chemicals are unused products.

With respect to note (2) above, this is not to say that the used chemical is necessarily a non-hazardous waste! For example, it may exhibit any one or more of the hazardous waste characteristics described next.

Characteristic Wastes

In addition to the four lists of hazardous wastes described above, California classifies a waste as hazardous if it exhibits any one or more of the following "characteristics": ignitability, corrosivity, reactivity or toxicity. The **T-R-I-C**-k to remember these characteristics is the **T**oxicity, **R**eactivity, **I**gnitability, and **C**orrosivity mnemonic (T-R-I-C)! A detailed description of each of these characteristics is contained in 22 CCR 66261.20 - 66261.24.

- Toxicity: A waste exhibits the toxicity characteristic if it exceeds specified concentrations of certain metals and organic compounds or stated criteria in several biological tests;
- Reactivity: Reactive wastes are unstable and capable of readily undergoing violent change, often in the presence of water. Few standard test measures exist for this characteristic;
- Ignitability: Ignitable is generally associated with wastes having a flash point of less than 140 degrees Fahrenheit, ignitable compressed gases, and certain oxidizers; and
- Corrosivity: Corrosive wastes exhibit a pH ≤ 2 or ≥ 12.5 or corrode steel at a specified rate.

The logic diagrams presented in Appendix 2B (Worksheets to Identify Hazardous Waste) can be used to determine whether a particular waste is characteristically hazardous. Note that sampling and analysis of wastes is not required if there is sufficient knowledge of the materials or processes used in the generation of the waste. However, when it is apparent that a detailed analysis of the chemical and physical characteristics of a waste is required, the "Sampling and Analytical Considerations" shown in Appendix 2C may be helpful.

What Are Extremely Hazardous Wastes and Special Wastes?

To paraphrase a quote from Animal Farm by George Orwell, "While all hazardous wastes are created equally, some are created "more equal" than others!" Specifically, certain hazardous wastes are considered "extremely hazardous" wastes because of their acute toxicity or under certain conditions, their water reactivity. More restrictive manifesting and disposal requirements apply for these wastes. Other wastes qualify for disposal in a landfill which may not necessarily meet the construction standards imposed upon hazardous waste landfills. This type of waste is called a "special waste".

A description and summary of requirements that apply to "extremely hazardous and "special wastes" are provided in Section 5.8.

Hazardous Waste Identification Model

Now that the two basic classifications of hazardous waste have been described ("listed" and "characteristic") and it is clear that the generator has a regulatory responsibility to determine whether the waste it generates is hazardous, a process model for identifying hazardous wastes is needed.

Review the logic diagram provided in Figure 2.1 for a systematic approach to hazardous waste identification. Then, read through the next six steps to complete the process. To simplify the model, variances, exclusions, and similar exceptions to waste determinations are not included. Guidance relative to some of these issues is presented in other areas of this document. For further clarification, work with the Regional Environmental Health and Safety (EH&S) department.

Hazardous Waste Identification Step 1

Start the hazardous waste identification process by identifying waste generating departments. This may be accomplished by conducting a facility tour, interviewing area managers, and conducting a records review (purchasing records/ Material Safety Data Sheets/ Hazard Communication Plans/ hazardous waste manifests/ biennial EPA hazardous waste reports). Typical Waste generating departments at Kaiser Permanente may include laboratories, pharmacies, Engineering, Construction Service, and radiology.

Hazardous Waste Identification Step 2

Next, observe waste generating processes within each department or area and gain an understanding of the "goes-ins" and the "goes-outs"; a process diagram complete with material balance may be helpful in this step. The "goes-outs" are the products of interest - these are the wastes.

Hazardous Waste Identification Step 3

Once the waste is identified, determine if it is listed or is a mixture of a listed waste and a non-hazardous waste.

For mixtures of a listed waste and a non-hazardous waste, if the hazardous portion of the waste is listed in the regulations solely because it is ignitable, corrosive, or reactive, **AND** the resultant mixture no longer demonstrates any of these characteristics, the mixture might not be considered a hazardous waste (Note: wastes that are listed solely because they are characteristic will have an

"(I)", "(R)", or "(C)" following their name in 22 CCR 66261.31 et.seq.). An example of a waste listed solely because it is ignitable is acetone (U002).

For mixtures of a characteristic waste and a non-hazardous waste, go to Step 4.

Hazardous Waste Identification Step 4

Determine if the waste exhibits a characteristic. As described earlier, the logic diagrams in Appendix 2B can be used to help determine whether a particular waste is characteristically hazardous. If sampling and analysis is required, the Waste Analysis Worksheet, in Appendix 2C, may be helpful in devising a strategy that minimizes analytical cost but ensures proper identification of the waste.

Hazardous Waste Identification Step 5

Evaluate if the waste meets the criteria for being "extremely hazardous" or alternatively, if it may qualify for relaxed management requirements by obtaining approval as a "special waste".

Hazardous Waste Identification Step 6

Once you have made your determination, keep records to demonstrate that your actions have met regulatory requirements. (NOTE: Hazardous waste generators are required to keep records of any test results, waste analyses, or other determinations for at least three years from the date that the waste was last sent off-site to a treatment, storage, or disposal facility. Establish a system to demonstrate compliance with this requirement!).

At this point, you should know what wastes your facility generates, and for each waste, have arrived at one of three conclusions:

- Your waste is not a hazardous waste
- Your waste is a hazardous waste
- You aren't sure

If you are uncertain about a waste determination, please ask the Regional EH&S department for assistance! To get you started, a database of common wastestream determinations is included in Appendix 2D.

Summary of Chapter 2

In summary, whether a waste is considered hazardous or not primarily depends on if it is *"listed"* or demonstrates any one or more so-called *"characteristics"*.

Listed Hazardous Wastes	Characteristic Hazardous Wastes
K-listed	**T**oxicity
F-listed	**R**eactivity
P-listed	**I**gnitability
U-listed	**C**orrosivity

Hazardous waste generators are required by law to make this determination. Once hazardous waste determinations are made, your job is just beginning! The next step is to verify compliance with the regulatory requirements described throughout the remainder of this document.

Chapter 3. Hazardous Waste Exclusions and Recycling Exemptions

Some materials are expressly excluded from the definition of "hazardous waste." Other materials have relaxed or less restrictive compliance requirements associated with them. This section provides a summary of hazardous waste exclusions and special requirements which may be applicable to Kaiser Permanente operations in California. Reviewing this material prior to Chapter 5 ("Managing Hazardous Waste On-Site") will facilitate understanding of what requirements are applicable to what wastestreams.

Materials which are not considered hazardous waste:

The following materials are not considered hazardous waste and are therefore not subject to hazardous waste generator requirements.

- Samples of waste which are collected for the sole purpose of testing to determine characteristics or composition.
- Chlorofluorocarbons that are removed from cooling systems and are reclaimed for reuse. (1)
- Materials which are not reclaimed prior to being used or reused:
  - as an ingredient in an industrial process;
  - as a safe and effective substitute for commercial products, or;
  - as a substitute for raw material feedstock in the original processes from which it was generated. (1)

- A material which would not be classified as a federal hazardous waste and is recycled and used at the site where the material was generated. (1)

- A material which is a "product" and has been processed from a hazardous waste and:
    1. Does not contain constituents other than those for which the material is being recycled which renders it hazardous, and;
    3. The product is used, or distributed or sold for use, in a manner for which the product is commonly used. (1)

- A fuel which is removed from a fuel tank, is either contaminated with water or by nonhazardous debris of not more than 2% by weight, and is transferred to, and processed into a fuel. (1)

(2) In order for the recyclable materials described above to be excluded from classification as a waste:

4. Containers or tanks containing the materials must be labeled, marked, and placarded in accordance with generator requirements but use the words "Excluded Recyclable Material" instead of "Hazardous Waste."
5. The business location must maintain a business plan meeting the requirements of section 25504 of the health and safety code (including emergency response plans).
6. The material shall be stored and handled in accordance with all local ordinances and codes.

Special Rules for Certain Recyclable Materials

All other recyclable materials are subject to applicable requirements for hazardous waste generators, except as specified below:

- Surplus Material: "Surplus Material" is raw material or commercial product obtained by a person who intended to use or sell it, but who no longer needs it, and who transfers ownership of it to another person for use in a manner for which the material is commonly used. Recycled surplus material is not subject to regulation as a hazardous waste.

- Scrap metal: "Scrap Metal" includes manufactured, solid metal objects and products as well as metal workings (cuttings, shavings, etc.) and solid metal residues of metal production. Recycled scrap metal is not subject to regulation as a hazardous waste.

- Used Oil Filters: Used oil filters which are drained free of flowing liquid and transferred off-site for the purpose of metal reclamation are not regulated as hazardous waste.

- Waste Elemental Mercury:
  Up to 10 lbs of which is a non-RCRA hazardous waste, may be stored on-site without a storage permit. All other applicable hazardous waste requirements apply.

- Spent Lead-Acid Storage Batteries:
  A person who generates or stores less than 10 lead-acid storage batteries per year, and who transfers or intends to transfer them to a battery recycler or storage facility is exempt from hazardous waste generator requirements with the exception of manifesting these wastes.

- Fluorescent Light Ballasts which contain PCBs:
  Up to two 55 gallon drums of fluorescent light ballasts which contain PCBs may be transported off-site at any one time without regard to hazardous waste generator requirements with the exception of manifesting.

- Fluorescent Light Tubes:
  If the waste is not regulated as federal hazardous waste (i.e., waste passes the federal Toxicity Characteristic Leaching Procedure (TCLP) for mercury or the generator facility produces less than 100 kg of hazardous waste per month), the generator may dispose up to 25 tubes at any one time in a day. If more than 25 tubes are to be disposed at any one time in a day, the tubes must be managed as a hazardous waste.

- Used Oil:
  Waste lubricating oil is covered by the requirements for hazardous waste handling with the exception that the hauler may complete both the generator's and the haulers sections of the manifest using the hauler's name and EPA Identification Number. *Note: Used oil which passes certain purity requirements may be treated as a non-hazardous waste.*

Recordkeeping / Reporting

Any person who claims an exclusion or exemption must maintain adequate records to demonstrate that there is a known market or disposition for the material and that the requirements of the exemption/exclusion are met.

Chapter 4. Obtaining an EPA Identification Number

What Is An EPA Identification Number and Who Needs One?

The Environmental Protection Agency (EPA) identification number is a twelve-character number used by EPA and the states as part of a national data base on hazardous waste activities. In California, no generator may treat, store, dispose, transport, or offer for transportation, hazardous waste without an identification number.

How Many Identification Numbers Should a Facility Have?

There should be one hazardous waste identification number for all processes and areas which are under the control of the same owner/operator and are on "contiguous" properties. For example, if Kaiser Permanente owns two adjacent parcels of land, each of which has a building from which hazardous waste is generated, both parcels are considered one "facility", and therefore should have one EPA identification number.

Facilities that generate more than 100 kg per calendar month of RCRA hazardous haste (or 1 kg of acutely hazardous waste and any amount of non-RCRA hazardous waste) will receive a federal identification number. The prefix for this number is "CAD", "CA" or "CAT." Facilities that generate only non-RCRA hazardous waste and/or those which generate under 100 kilograms per calendar month of a RCRA hazardous waste, will receive a state identification number. The prefix for this number is "CAL".

How Does a Facility Obtain an EPA Identification Number?

Call or write The Department of Toxic Substances Control at (916) 324-1781 or 1-800-618-6942 and ask for a copy of EPA Form 8700-12, "Notification Of Hazardous Waste Activity." You will be sent a booklet containing the form and instructions for filling it out. Appendix 4A provides a sample copy of a completed identification form to show you the kind of information required.

Fill in the form with the same kinds of information shown in the Appendix; the information covers your business site and your hazardous wastes.

To complete Item IX of the form, you need to identify your hazardous waste by federal and/or state waste codes. Note that federal hazardous waste codes can be found in 40 CFR 261, Subparts C and D. State hazardous waste codes can be found on the back of California's hazardous waste manifest (see Chapter 7) or Appendix XII of 22 CCR 261.126.

Make sure your form is filled out completely and correctly and sign the certification in Item X. Facilities that generate more than 100 kg per calendar month of RCRA hazardous waste submit their form to the US EPA Regional Office. Facilities that generate California-only hazardous waste or less than 100 kg of RCRA hazardous waste in any calendar month, submit their form to the DTSC. Identification numbers are generally received within eight weeks of request. Use this number on all hazardous waste shipping papers and other hazardous waste documentation where required.

Chapter 5. Managing Hazardous Waste On-Site

Once it has been determined that the facility generates a hazardous waste, a number of complicated and rigorously enforced on-site storage and handling requirements apply.

This Chapter will describe these on-site handling requirements for hazardous wastes, including the following elements:

Section 5.1: Satellite accumulation area requirements
Section 5.2: Accumulation area requirements
Section 5.3: Container and tank management
Section 5.4: Hazardous waste self-inspections
Section 5.5: Preparedness and prevention responsibilities
Section 5.6: Contingency planning
Section 5.7: Personnel training requirements
Section 5.8: Special Wastes and Extremely Hazardous Wastes

Introduction

The central issue driving hazardous waste on-site management requirements is short term storage.

Due to the concern about hazardous wastes being stored improperly and sometimes abandoned on-site, there are very strict rules about how much waste generators can accumulate, where it can be accumulated, and for how long. For example, because generators accumulate hazardous waste on-site, the DTSC mandates compliance with the following requirements:

- Container and tank management standards

- Inspection requirements
- Personnel training
- Preparedness and Prevention
- Contingency planning

Since accumulation of hazardous waste by generators prompts so many of the other management requirements, it is appropriate to begin this chapter by reviewing the definition of accumulation:

Accumulation:	*The short term storage of hazardous waste by generators. Accumulation may either occur at the point of generation or in a designated, remote accumulation area. Point of generation accumulation is commonly called "satellite accumulation." Remote accumulation areas will simply be referred to as "accumulation areas."*

The main differences between a satellite accumulation point and an accumulation area are the volume and the length of time wastes may be accumulated. At a satellite accumulation point, up to 55 gallons of hazardous waste may be accumulated up to one year. At an accumulation area, larger volumes of waste may be accumulated in tanks or containers for a fixed period of time.

Long term storage of hazardous waste requires a special permit and incurs a host of specific design and operational requirements which are more stringent than those governing accumulation areas. Permitted storage areas are not needed for the types and quantities of wastes generated at Kaiser Permanente.

Throughout the remainder of this chapter "accumulation" will be used to refer to short-term, non-permitted storage. Long term storage (or "storage") requirements are outside the scope of this work and will not be further discussed.

Section 5.1 Satellite Accumulation Areas

Satellite accumulation allows generators to store up to 55 gallons of hazardous waste, 1-quart of acutely hazardous waste (i.e., the P-list), or 1 quart of extremely hazardous waste in containers at or near the point of generation, provided:

Satellite Accumulation Requirements

- The area is under the control of the operator generating the waste.
- The containers are in good condition.
- The containers are compatible with the waste.
- The containers are kept closed except when adding or removing waste.
- The containers are labeled or marked with the words "Hazardous Waste" and the following information:
  - Composition and physical state of the waste
  - Statement or statements which call attention to the particular hazardous properties of the waste (e.g., "Flammable," "Corrosive")
  - Name and address of person producing the waste
  - Initial date of waste accumulation
- The total amount of waste at each satellite accumulation point does not exceed 55-gallons (or the 1-quart accumulation limit).
- The waste is not held onsite for more than one year from the initial date of accumulation, or 90 days from the date the quantity limitations described above are reached, whichever occurs first.
- The initial date of waste accumulation is clearly marked and visible for inspection on each container used for accumulation of hazardous waste.

Once the 55-gallon (or 1-quart of acutely or extremely hazardous waste) limit is exceeded at the satellite accumulation point, the container holding the excess waste must be marked with the date the excess began accumulating. This container must then be moved within 3-days to an accumulation area or to a permitted treatment, storage, or disposal facility.

Examples of how to comply with satellite accumulation area container labeling requirements are shown in Figures 5.1A & 5.1B. Marking directly on the container with indelible ink would also be appropriate.

[See following pages for Figures 5.1A and 5.1B Container Labels]

Figure 5.1A Container Label

Describe contents so that it is clear which waste is supposed to be placed here.

Figure 5.1B Container Label

Once the 55 gallon limit is exceeded, the container holding the excess waste must be marked with the date the excess began accumulating.

Section 5.2 Accumulation Areas - A Summary of Requirements

As described in Section 5.1, satellite accumulation rules allow generators to store up to 55 gallons of hazardous waste or 1-quart of acutely or extremely hazardous waste, in containers at or near the point of generation. This section describes requirements relative to accumulating hazardous waste on-site in a designated accumulation area.

One of the more limiting restrictions that apply to accumulation areas is the length of time a generator may accumulate hazardous waste on site. In California, a facility may accumulate hazardous waste on-site for 90 days or less without a permit. For generators of less than 100 kg of hazardous waste during any calendar month (or one kilogram of extremely hazardous waste), the 90 day period begins on the date the generator has exceeded any of the thresholds described above. For generators of more than 100 kg of hazardous waste during any calendar month, the 90 day period begins on the first date on which any amount of hazardous waste begins to accumulate during that month.

Other requirements associated with accumulation areas are outlined below.

Requirements for Accumulating Hazardous Waste

- Comply with container and tank management requirements including formal inspections (Sections 5.3 and 5.4).
- Observe preparedness and prevention requirements (Section 5.5).
- Comply with Contingency Planning requirements (Section 5.6).
- Observe personnel training requirements (Section 5.7).
- Label each container and tank used for on-site accumulation of hazardous waste with the words "Hazardous Waste" and the following information (see Figure 5.2):
  - Composition and physical state of the waste
  - Statement or statements which call attention to the particular hazardous properties of the waste
  - Name and address of the person producing the waste
- Clearly mark and make visible for inspection the date upon which each period of accumulation begins.
- Close the facility in a manner which minimizes the need for further maintenance and controls, minimizes, or eliminates post-closure escape or hazardous waste.

Note: A generator who accumulates more than 5,000 U.S. gallons or 95,000 pounds of hazardous waste is subject to stringent hazardous waste permit requirements.

Figure 5.2 Sample Hazardous Waste Label

Section 5.3 Container & Tank Management Requirements

Generators who place hazardous waste in on-site accumulation areas must comply with a host of requirements for container and tank management. *A description of container and tank inspection requirements, including sample inspection forms, is provided in Section 5.4.*

Container Management Requirements

A container is any device that is portable and in which a material can be stored, handled, treated, transported, recycled, or disposed. Containers accumulating hazardous waste are managed in accordance with the following standards:

- ✓ While being accumulated on-site, each container is labeled or marked with the words "Hazardous Waste" and the date upon which each period of accumulation begins is clearly marked and visible for inspection.
- ✓ Containers are in good condition and non-leaking.
- ✓ Containers are compatible with wastes being stored.
- ✓ Containers are kept closed except when adding or removing waste.
- ✓ Containers are managed to avoid rupture.
- ✓ Incompatible wastes are segregated by a berm, dike, wall or other device (see Appendix 5A for a description of incompatible).
- ✓ Incompatible wastes are not placed in the same container.
- ✓ Ignitable or reactive wastes are kept at least 50 feet from the property line.
- ✓ Areas where containers are stored are inspected at least weekly (Inspection requirements and forms are provided in Section 5.4).

Tank Management Requirements

A tank is a stationary receptacle, designed to contain an accumulation of hazardous waste and is constructed primarily of non-earthen materials. Tanks accumulating hazardous wastes are managed in accordance with the following standards:

- ✓ Tanks are labeled or marked clearly with the words, "Hazardous Waste" and the date upon which each period of accumulation begins is clearly marked and visible for inspection. Note that the accumulation start date for tanks is the date that the first amount of waste is added to the tank.

Additionally;

- ✓ Tanks installed before July 1986 which do not yet have secondary containment meeting the requirements of 22 CFR 66265.193 (outlined later) must undergo an integrity assessment performed by an independent, qualified, professional engineer.

- ✓ Tanks installed after July 1986 must conform to specific design and installation standards. This includes the owner or operator obtaining a written assessment reviewed and certified by an independent, qualified, professional engineer, attesting that the system has sufficient structural integrity and is acceptable for the transferring, storing, or treating of hazardous waste.

- ✓ Secondary containment systems must be designed, installed, and operated to prevent any migration of wastes or accumulated liquid out of the system to the soil, ground water or surface water. They must also be capable of detecting and collecting releases until the material is removed. These requirements apply for all new (post 7/86) tank systems prior to their being put into service. They also apply to existing systems on a phased-in compliance schedule pursuant to 22 CCR 66265.193.

- ✓ The owner or operator must use appropriate controls and practices (e.g. level sensing devices, high level alarms, sufficient freeboard) to prevent spills and overflows and ensure the system is operated in a fashion that does not threaten human health or the environment.

- ✓ Ignitable or reactive waste must not be placed in a tank system unless the system is used solely for emergencies, the waste is stored or treated in such a way that it is protected from incompatible materials, or the waste no longer meets the definition of ignitable or reactive (due to mixing, treating, etc.) immediately before or after it is placed in the tank.

- ✓ The system must be inspected at least once each operating day.

- ✓ At closure of a tank system, all waste residues, contaminated containment system components, contaminated soils, and structures and equipment with waste shall be removed or decontaminated in accordance with Department approved closure plan.

Section 5.4 Hazardous Waste Self Inspections

General Requirements

Hazardous waste tank areas *must be inspected daily* and container accumulation areas *must be inspected weekly*. While formal inspection of satellite accumulation areas is not required, it is nevertheless a good management practice.

The purpose of these inspections is to identify malfunctions and deteriorations, operator errors, and spills or leaks which may be causing, or may lead to a release of hazardous waste to the environment or a threat to human health.

Hazardous waste safety and emergency equipment, monitoring equipment, and security devices that are important to preventing, detecting, or responding to environmental or human health hazards must also be inspected. The frequency of these inspections is left to the generator but should be based on the probability of an environmental or human health incident if the deterioration, malfunction, or operator error goes undetected between inspections.

Any deterioration or malfunction which the inspection reveals must be remedied on a schedule which ensures that the problem does not lead to an environmental or human health hazard. Where a hazard is imminent or has already occurred, remedial action must be taken immediately.

Recordkeeping

A written inspection schedule must be established and maintained at the facility. Additionally, inspections must be recorded on an inspection log or similar form and maintained for three years from the date of inspection. These records MUST include the date and time of the inspection, the name of the inspector, an annotation of the observations made, and the date and nature of any repairs or other remedial actions.

One example of a weekly accumulation area inspection log is shown in Figure 5.4.1 "Weekly Accumulation Inspection Log." An example of a daily tank inspection log is shown in Figure 5.4.2 "Daily Tank Accumulation Inspection Log".

Figure 5.4.1 Weekly Container Accumulation Area Inspection Log

Location: _____ Organization: _____

Inspected By: _____ Date: _____ Time: _____

Signature of Inspector: _____ Supervisor Review: _____

Hazardous Waste Containers			
Container Condition & Marking		Yes	No
	Are all containers closed?		
	Are all containers in good condition?		
	Is there no evidence of container leaks or spills?		
	Are grounding wires attached to flammable waste drums?		
	Are labels clearly visible & legible?		
	Are labels marked with the words "hazardous waste," an accumulation start date, the name and address of generator, the hazardous properties of the waste, and waste composition and physical state?		
	Are all drums less than 90 days old? (See Note 1 below)		
If any of these questions were marked no, please comment:			
Describe actions taken to correct situation (See Note 2 below):			
Accumulation Point			
Is the accumulation point free of structural deterioration?			
Is adequate aisle space present between drums to allow unobstructed movement for emergency response?			
Are incompatible wastes separated by means of a dike, berm, wall, or other device?			
Are containers holding ignitable or reactive waste at least 50' from the			

facility's property line?			
Are drip pans, where needed, in place and clean?			
If any of these questions were marked no, please comment:			
Describe actions taken to correct situation (see Note 2 below):			
Emergency Response Equipment			
Telephone	Is it easily accessible in case of emergency?		
	Is it in working order?		
	Is the telephone number of the emergency coordinator posted, as well as the location of nearby fire extinguishers and spill control equipment?		
Spill Control	Is an empty salvage drum near by?		
	Are unused absorbent material or booms available?		
	Is all required personal protective equipment nearby? ☐Gloves ☐Boots ☐Apron ☐Goggles ☐Respirator		
Fire Protection	Is a fire extinguisher or extinguisher system readily accessible?		
	Is the fire extinguisher fully charged?		
	Is the fire extinguisher seal intact?		
If any of these questions were marked no, please comment:			
Describe actions taken to correct situation (see Note 2 below):			

Note 1: Coordinate with the person responsible for off-site shipments to ensure adequate space is available in the area and accumulation time requirements are met.

Note 2: Include the date and nature of any repairs or other remedial actions.

Figure 5.4.1 (cont.) Weekly Container Accumulation Area Inspection Log Instructions

General: There is one hazardous waste container accumulation point at the XYZ facility. This area must be inspected weekly in accordance with the attached checklist. If an item is found to be okay, a check mark should be placed in the appropriate column on the inspection checklist. If a discrepancy is found, the nature of the non-conformance should be noted in the comments section of the checklist and reported immediately to the Safety Officer and the affected Department Manager. Whenever possible, the inspector shall remain in the area until the corrective action has been completed. Completed corrective actions witnessed by the inspector will be signed and dated by the inspector in the comments section of the checksheet. Following the inspection, the inspector shall sign and write the date and time of the inspection on the checklist.

Instructions:

1. Container Condition & Marking: Visually inspect each container, making sure it is closed and in good condition (not bulging, corroded, significantly dented). Ensure grounding wires are attached to flammable waste drums. Observe container and the floor for signs of leakage or spills. Verify that each container has a hazardous waste label with an accumulation start date and the contents of the drum clearly described. Ensure all labels are clearly visible and legible.

2. Accumulation Point Conditions: Ensure the accumulation point floor is free of cracks and holes. Walk between containers to ensure there is adequate aisle space to allow unobstructed movement for emergency response. Ensure drip pans, where needed, are in place and clean.

3. Emergency Response Equipment: While this equipment is not required to be checked weekly, it is sound management practice to inspect this equipment while performing the weekly accumulation point rounds. Check to ensure that spill control and fire protection equipment as described in the facility's contingency plan is in place and good condition.. Verify that a nearby telephone is in place and in working condition and that posted by the phone is the name and telephone number of the emergency coordinator, the fire department, and the location of nearby fire extinguishers and spill control equipment.

Figure 5.4.2 Daily Tank Accumulation Area Inspection Log

Location: _____ Organization: _____

Inspected By: _____ Date: _____ Time: _____

Signature of Inspector: _____ Supervisor Review: _____

Hazardous Waste Containers			
Operational Requirements		Yes	No
	Do the foundation, structural support, seams, and connections appear sturdy and in good condition?		
	Is the secondary containment system capable of detecting and collecting releases?		
	Is piping visible for inspection, free of leaks / corrosion?		
	Is the overfill prevention control (e.g., level sensing device, high level alarm, feed cut-off) operating satisfactorily?		
	Is the general area free of evidence indicating tank leaks or spills?		
	Is tank label clearly visible and legible?		
	Is tank labeled with the words "hazardous waste," an accumulating start date, the name & address of generator, the hazardous properties of the waste, and the waste composition and physical state?		
	Is appropriate spill control equipment available and accessible?		
If any of these questions were marked no, please comment:			
Describe actions taken to correct situation (See Note 2 below):			

Section 5.5 Preparedness and Prevention

Hazardous waste generators must operate and maintain their facility to minimize the possibility of fire, explosion, or release of hazardous waste, which could threaten human health or the environment. Specific requirements relative to these efforts are described in the Department's "Preparedness and Prevention" standards. These standards require specific preventative or proactive measures for protecting environmental, health, and safety. In section 5.6, "Contingency Planning", specific "reactive" measures are described.

Facilities must be equipped with the following equipment:

- ✓ An alarm system or internal communications system for providing immediate emergency instruction to facility personnel;
- ✓ A device for summoning emergency assistance (such as a telephone or two-way radio), immediately available at the scene of operations;
- ✓ Portable fire extinguishers and fire control equipment, spill control equipment, and decontamination equipment, if necessary; and
- ✓ Water at adequate volume and pressure for fire fighting purposes.

Additionally:

- ✓ Facilities must test and maintain the equipment described above on a frequent enough schedule to assure its proper operation;
- ✓ Personnel involved in hazardous waste handling operations must have immediate access to alarms or internal communication devices;
- ✓ Adequate aisle space must be maintained to allow the unobstructed movement of personnel, fire protection equipment, and spill control equipment; and
- ✓ Arrangements with local authorities must be made for the type and amount of service expected in an emergency. Examples include familiarizing the local police, fire and Office of Emergency Services departments with the layout of the facility, hazardous materials and wastes handled, and evacuation routes in an emergency. Other authorities which may need to be contacted include state and local emergency response teams, spill contractors, and local hospitals. Where State or local authorities decline to enter into such arrangements, the facility must document and keep on record this refusal.

Section 5.6 Contingency Plan

Contingency planning is the process of predetermining responses to chance events. The purpose of such plans is to enable responses consistent with overall goals and strategies in preference to responses left purely to chance. Specifically, the plan must be designed to minimize hazards to human health or the environmental from fires, explosions, or any unplanned release of hazardous waste to air, soil, or surface water.

NOTE

Implementation of the Contingency Plan is **not required** for incidental releases of hazardous substances that are limited in quantity and pose no emergency or significant threat to the safety and health of employees in the immediate vicinity of those assigned to clean them up.

If the hazardous substances in a work area are always stored in small quantities, such as a laboratory which handles amounts in pints or less, and the hazardous substances do not pose a significant safety and health threat at that volume, then the risk of having a release that escalates into an emergency, and therefore requiring implementation of the Contingency Plan, may be minimal.

Contingency Plan Requirements

Hazardous waste generators must have a contingency plan for their facility. If the facility already has some other emergency plan or procedures, such as the California Hazardous Materials Business Plan, it need only be amended to incorporate hazardous waste management provisions that are sufficient to comply with requirements of this section.

The provisions of the contingency plan must be carried out immediately whenever there is a fire, explosion, or release of hazardous waste which could threaten human health or the environment. A copy of the plan and all revisions must be:

- Maintained at the facility; and
- Submitted to all local police and fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services.

Content of the Contingency Plan

The contingency plan must describe actions facility personnel take to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden releases of hazardous waste constituents to air, soil, or surface water. Specific contingency plan program elements are described below.

☐ Emergency Assistance Agreements

A description of arrangements agreed to by local police departments, fire departments, hospitals, contractors, and State and local emergency response teams (as appropriate) to coordinate emergency services. The plan should document the capabilities of each organization as well as present some evidence (such as a signed letter) that the organization has agreed to assist.

Example: "The Stafford Fire Department has been provided a copy of the contingency plan and has been familiarized with the layout of the facility and general operating conditions. They are expected to provide the following services:

- Rescue and emergency services
- Primary fire fighting and spill response services
- Primary emergency authority, to be coordinated with the State Police on the scene.
- Attachment Eight to the Contingency Plan includes a letter of understanding between this facility and the Stafford Fire Department relative to expected services during an emergency".

Note: The plan must include the current telephone numbers of the State Office of Emergency Services.

☐ Emergency Coordinator

The plan must list names, addresses, and phone numbers (office and home) of all persons qualified to act as "Emergency coordinator". Where more than one person is listed, one must be named as primary emergency coordinator and others must be listed in the order in which they will assume responsibility.

Example: "Primary Emergency Coordinator:

Name: Dave Barnes
Office Telephone: (510) 684-5881 Ext. 205

Home Address: 6 Avery St
Glenhurst, CA 94613
Home Telephone (510) 987-4562

Assistant Emergency Coordinator:

Name: John Maxwell
Office Telephone: (510) 684-5881 Ext. 212

Home Address: 9 Jackson Dr
Summitt, CA 94320
Home Telephone (510) 947-9812"

Note that at least one of these coordinators must be on call or at the facility at all times and all coordinators must be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities involving hazardous waste at the facility, the location and characteristic of waste handled, the location of all applicable records at the facility, and the facility layout. In addition, this person must have the authority to commit the resources needed to carry out the contingency plan.

☐ Emergency Equipment

The plan must include a list of all required emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarms systems, and decontamination equipment). This list must be kept up to date and include the location and a physical description of each item on the listed, and a brief outline of its capabilities.

One example of how this information might be provided is shown below in Figure 5.5:

Figure 5.5 Safety and Emergency Equipment

Items	Physical Description	Capability	Location
Catch Basin Covers	Rubber, form fitting	Spill Containment	Shipping & Receiving
Absorbent Material	Vermiculite, multi-purpose dry absorbent	Spill Containment & Absorption	See Site Map
Salvage Drums	Plastic, 75 gallon container. Screw top	Over-packing 55 g "leakers"	Accumulation Area
Rubber Boots	Nitrile, steel toe, kneehigh	Foot protection for corrosives & ignitables	Central Storage
Etc.....			

It is the facility's responsibility to evaluate what emergency equipment is necessary to abate emergencies that may be reasonably anticipated to occur at that location. For example, situated near an accumulation area for hazardous waste containers of ignitable waste, the contingency plan may specify a fire extinguisher, overpack drums, spark-proof shovels, bags of granular absorbent, a telephone and an alarm.

☐ Evacuation Plan

The plan must include an evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe signals(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of hazardous wastes or fires). The plan should also describe who makes the evacuation decision and the decision to re-enter the area or the facility.

☐ Emergency Procedures

The most important part of the contingency plan is a description of the procedures that will be followed for each type of hazardous waste-related emergency situation that may arise on-site. The plan should detail response actions in the event of a release, fire, or explosion in each area with hazardous waste. Emergency procedures should be directed by the emergency coordinator or their designated representative.

Regardless whether the facility has a stand-alone contingency plan or it is incorporated into an already existing document, emergency procedures must include the following:

- ✓ The emergency coordinator's responsibility to identify the character, source, amount, and extent of any released materials and to immediately assess possible hazards to human health or the environment.
- ✓ The mechanisms for notifying facility personnel and where appropriate, state or local agencies, of an imminent or actual emergency situation.
- ✓ Measures taken to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous waste at the facility.
- ✓ A description of actions necessary to prevent or minimize hazards from operations that may have been stopped in response to the emergency.
- ✓ Provisions for containing and disposing of recovered waste.
- ✓ External reporting requirements.

Amendment of Contingency Plan

The contingency plan shall be reviewed and amended whenever:

- ✓ The plan fails in an emergency;
- ✓ The list of emergency coordinators changes;
- ✓ The list of emergency equipment changes;
- ✓ Applicable regulations are revised; or,
- ✓ The facility changes in its construction, operation, or other circumstances in a way that materially increases the potential for releases of hazardous waste or fines, or changes the response necessary in an emergency.

Section 5.7 Hazardous Waste Management Training

The purpose of hazardous waste management training is to ensure that facility personnel are thoroughly familiar with proper waste handling and emergency procedures, relevant to their responsibilities during normal facility operations and emergencies. Since Hazard Communication or similar training is generally not of sufficient detail to assure management that their personnel are "thoroughly familiar" with waste handling and emergency procedures, hazardous waste specific training must be implemented.

Who Must Be Trained and How Often?

At Kaiser Permanente, personnel who require training may include (but are not limited to) those persons who perform any of the following tasks:

- Decide which wastes are hazardous waste
- Add hazardous waste into accumulation containers or tanks
- Treat hazardous waste on-site
- Transport hazardous waste internal to the facility
- Offer hazardous waste for off-site transportation
- Respond to spills, fires, or explosions involving hazardous waste (or are otherwise involved in the facility's contingency plan)
- Complete hazardous waste manifests, annual reports, or exception reports
- Operate or work at accumulation points
- Inspect hazardous waste accumulation points

Training must be completed within six months after assignment to the facility or to a new position at the facility. Until that time, untrained personnel must not perform any tasks involving hazardous waste management unless supervised by trained personnel. Affected facility personnel must also take part in an *annual review* of the entire training program.

How Should Training Be Implemented?

Federal Regulations allow training to be conducted on-the-job or in a classroom environment. While both mechanisms have desirable features, neither is recommended as a stand-alone vehicle

for personnel training for all job classifications and types. It is anticipated that KP hazardous waste generators will elect to incorporate selected aspects of each training delivery mechanism into their personnel training program.

Scope of Mandatory Training Requirements

At a minimum, the training program must be designed to ensure that facility personnel are able to respond effectively to emergencies by familiarizing them with emergency procedures and to perform their duties in a way that ensures the facility's compliance with the regulations. To this end, an example of topics discussed in a facility's hazardous waste management training program might include:

- Regulation of Hazardous Waste
- Organizational Accountability and Management Systems
- Hazardous Waste Identification
- Accumulation Point Operations
- Preparedness and Prevention
- Emergency Procedures, Equipment, and Systems (Contingency Planning & Response)
- Hazardous Waste Manifest and Land Disposal Restrictions
- Tiered permitting requirements
- Recordkeeping and Reporting
- Enforcement and Liability

To ensure that training is focused on the needs and learning objectives of the audience, consider arranging specific training for specific groups (developing a matrix of job classifications and corresponding training requirements would be helpful). For example, some personnel may only become involved in hazardous waste management when they respond to emergencies. Others, like the facility administrator, should have a basic understanding of hazardous waste requirements and potential enforcement and liability issues. A laboratory manager still has other training needs that are related to hazardous waste identification and accumulation point issues. Each requires training so that they will be able to conduct their responsibilities in a manner which complies with the regulations.

Recordkeeping and Documentation

Hazardous waste generators must maintain the following documents and records at their facility:

- ✓ The job title for each position at the facility related to hazardous waste management, and the name of each employee filling each job;
- ✓ A written job description for each position listed above, which must include the requisite skill, education, or other qualifications, and duties of facility personnel assigned to each position;
- ✓ A written description of the type and amount of both introductory and continuing training that will be give to each person filling a position as listed above
- ✓ Records that document that the required training has been give to, and completed by, facility personnel.

Training records on current personnel must be kept until closure of the facility. Training records on former employees must be kept for at least three years from the date the employee last worked at the facility. Examples of how these records may be organized and how training might be documented are shown below.

Example One - Organization of Training Records

Employee Job Description and Training Information

Job Title: *Safety Officer*

Job Description: *Serves as primary emergency coordinator. Conducts periodic assessments of the hazardous waste management program. Reports to site administrator on the status of the program.*

Requisite Skill, Education, or Qualifications:

Two year college degree or equivalent. Qualifications: Thorough understanding of hazardous materials management. Completion of OSHA 40 hour training.

Training Required: *See Training Matrix (this would describe both the type and amount of initial and on-going training job description would get).*

While generators are required to include the name of each person filling each affected job title, it is much easier to manage this piece of the program (due to turnover) if the names are kept separately from this training description.

Example Two - Documentation of Training Performed

One way to document the training given is to maintain a hazardous waste training record such as that shown below. Regardless of whether on-the-job or classroom training is given, however, the facility should maintain a written outline of the training which describes learning objectives and course content.

Hazardous Waste Training Record:

Name of Employee:

Hazardous Waste Management Position:

Type of Training:
Training Session On the Job Training

Date Initial Training Received:
Given By:
Signature of Trainee:

Annual Review Session:

Date:	Trainee Initials:	Instructor Initials:	Comments or Remarks

Section 5.8 Extremely Hazardous Wastes and Special Wastes

There are two specific categories of waste that warrant further discussion: "extremely hazardous wastes" and "special wastes". Extremely hazardous wastes are particularly hazardous by virtue of their toxicity or reactivity with water. Special wastes are specifically identified wastes or wastes that meet certain criteria which allows the waste to be managed or disposed in a manner somewhat less stringent than for hazardous wastes.

Extremely Hazardous Wastes

☐ Any waste or material is extremely hazardous if it:

√ Has an acute oral LD_{50} less than or equal to 50 milligrams per kilogram.

√ Has an acute dermal LD_{50} less than or equal to 43 milligrams per kilogram.

√ Has an acute inhalation LC_{50} less than or equal to 100 parts per million as a gas or vapor.

√ Contains any of the substance listed in section 66261.24(a)(7) at a single or combined concentration equal to or exceeding 0.1 percent by weight. An example of a material on this list found at some Kaiser Permanente laboratories is 4-Dimethylaminozobenzene (DAB).

√ Is water-reactive.

√ May result in death, disabling injury, or serious illness because of the carcinogenicity, high acute or chronic toxicity, bioaccumulation properties, or environmental persistence.

√ Contains a substance listed in 22 CCR 66261.113 at a concentration equal to or exceeding its listed total threshold limit concentration. Examples of materials on this list found at some Kaiser Permanente facilities are lindane, mercury, cadmium and lead compounds.

☐ In addition to hazardous waste requirements described elsewhere, extremely hazardous wastes are subject to the following restrictions:

√ Treatment of extremely hazardous waste is excluded from tiered permitting (Chapter 6).

√ An extremely hazardous disposal permit must be applied for at least 15 days prior to the intended date of disposal.

√ A satellite accumulation area can only hold up to one kilogram of hazardous waste before it must be shipped off-site or relocated to a central accumulation area.

√ For generators of less than 100 kilograms per month of hazardous waste or 1 kilogram per month of extremely hazardous waste, the 90 day central accumulation "time-clock" begins on the first day that 100 kilograms of hazardous waste or 1 kilogram of extremely hazardous waste has accumulated.

Special Wastes

☐ A waste is a "special waste" if it:

√ Is specifically listed as a waste which may be classified by the Department as a special waste. The only waste that appears likely to be generated at a Kaiser Permanente facility which fits into this category is "sand from sandblasting". Other potential special wastes are cited in 22 CCR 66261.120.

√ Meets all of the following criteria:

- It is a solid, a water-based sludge, or a water-based slurry
- It is a hazardous waste only because it exceeds the STLC or TTLC
- No soluble extractable constituent which exceeds the STLC, exceeds the TTLC
- No contaminant may exceed the TTLC levels for extremely hazardous wastes
- It is not reactive, ignitable, corrosive, or toxic by the TCLP procedure
- It is not a RCRA hazardous waste
- It does not contain more than 0.1 percent extremely hazardous waste
- It does not contain more than 1.0 percent of materials with characteristics described in 22 CCR 66261.24 (a)(3), (4), or (5)

☐ The generator of a special waste is subject to all generator requirements with the exception that the special waste may be disposed of at a landfill disposal facility which is not operated under a hazardous waste facility permit. (NOTE: The landfill must operate under requirements specified by the Regional Water Quality Control Board and the facility have been granted a variance to dispose special wastes by the Department).

Appendix 5A "Hazardous Waste Compatability"

As described in Sections 5.1 and 5.3.

1. Containers must be made of or lined with materials that are *compatible* with the hazardous waste stored in them;

2. Containers holding a hazardous waste must be separated from other containers which hold *incompatible* materials or wastes by means of a dike, berm, wall, or other device; AND,

3. *Incompatible* wastes must not be placed in the same container.

What does *compatible* or *incompatible* mean?

In its most basic sense, different materials are compatible if they can co-exist in harmony. Relative to RCRA then, "incompatible" means materials and/or wastes which, when mixed, have harmful (or dis-harmonious!) consequences. Examples of what can go wrong when incompatible materials are mixed are shown below.:

When you mix:	You may get:
Strong acids with bases	Generation of intense heat
Strong oxidizing agents (like bleach) with strong acids	Generation of toxic gases (like chlorine)
Combustible and Flammable materials with oxidizing mineral acids	Fire or intense heat
Alcohols with organic acids	Violent polymerization

EPA has published a list of potentially incompatible wastes, waste components, and materials along with the harmful consequences of mixing those materials together. This list, shown on the next two pages, does not include every possible hazardous chemical reaction, but should be used as a guide in packaging and storing these materials. An example of how to read this table is as follows:

> If you mix a Group 2-A waste with a group 2-B waste, a fire or explosion, or generation of hydrogen gas may occur.

Pay close attention to any waste characterization data you receive on material reactivity and compatibility. In addition, review the MSDS for chemical reactivity and incompatibility information. Ensure all personnel who handle and accumulate hazardous wastes can correctly determine the storage compatibility of the wastes they handle.

Chapter 6. On-site Treatment of Hazardous Waste: The Tiered Permitting Program

Any facility in California that treats, stores, or disposes of hazardous waste must obtain a treatment permit. For permitting that is not federally mandated (see Appendix 6A), the state has implemented a streamlined permitting process called "tiered permitting". The purpose of the tiered permitting program is to impose a reasonable level of regulatory requirements given the magnitude of risk involved.

Specifically, there are three tiers of permits that apply to on-site treatment of hazardous waste in California. These tiers, established by Assembly Bill 1772, the "Wright-Polanco-Lempert Hazardous Waste Treatment Permit Reform Act of 1992", are:

- Conditional Exemption {which includes, Conditional Exemption-Small Quantity Treatment (CESQT) and Conditional Exemption-Specified Wastestreams (CESW)}
- Conditional Authorization (CA)
- Permit by Rule (PBR)

☐ Conditionally Exempt - Small Quantity Treatment (CESQT) category is approved for treatment technologies in volumes less than 55 gallon or 500 pounds per month (NOTE: This limit applies to the entire facility). A higher level of permitting or additional permitting disqualifies the generator from this category.

☐ Conditionally Exempt - Specified Waste Stream (CESW) category applies to specified technologies used by certain industries.

☐ Conditionally Authorized (CA) category applies to generally approved technologies in volumes less than 5,000 gallons or 45,000 pounds per month (NOTE: This limit applies to each treatment unit). Certain aqueous waste streams have no limit.

☐ Permit by Rule category applies to generally approved technologies with no volume limit.

The following two sections provide a summary of criteria applicable to treatment under the tiered permitting program and regulatory requirements for each tier. A process for determining if a facility is subject to hazardous waste treatment permitting is then described. Before proceeding, note that recyclable material which is (1) managed in accordance with all applicable requirements for generators of hazardous waste, (2) recycled and used at the same facility at which the material was generated, and (3) recycled within 90 days of its generation is not subject to tiered permitting. An example of this type of operation is the Berkeley Regional Lab distillation unit, which recycles spent xylene and alcohol from waste produced on-site.

Tiered Permitting Applicability

In order to qualify for the tiered permitting program, a treatment operation must meet the following criteria:

- ☐ Treatment is exempt from RCRA permit requirements.
- ☐ Waste is generated on the site where being treated.
- ☐ Waste is not reactive or extremely hazardous.
- ☐ Treatment is carried out in tanks or containers.
- ☐ All air emissions from the treatment process comply with applicable federal, state, and local air discharge requirements.
- ☐ Treatment does not result in a release of hazardous waste into the environment as a means of disposal.
- ☐ And, for "conditionally exempt" units only, the generator is not required to obtain a hazardous waste permit for any other activity at the facility.

Determination of the proper permitting tier is based on factors such as the type of hazardous waste treated, the treatment technology used, the monthly volume treated, and in some cases, the concentration of the waste constituent. Appendix 6B lists these parameters for wastestreams that may be present in the Healthcare setting.

Summary of Regulatory Requirements

The purpose of the tiered permitting program is to impose a reasonable level of regulatory requirements given the magnitude of risk involved. Subsequently, there are increasing regulatory requirements as a facility moves from the conditionally exempt through the permit-by-rule tiers. This section summarizes regulatory requirements for each tier.

Conditionally Exempt Small Quantity Treatment (CESQT) and Conditionally Exempt Specified Waste Stream (CESW)	**Conditionally Authorized Facility**	**Permit-By-Rule**
Meet all applicable hazardous waste generator requirements (described throughout this text).	Observe all applicable requirements for CESQT and CESW.	Observe all applicable requirements for CESQT, CESW, and Conditionally Authorized categories.
Properly manage treatment residuals (i.e., the waste that may result from the treatment process must be handled in accordance with state and local law).	Prepare and submit an annual waste minimization certification.	Meet financial assurance requirements for closure and for bodily injury & property damage caused by sudden accidental occurrence.
Prepare and maintain written operating instructions and a record of the dates, concentrations, amounts, and types of waste treated (1).	Conduct an Environmental Assessment (phase one) pursuant to Health & Safety Code 25200.14. Due no later than 1 year after grant to operate.	Maintain a written closure plan.
Prepare and maintain a written inspection schedule and log of inspections conducted.	Maintain container storage area containment standards.	Comply with corrective action requirements from environmental investigations, 22 CCR 67450.7(a).
Remove or decontaminate all waste residues upon closure.		Permanently mark the exterior of each FTU with name of owner/operator, facility I.D. #, and an individual serial number.
Submit annual notification forms and fees.		Maintain waste analysis plan pursuant 66265.13 (b).

(1) Written operating instructions should include:
1. How to operate the treatment unit;
2. How to recognize potential and actual process upsets and respond to them;
3. How to determine if the treatment is efficacious; and
4. How to address the residuals of waste treatment.

Tiered Permitting Evaluation Process

Now that you have an understanding of the regulatory requirements that apply to tiered permitting, as well as the criteria applicable to treatment under each tier, a process by which your facility can determine whether it is subject to hazardous waste treatment permitting is outlined below. Since treatment of hazardous waste at an unpermitted facility is a serious violation of state (and possibly federal) law, the reader should carefully review relevant regulatory requirements before proceeding with any treatment operation.

Step One: Is treatment being conducted?

That is, is the facility using any method, technique, or process, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous or less hazardous, safe to transport, store or dispose of, or amenable for recovery or storage, or reduction in volume?

Step Two: Is the material being treated as a hazardous waste?

Chapter 2 provides a definition for hazardous waste. It is important at this step to determine whether a RCRA waste is involved and whether the waste(s) is extremely hazardous or reactive. Treatment of extremely hazardous or reactive wastes does not qualify for tiered permitting and treatment of RCRA waste can only be performed if the process is exempt from RCRA permitting. See Appendix 6A for a description of processes exempt from RCRA permitting.

Step Three: Is the "hazardous waste" recycled on-site?

As long as materials that would otherwise be hazardous wastes are reused on-site, they are not subject to permitting of their treatment prior to reuse.

Step Four: Is the hazardous waste type and the treatment method eligible for treatment? If so, which tier applies to each treatment unit?

Refer to Appendix 6B for a summary of the types of wastes that are generally associated with the Healthcare industry as well as the allowable treatment methods.

Step Five: Prepare and submit the proper notification forms and fees to the DTSC for each tier.

This must be done no later than 60 days prior to beginning the first treatment. Observe the applicable operating requirements.

Step Six: Submit annual on-site hazardous waste treatment notification forms and fees. Maintain required documentation.

The job's not done 'til the paperwork's finished. Who's the keeper of the keys at your facility?

Chapter 7. Moving Waste Off-Site

This chapter provides the generator with information needed to properly prepare, package, and ship wastes off-site in compliance with hazardous waste and Department of Transportation (DOT) regulations.

Specific issues that will be addressed include:

7.1 Preparing the Hazardous Waste Manifest
7.2 Land Disposal Restriction Requirements
7.3 Department of Transportation Requirements
7.4 Biennial Reporting

Section 7.1 The Hazardous Waste Manifest

The hazardous waste manifest is a multi-copy shipping document designed to ensure that shipments of hazardous waste can be tracked from their point-of -generation to their final destination (a.k.a., "cradle to grave"). Additionally, the manifest provides valuable information which may be used during transportation emergencies. A copy of a completed hazardous waste manifest is shown in Appendix 7A.

The Manifest System

When a waste leaves your facility, all sections of the manifest through the transporter's signature line (Blocks 1 - 17) must be completed. The manifest consists of at least six copies. One copy of the manifest must be kept on file at the facility which generated the waste. In addition, the generator must send one copy of the manifest to the Department and provide the transporter with the remaining copies. The designated Treatment, Storage, or Disposal Facility (TSDF) must send a signed manifest copy back to the generator, so that the generator can be sure that their shipment arrived and was accepted by the designated facility. For wastes that are shipped out of state it is often necessary to send a manifest copy to the state agency in which the waste is being disposed.

Acquisition and Selection of Manifests

You can obtain blank copies of the manifest from several sources. To determine which source you should use, follow this system:

1. If you are shipping out of state and the state to which you are shipping your waste supplies the manifest and requires its use, you must use that manifest form. Contact the hazardous waste management agency of that state, your hauler, or the designated facility you intend to use for manifest forms.

2. If you are shipping in state, or the state to which are shipping your waste does not supply the manifest, use the California Uniform Hazardous Waste Manifest, EPA 8700-22/DTSC 8022A. Contact your hauler or your state hazardous waste agency for blank forms.

Completion of the Manifest

A sample copy of a hazardous waste manifest was shown in Appendix 7A. Instructions for completing the manifest are on the back-side of the Appendix.

Note that there are three basic parts to the manifest. The top portion identifies the organizations that will be handling the waste; the middle portion identifies the shipment; and the bottom portion contains the signatures of the individuals who handled the waste. A generator must designate one facility which is permitted to handle the waste described on the manifest. A generator may also designated on the manifest one alternate facility which is authorized to handle their waste in the event an emergency prevents delivery of the waste to the primary designated facility.

One of the more difficult sections of the manifest to complete for many generators is block 11, "US DOT Description". While a more thorough description of Department of Transportation (DOT) requirements is provided in Section 7.3, the basic description of a hazardous waste must appear in the following sequence:

1. Proper shipping name
2. Hazard class or division number
3. UN/NA number
4. Packing group

This information is found in 49 CFR 172.101. Note that the DOT also requires a 24 hour emergency response telephone number to appear on the manifest. This number is typically placed in block 15.

When the generator signs the certification in ITEM 16, he or she is personally confirming that:

✓ The manifest is complete and accurately describers the shipment;

✓ The shipment is ready for transport; and,

✓ Given the budget, waste management arrangements are the best to reduce the amount and hazardous nature of the wastes at the facility.

Your hazardous waste TSDF will often be the best source for packaging and shipping information for completing the manifest. In fact, many commercial hazardous waste TSDFs will provide you with a copy of manifest items 1 - 15 pre-printed. Determine if your vendor provides this service.

If you are having trouble obtaining, filling out, or using the manifest, ask your hauler, your designated facility, or the Regional EH&S Department for assistance.

Manifest Discrepancies

The facility receiving your hazardous waste manifest must note in block 19 any significant discrepancy between the waste described in blocks 11 - 14 and the waste actually received at the facility. Significant discrepancies in quantity include any variation in "piece-count" such as a discrepancy of one drum in a truckload. Significant discrepancies in type are obvious differences which can be discovered by inspection or waste analysis, such as waste solvent substituted for waste acid or toxic constituents not reported on the manifest.

The EPA or the DTSC may use this information (and any other discrepancies they find) as a basis for issuing you a notice of violation or a fine. For these and other reasons, it is a good idea to have a "second-check" of the manifest done by a trained facility person other than the one who originally completed the manifest.

Recordkeeping and Reporting:

A copy of each manifest signed by the TSDF and returned to the generator must be retained on site for at least three years from the date the waste was accepted by the initial transporter.

A generator who does not receive a copy of the of the manifest with the hand-written signature of the owner or operator of the designated facility within 35 days of shipment must contact the facility to determine the status of the hazardous waste. If a copy of the manifest is not received within 45 days of the date the waste was accepted by the initial transporter, an exception report must be submitted to the Department. The report must include:

- A legible copy of the manifest for which the generator does not have confirmation of delivery; and,

- A cover letter explaining the efforts taken to locate the hazardous waste and the results of those efforts.

One example of how you can manually track the status of your hazardous waste manifest is shown on the next page.

Hazardous Waste Manifest Shipment Log:

Date Shipped\ Transporter	Designated Facility (Name & EPA ID)	Type & Amount of Hazardous Waste	TSDF Copy Due By:	TSDF Copy Received

Section 7.2 Land Disposal Restrictions (LDRs)

Along with the hazardous waste manifest, land disposal restriction forms may have to accompany an off-site shipment of hazardous waste.

The main purpose of land disposal restrictions (LDRs) is to discourage activities that involve placing untreated wastes in or on the land if a better treatment or immobilization alternative exists. Examples of land disposal include landfill, surface impoundment, and injection well.

The EPA has developed treatment standards that either require the use of one or more specified treatment technologies, or require that wastes be treated to meet certain concentration limits for hazardous constituents prior to land disposal. In addition, California has developed restrictions for land-disposal of non-RCRA hazardous waste. The land disposal restriction form notifies the TSDF of the appropriate treatment standards. *Completion of this form is a generator responsibility!*

As a practical matter, most commercial waste management facilities have prepared their own LDR forms that must be used as part of their waste-acceptance procedures. It is recommended that generators work closely with their waste management facilities in completing the LDR form. A complete description of Land Disposal Requirements appears in 22 CCR 66268.

General Compliance Strategy

The fundamental requirements to achieve compliance with the LDR involve the following five steps:

1. Determine if the waste is a hazardous waste and assign it the appropriate hazardous waste code(s) (Section 2).

2. Determine if the waste is a "wastewater" as defined here or a nonwastewater ("Wastewater" is generally defined as a waste containing less than one percent total suspended solids and less than one percent total organic carbon. Note: For the F001 through F005 solvent wastes, the definition of a "wastewater" is slightly different; a wastewater for this purpose is a solvent-water mixture that contains less than one percent total of the solvents listed in F001-F005).

3. Using this information, look up the LDR treatment standards for the applicable waste codes. The complete list of standards is found in 22 CCR 66268.

   (The general methodology in determining LDR treatment standards is to first review the Table entitled "Technology-based Standards by RCRA Waste Code". Waste identified on this table must be treated via the Best Demonstrated Available Technology (BDAT) specified. Then, check "Table CCWE - Constituent Concentration in Waste Extract" and

finally, "Table CCW - Constituent Concentration in Waste." For each waste included on the CCW and CCWE tables, the regulated constituents are listed as well as the treatment level that must be achieved prior to land disposal of that waste).

To facilitate understanding of the treatment standards, some information that appears in the tables described above has been consolidated into the format presented in Appendix 6B. Some common Kaiser Permanente wastes are shown. Be advised that the information presented here is but a very small sample of that appearing in the Regulations.

4. Determine if your waste meets the treatment standards described in the Table. Waste that does not meet the standards must be treated (by the TSDF) prior to land disposal.

5. Prepare and retain all of the paperwork required under the LDR program. This includes completing a notification document that informs the treatment or storage facility in writing of the appropriate treatment standards and any applicable prohibition levels. This notice must include:

   - The EPA Hazardous Waste Number
   - The corresponding treatment standards
   - The manifest number associated with the shipment of waste
   - Waste analysis data, where available.

One example of a completed LDR form is shown in Appendix 7B.

LDR Exercise

What are the LDR requirements that apply to waste xylene generated in the laboratory?

1. Q: Is the waste stream a hazardous waste?
   A: Yes, waste xylene is both listed (F003) and ignitable (D001).

2. Q: Is the waste stream a wastewater or non-wastewater?
   A: The wastestream is a non-wastewater, as defined above (For the F001 through F005 solvent wastes, the definition of a "wastewater" is a solvent-water mixture that contains less than one percent total of the solvents listed in F001-F005.).

3. Q: What are the LDR treatment standards for these waste codes?

A: A review of "Technology-based Standards by RCRA Waste Code" contained in 22 CCR 66268.42 indicates that D001 waste with greater than or equal to 10% total organic carbon must be treated by INCIN (incineration), RORGS (recovery of organics), or FSUBS (fuel substitution). Waste xylene falls into this category.

Additionally, pursuant to "Table CCWE," F003 non-wastewaters containing xylene, must be at a concentration of less than 0.15 mg/l prior to being disposed. Lastly, "Table CCW" is checked and indicates no special requirements.

At this point, the generator would complete the land disposal restriction notification provided it by their commercial waste treatment facility. A copy of the notification is kept on file for at least five years and the original is given to the waste transporter with the appropriate copies of the manifest.

Section 7.3 Department of Transportation Requirements

Hazardous waste regulations refer to Department of Transportation (DOT) for a description of materials, packaging, labeling, marking hazardous waste containers, and placarding vehicles used in the transportation of hazardous waste.

Where to Start?

In order to complete block 11 of the Hazardous Waste Manifest and properly label, package, and mark your waste for transportation, you must first determine the proper DOT description for the hazardous waste. Most of this information can be found in the DOT Hazardous Materials Table. The DOT Hazardous Material Table, located in 49 CFR 172.101, was designed as a guide to assist the shipper and transporter with regulatory compliance. This table is a compilation of materials which the DOT considers hazardous during transportation. It consists of 10 columns describing requirements regarding classification, hazard communication, packaging, vessel storage, and special transportation provisions. The portion of the Hazardous Material Table most applicable to completing the hazardous waste manifest (block 11) is shown on the following page. The reader is encouraged to review the entire table to evaluate the impact of other provisions on their operations.

§172.101 - Hazardous Materials Table					
Symbols (1)	Hazardous Materials descriptions and proper shipping names (2)	Hazard class or Division (3)	Identification Numbers (4)	Packing Group (5)	Label(s) required (if not excepted) (6)

	Acetone	3	UN1090	II	Flammable Liquid

Column One - May contain one or more symbols which restrict the application of the requirements of the remaining portion of the table to a particular mode of transportation. For example, a "W" restricts the application of the DOT requirements to materials offered or intended for transportation by vessel, unless the material is a hazardous waste or a "hazardous substance" as defined by DOT.

Column Two - Lists the proper DOT shipping name for the hazardous materials. To legally ship a hazardous material, it must be identified using one of the names on this table. The shipping name will be used on shipping papers (e.g. the manifest) and on marking the package (the hazardous waste label). Determination of the appropriate name to use can often require a great deal of time searching through the Table. Guidance relative to making this search process easier is described later.
Column Three - Lists the hazard class or division corresponding to the proper shipping name. The DOT uses nine hazard classes to identify hazardous materials. Hazard Class and division definitions are found at 49 CFR Part 173. The hazard classes most commonly associated with KP wastestreams include Class 3 (Flammable and Combustible liquids), Class 8 (Corrosive liquids and solids), and Class 9 (miscellaneous hazardous materials which includes certain hazardous substances and wastes)

Column Four - Lists the identification number assigned to each proper shipping name.
Identification numbers preceded by the letters "UN" are appropriate for international and domestic transportation, while those preceded by "NA" are appropriate for domestic transportation only. The identification numbers with the prefix are used on shipping papers (e.g., the manifest) and on marking the package (the hazardous waste label).

Column Five - Specifies one or more packing groups assigned to a hazardous material corresponding to the proper shipping name and the hazard class. Packing Group numbers represent the degree of danger presented by the material and correspond with packaging requirements for the material.

Packing Group I - Great Hazard
Packing Group II - Medium Hazard
Packing Group III - Minor Hazard

Column Six identifies the hazard warning label(s) required on each package containing the listed material.

The remaining columns (not shown) of the Hazardous Material Table specify codes for special transportation provisions, additional packaging requirements, maximum quantities that may be offered for transportation aboard aircraft and railcar, and vessel storage requirements.

Modifications To Basic Hazardous Material Table Descriptions

There are a number of modifications to the basic descriptions provided in the Hazardous Materials Table that may affect Kaiser Permanente operations. A list of the most common modifications is presented below.

1. If the material is a hazardous substance in an amount that represents reportable quantities in one package (see Appendix A to 49 CFR 172.101), enter the words "RQ" either before or after the proper shipping name.

"RQ, Waste Xylene, 3, UN1307, PG II" or "Waste Xylene, 3, UN 1307, PG II, RQ"

2. The hazard class associated with the material must match the Hazard Class in the Hazard Class Column of the Hazardous Materials Table for the shipping name selected.

3. If more than one DOT Hazard Class applies to the material, determine the primary hazard by referring to the precedence table at 49 CFR 173.2a. The shipping name is determined based on the primary hazard.

4. If no DOT hazard classes apply to the material in question and materials are hazardous waste per Federal Regulations, the materials are Hazard Class 9.

5. If a hazardous material consists of a mixture of a material specifically named by a technical (chemical) name in the Table, it should be named by that technical name with the qualifying word "solution" or "mixture" as appropriate.

6. If a material has a chemical generic proper shipping name listed at 49 CFR 172.203 (k)(3), the technical name of the hazardous material must be entered in parentheses in association with the chemical generic n.o.s. (not otherwise specified) name. For example:

   Corrosive liquids, n.o.s., (sulfuric acid, hydrofluoric acid), 8, UN 1760, PG II

7. If a material has a chemical generic proper shipping name listed at 49 CFR 172.203 (k)(3) and is a mixture or solution of two or more hazardous materials, the technical names of at least two components most predominantly contributing to the hazards of the mixture must be indicated as described above. For example:

   Waste flammable liquids, Corrosive, n.o.s., (ethanol, sodium hydroxide), 8, UN 2920, PG I

8. If the n.o.s. description contains the name of the chemical element or group as part of its name (e.g., "Mercury compounds, solid, n.o.s., 6.1, UN 2025, PG II"), then 6 and 7 above do not apply.

9. If the material is not identified by name in the Table, which is often the case for mixtures or solutions, then the shipper must designate a generic N.O.S. name, which most appropriately describes the material's end use or its primary (see 3. above) DOT Class of Hazard.

   Waste Flammable Liquid, n.o.s., (Acetone, Methyl Ethyl Ketone), 3, UN 1993, PG II

10. If the material is "Hazardous Waste, liquid or solid, n.o.s.", Class 9, the EPA hazardous waste number should be included on the shipping paper in association with the basic description. If the EPA hazardous waste number is included, 6 and 7 above do not apply.

11. The word "waste" should precede the proper shipping name of a hazardous waste, unless it is already part of the proper shipping name. For example:

    "Waste Xylene, 3, UN1307, PG II"

12. When one entry refers to another entry in the Hazardous Materials Table by using the word "see", either proper shipping name in Roman type may be used.

13. Punctuation marks and words in italics in the Hazardous Materials Table are not part of the proper shipping name but may be used in addition to the proper shipping name.

Packaging

Once the DOT description is completed, packages must be selected and prepared for transportation in such a manner as to prevent the release of hazardous materials to the environment. In addition, each package must be compatible to the contents of the package.

The DOT authorizes packaging options for each hazardous material. Authorized packaging options are listed in 49 CFR 173. The specific section of 49 CFR 173 for packaging a particular hazardous material is found by reference in column 8 of the Hazardous Materials Table. Each material as defined by its proper shipping name is also subject to special packaging reliefs, restrictions, and limitations per column 7 of the Table. (see Section 172.102 for an explanation of these provisions.)

Generally, hazardous waste is packaged in non-bulk packaging. By definition, non-bulk packaging is greater than 5 gallons (general limited quantity) and less than 119 gallons (the definition of bulk). Authorized non-bulk packages are referenced per material in column 8b of the 172.101 Hazardous materials Table. Non-bulk packages must meet DOT "performance oriented packaging" standards and tests [49 CFR 178, Subparts L and M], as well as DOT general packaging requirements.

A common package used in transporting hazardous waste is the overpacked drum, otherwise known as the lab pack. To use a lab pack, inside containers:

- cannot leak and must be compatible with the contents;
- must be tightly and securely sealed;
- must meet specifications as defined by any packaging requirements at 49 CFR Parts 173, 178, and 179 for the particular waste; and
- must be surrounded by a sufficient quantity (to absorb contents of all containers) of nonbiodegradable sorbent material that is compatible with the contents of the inner containers.

The outside container:

- must be an open head DOT-specification metal shipping container (see 49 CFR Parts 178 and 179) of no more than 110 gallon capacity;
- must be full after it has been packed; and
- must not contain any incompatible wastes.

Reactive wastes (except for cyanide- and sulfide-bearing reactive wastes) must be treated or rendered non-reactive prior to packaging.

There are exceptions to the above requirements for certain hazard classes (3, 4.1, 4.2, 4.3, 5.1, 6.1, 8, or 9). However, 6.1, PG I materials; 4.2, PG I materials; bromine pentafluoride, bromine trifluoride, chloric acid, and oleum (fuming sulfuric acid) cannot be packaged as outlined below.

The exceptions apply if the waste is transported by highway only and if the following packaging requirements are met:

- The outer packaging must be a UN 1A2 or UN 1B2 metal drum, a UN 1D plywood drum, a UN 1 G fiber drum, or a UN 1H2 plastic drum with PGIII containing only one Hazard Class of material.
- The inner packagings must be either glass (less than 1 gallon), or metal or plastic (less than 5.3 gallons).
- The inner packagings must be surrounded by a chemically compatible absorbent material in sufficient quantity to absorb the total liquid contents.
- The gross weight of the complete package may not exceed 452 lbs.

In addition, 6. and 7. of the "Modifications To Basic Hazardous Material Table Descriptions" do not apply if the above packaging requirements are met, as long as the material in question is not a hazardous substance (49 CFR 172.203(c)) or a poisonous material (49 CFR 172.203(m)).

Marking

Markings are intended to indicate which package contains which hazardous material. Package markings must include the proper shipping name and Identification Number (UN/NA) as they appear in columns 2 and 4 of the 172.101 Hazardous Materials Table. Markings must be durable, in English, and printed on or affixed to the surface of a package, label, or sign. They must be unobscured by labels or other attachments and must be located away from any other markings that could substantially reduce its effectiveness.

The most common marking that generators may be familiar with is the following information that must be displayed on each container of hazardous waste which is 110 gallons or less:

HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.

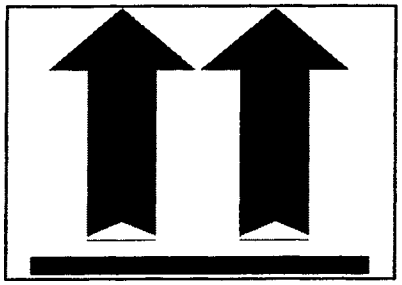
Generator's name and address _____

Manifest Document Number _____

An example of such a marking is shown in Figure 7.3 "Hazardous Waste Label (Marking)".

Figure 7.3 Hazardous Waste Label (Marking)

One additional, special marking requirement, which may apply to Kaiser Permanente operations is in non-bulk combination packages (i.e., lab pack boxes) containing liquid hazardous waste. These must be packed with closures upward and be marked with orientation arrows pointing in the upright direction (except if inner packages are cylinders, liquids contained in manufactured articles [e.g., alcohol or mercury in thermometers] which are leak tight, or if inner packagings are hermetically sealed).



Labeling

Warning labels immediately reflect the hazards of the package. Unless otherwise excepted, all hazardous materials must be labeled with primary (and subsidiary) labels as specified in columns 6 of the Hazardous Materials Table. For each entry, the first label in the column is the primary hazard. The appropriate hazard class must be displayed in the lower corner of a primary hazard label. The label must be on the same surface as and near the proper shipping name marking.

Placarding

Placards reflect the hazards contained within a transport vehicle. Similar to labels in shape, color, and design, placards warn and guide emergency responders in determining the appropriate actions that must be taken in the event of an emergency. The type of placard which must be displayed varies according to the hazard class and the weight of the materials being transported. An example of some common placards is shown in Appendix 7C.

The generator, as well as the transporter, must ensure that the transport vehicle is properly placarded. Due to the complexity of the DOT requirements, and to ensure the transporter's own requirements with these standards, a reputable hazardous waste hauler will usually assist generators with transportation requirements.

Emergency Response Information

The shipping paper must contain an emergency response telephone number entered on the shipping paper in a clearly visible location. The telephone number must apply to each hazardous material entered on the manifest and/or shipping paper and it must be indicated that the telephone number is for emergency response information (for example: emergency contact: xxx-xxx-xxxx)).

The telephone number discussed above must be monitored at all times the hazardous waste is in transportation and must be the number of a person who is knowledgeable of the hazards and characteristics of the hazardous waste being shipped. This person must also have comprehensive emergency response and incident mitigation information for the hazardous waste. The number can be for an operator who can connect the DOT to the knowledgeable person.

Emergency response information related to the hazardous material (see bulleted list below) must be made immediately accessible to drivers of motor vehicles for use in the event of incidents involving such materials. In addition, each operator of a facility where a hazardous material is received, stored or handled during transportation must maintain an MSDS or other document with the following information whenever the hazardous material is present:

- basic description and technical name of the hazardous material;
- immediate hazards to health;
- risks of fire or explosion;
- immediate precautions to be taken in event of an accident or incident;
- immediate methods for handling;
- initial methods for handling spills or leaks in the absence of fire; and
- preliminary first aid measures.

Training Requirements

Per 49 CFR 173.1(b), "it is the duty of each person who offers hazardous materials for transportation [hazmat employer] to instruct each of his officers, agents, and employees having any responsibility for preparing hazardous materials for shipment as to applicable regulations."

Training can be provided by the hazmat employer or other public or private sources; however, the employer must ensure that each of its hazmat employees is tested by appropriate means on covered subjects of:

- general awareness / familiarization training;
- function specific training; and,
- safety training for hazmat employees who handle or transport packagings containing hazardous materials during the course of transportation (packers and warehouse workers) and persons who have the potential for exposure to hazardous materials as a result of a transportation accident (drivers).

A hazmat employee is a person who is employed by a hazmat employer and who in the course of employment directly affects hazardous materials transportation safety. Training for new HAZMAT employees must be completed within 90 days of employment; HAZMAT employees shall receive the training at least once every two

years. If HAZCOM or other training covers the above information, the training does not need to be duplicated.

Training records must be kept for the past two years for each hazmat employee, and kept for 90 days after the end of employment. Records include:

- hazmat employee's name;
- most recent training completion date of training;
- description, copy or location of training materials used;
- name and address of person providing training; and,
- certification that hazmat employee has been trained and tested.

Section 7.4 Biennial Reporting

Generators who ship any hazardous waste off-site to a transfer, storage, or disposal facility must prepare and submit a "Biennial Report" to the Department by March 1 of each even numbered year. The report is submitted on EPA Form 8700-13A/B, and covers the generator's activities during the previous year.

The Biennial Report includes, among others, the following information:

√ The hazardous waste identification number and address of the generator.

√ The calendar year covered by the report.

√ The hazardous waste identification number, name, and address for each off-site treatment, storage, or disposal facility to which waste was shipped during the year.

√ The name and identification number of each transporter used during the reporting year.

√ A description, EPA hazardous waste identification number, California Hazardous Waste Category Number (Appendix XII of 66262.126), DOT hazard class, and quantity of each hazardous waste shipped off-site for shipments to a Treatment, Storage, or Disposal Facility (TSDF).

√ A description of efforts undertaken during the year to reduce the volume and toxicity of waste generated.

√ A description of the changes in volume and toxicity of waste actually achieved during the year in comparison to previous years.

√ The certification signed by the generator or authorized representative.

As can be seen from these requirements, good recordkeeping and tracking practices facilitate the timely completion of an accurate Biennial Report.

Note
A generator who treats, stores, disposes of hazardous waste on-site shall submit an annual report covering these wastes.

Chapter 8. Hazardous Waste Minimization Requirements

Facilities in California which generate greater than 12,000 kilograms of hazardous waste per year (or 5,000 kilograms of waste which is eligible for a certified treatment technology, e.g., formaldehyde treatment with formalex) are subject to State-specific hazardous waste minimization requirements. These requirements are described in the "Hazardous Waste Source Reduction and Management Review Act of 1989" and 22 CCR 67100.1 *et.seq*. The waste minimization requirements apply to major routinely generated hazardous waste streams (i.e., those that make up greater than 5% by weight of the total facility hazardous waste stream); they are in addition to describing waste minimization efforts on biennial reports and certifying on the hazardous waste manifest that there is a program in place to reduce the volume and toxicity of waste generated on site.

The primary purpose of waste minimization is to ensure that hazardous wastes are managed properly through methods such as source reduction and recycling. Clearly, however, waste minimization makes good sense from a business point of view by limiting the short-term cost of disposal and the long-term liability associated with "cradle-to-grave" ownership of hazardous waste. In addition, waste minimization strategies are consistent with Kaiser Permanente's policy of protecting the earth's environment.

What Are The Hazardous Waste Source Reduction and Management Review Act Requirements?

Facilities affected by the Hazardous Waste Source Reduction and Management Review Act must:

√ Examine their waste generating processes to determine amounts and types of waste generated;

√ Determine waste minimization procedures to reduce waste generation at the source; and

√ Develop, and have available for inspection, written documentation addressing waste reduction, including:

- ☐ A source reduction evaluation review and plan and a plan summary; and

- ☐ A hazardous waste management report and a report summary

On behalf of the Northern California Region, the Regional EHS Department has developed a comprehensive document entitled "*Hazardous Waste Management & Source Reduction Compliance Plans and Reports*." This document describes the processes, operations, and activities that generate hazardous wastes and evaluates source reduction measures that are being implemented at the Medical Facilities. In addition, the document describes the Regional hazardous waste management approach, including details about waste stream characteristics and volumes. This document must be updated every four years.

What Are My Responsibilities at a Facility?

Hazardous waste generators who are required to comply with State waste minimization requirements have the following responsibilities:

1. Recognize that source reduction is important not only to comply with the law, but that it will (a) reduce disposal costs (b) improve employee health and safety (c) reduce chemical product cost (d) mitigate possible adverse effects of chemicals and (e) illustrate our commitment to improving the environment.

2. Be familiar with the Region's waste minimization plans and activities, including program-wide reduction goals. Establish facility specific waste minimization goals.

3. Observe the Regional waste minimization implementation plan as outlined in the Northern California Region's "*Hazardous Waste Management & Source Reduction Compliance Plans and Reports*."

4. Continue to identify, evaluate, and, where appropriate, implement, waste minimization alternatives that make sense at the local level. Share innovative ideas and practices with other Kaiser Permanente facilities.

5. Assist the Region in periodically updating the "Hazardous Waste Management & Source Reduction Compliance Plans and Reports" document.

For a copy of the Region's "*Hazardous Waste Management & Source Reduction Regulatory Compliance Plans and Reports*," contact your Regional EH&S Department.

Chapter 9. Recordkeeping and Reporting

Throughout this handbook, a number of recordkeeping and reporting requirements have been discussed. Appendix 9A is provided as a management tool to summarize and briefly describe the most common hazardous waste administrative requirements relative to recordkeeping and reporting. The Appendix directs the reader to the appropriate Chapter and Section in this handbook for further information and guidance.

A system should be established to ensure compliance with the applicable recordkeeping and reporting requirements. Well-organized maintenance and ready accessibility of these documents facilitates day-to-day environmental management and helps ensure that the need of the Region and the requirements of the department are met.

APPENDIX F
Hydrology Report

MCE CONSULTANTS LLC
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July 2, 2001
JN: 93.01

EIP Associates
12301 Wilshire Blvd., Suite 430
Los Angeles, CA 90025

Attention: Wendy Katagi

Subject: Downey NASA Site
Civil Engineer's Response to City Memo of May 15, 2001 by Desi Alvarez

We have completed our Hydrology and Drainage Section plan check revisions to the above referenced project as well as added the proposed Kaiser site to our analysis. Desi's comments are directed to EIP's draft of the Hydrology section. We have made our revisions to the EIP version. The following is an itemized response list to the comments contained in memo by Desi Alvarez:

Page 3.4-1, Section 3.4.2, General Characteristics

The paragraph has been reworded.

Page 3.4-1, Section 3.4.2, Area Wide Drainage

The paragraph has been revised to include a discussion of the Bellflower storm drains.

Page 3.4-3, Section 3.4.2, Site Drainage Patterns, paragraph 2

Corrected.

Page 3.4-5. Groundwater:

The paragraph has been rephrased per the City's comments.

Page 3.4-5, Section 3.4.3, Regulatory Framework:

The paragraph has been rephrased per the City's comments.

Page 3.4-6, Section 3.4.5, Impacts, Impact on Drainage Patterns:

The paragraph has been revised to include the Lakewood Boulevard and Clark Avenue storm drains.

Page 3.4-6, Section 3.4-5, Impacts, Impact on Drainage Patterns, Paragraph 1 and 3:

The paragraphs have been revised to include a discussion of basins and quality requirements.

Page 3.4-7, Section 3.4.5, Comparison of Existing and Proposed Flows

Bullet 1

The division of the storm drain in Bellflower and Imperial is discussed.

Bullet 2

Percentages have been added.

Bullet 3

This paragraph has been revised. The subareas for the existing and proposed watersheds have been modified to make them more directly comparable.

Page 3.4-8, Groundwater Impacts:

The proposed storm drain system was modeled with a very simple schematic design based upon the information available. The master plan of the proposed storm drain system may contain percolation basins but no information on the on-site storm drain system was available. Under the section for potentially significant impacts and again in the mitigation measures the point is made that percolation/detention basins should be constructed to mitigate any additional runoff from the site. A statement regarding the usage of percolation basins has been added.

Page 3.4-8, Groundwater Impacts:

The paragraph has been revised to include a discussion of the increase in landscaping.

Page 3.4-8, Potentially Significant Impacts, Impact 3.4-1:

This paragraph has been revised. The subareas for the existing and proposed watersheds have been modified to make them more directly comparable.

Page 3.4.8, Table 3.4-1:

The subarea references have been revised for clarity. The existing and proposed subareas have been renumbered for consistency.

Page 3.4-9, First Paragraph:

A discussion regarding the LA County ownership of the existing storm drains has been added.

Section 3.4.5 - General Comment:

There is little information available at the time on the proposed development in regards to the exact percentages of landscaping. The site was modeled as a commercial development, with a standard assumed percentage of landscape of 10%. We have revised some portions of the subareas based upon information that has become available in terms of pervious percentages, such as the park area, along with watershed boundaries.

Page 3.4-11, Impact 3.4-3, second paragraph:

The reference to the number of parking spaces has been added.

Page 3.4-12, first paragraph, first sentence:

The sentence has been revised for clarity.

Page 3.4-12, first paragraph, second sentence:

The sentence has been revised for clarity.

Page 3.4-12, second paragraph:

The CRWQCB reference has been added.

Page 3.4-12, first paragraph:

A TMDL discussion was added to the section.

Page 3.4-13, Section 3.4.6:

The reference corrected to "Storm Water Master Plan." A discussion regarding the LA County ownership of the existing storm drains has been added.

Page 3.4-13, Section 3.4.7, Mitigation:

Mitigation Measure 3.4-2 refers to construction BMPs. Mitigation Measure numbers 3.4-3 & -4 actually refer to post-construction BMPs. The intent is to have the developer obtain approval from the City of Downey for the post-construction BMPs prior to construction.

Page 3.4-15, Mitigation Measure 3.4-3, first bullet:

The reference to percolation basins has been added.

Page 3.4-15, Mitigation Measure 3.4-3, second bullet:

The reference to streets and roadways has been added.

Page 3.4-16, Mitigation Measure 3.4-4, first bullet:

The reference to infiltration and percolation basins has been added.

If you have any questions regarding these issues please do not hesitate to call me at (949) 376-6407.

Sincerely,

MCE CONSULTANTS, LLC

Thomas E. Carcelli

HYDROLOGY REPORT

Prepared for:

THE CITY OF DOWNEY

PROJECT: Downey NASA Site

ADDRESS: Former Rockwell/Boeing
NASA Property
Downey, CA

DATE: June 29, 2001

Prepared by:

MCE CONSULTANTS

CIVIL ENGINEERING
LAND SURVEYING

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7/02/01

Richard A. Moore, RCE 23971 Date

TABLE OF CONTENTS

1.0 NARRATIVE

1.1 PURPOSE

The purpose of this study is to determine the drainage impacts in and around the existing Rockwell/Boeing site in the City of Downey that will be created by the proposed construction of a 161-acre multi-use project.

1.2 PROPOSED PROJECT

The proposed project involves construction of a multi-use development that will include a shopping center, offices and buildings for warehouse, distribution, research and development activities. There is also a museum/school and park proposed along with a hospital and medical office building. Parking will be satisfied by surface parking lots located throughout the site.

1.3 SITE DESCRIPTION

The Rockwell/Boeing site is approximately 161-acres. The site is bounded by Imperial Highway to the south, Stewart and Gray Road to the north, Bellflower Boulevard to the east, and Clark Avenue and Lakewood Boulevard to the west. The topography is very flat with the most of the site paved with asphalt or concrete. The site contains numerous existing buildings throughout the site.

1.4 STUDY METHODOLOGY AND ASSUMPTIONS

A 25-year hydrology analysis was completed for the site for the existing conditions and the proposed condition. The existing and proposed conditions were analyzed in order to obtain the necessary flows required to determine the impact the proposed project will have on the existing off-site storm drain system.

The existing watershed is analyzed using the available information provided by the City of Downey. They include on-site storm drain facilities including pipe sizes, off-site storm drain facilities including pipe sizes and location, and the site plan for the Storm Water Pollution Prevention Plan (SWPPP). The City of Downey also provided the on-site topography.

Utilizing this information, the proposed site was divided into watershed subareas separated according to the point at which the storm drain exits the site (see Appendix - Hydrology Map). The flow under the proposed condition at these points was, then, compared to that under the existing condition.

The Rational Method was used for the analysis. The computations were done using the Rational Method Hydrology Computer Program Package by Advanced Engineering Software (aes), Ver. 1.5A, release date 01/01/95.

Because of the information provided was incomplete and insufficient to meet the objective of the study, the following assumptions were made in order to achieve the objective.

- All existing and proposed storm drain pipes are assumed to be RCPs.

- Slope of the existing storm drain is assumed to be the same as that of existing surface.
- Slopes of the existing storm drain lines were, then, rounded to numbers of the increment of 0.25.
- Invert elevations of catch basins (both existing and proposed) are assumed to be 4.0 feet below the top of grate.
- Slopes of the proposed storm drain lines are assumed to be 0.5% minimum (exception of storm drain connecting node 2.2 and 2.5, the slope of 0.3% is used).

1.5 CURRENT DRAINAGE PATTERNS

The existing watershed has been divided into 6 subareas lettered A through F (see Appendix - Hydrology Map - Existing Condition). As previously mentioned, the existing watershed is fully developed. The watershed subareas for the existing condition were therefore modeled as commercial areas.

Subarea A drains the most northeastern portion of the site and is tributary to an existing storm drain lateral from Bellflower Boulevard. This paved area includes approximately 10.4 acres.

Subarea B includes a portion of the site that is southerly of Subarea A. This paved subarea also drains to Bellflower via an existing onsite storm drain laterals and is approximately 25.6 acres in area.

Subarea C includes the most northwesterly portion of the site and is tributary to the storm drain in Lakewood Boulevard. This area contains 31.2 acres of small and large buildings, paving, and a small portion of landscape area next to Lakewood.

Subarea D is the largest subarea of the site and contains the middle and southerly portion of the site. The total area is 65.5 acres, incorporating over 40% of the total runoff area. This subarea drains southerly to Imperial Highway via an existing on-site storm drain system that collects the surface runoff through a series of collection inlets. This area consists mostly of buildings and paving, with a small percentage of area landscaped.

Subarea E includes approximately 23.7 acres along the westerly middle portion of the site and drains to Clark Avenue via an existing onsite storm drain lateral. Subareas F contains approximately 5.0 acres and also drain to Clark Avenue via existing onsite storm drain laterals. Subareas E and F are also mostly paved with few buildings.

Portions of the project designated N.A.P. are not included in the drainage analysis. No development will occur and existing runoff conditions will be maintained on these parcels.

1.6 PROPOSED DRAINAGE PATTERNS

The proposed watershed has also been divided into 6 subareas lettered A through F (see Appendix - Hydrology Map - Proposed Condition) to correspond with the existing pattern. The watershed subareas for the proposed condition were modeled as commercial areas, except for the area B.1, which was modeled as public park.

Subarea A, as in the existing condition, continues to drain to the existing storm drain in Bellflower Boulevard. This subarea will be fully developed as retail buildings and parking lot.

The flow from this area will be picked up by proposed catch basins and carried to the existing 81" storm drain in Bellflower Boulevard. The area includes approximately 9.3 acres.

Subarea B, also as in the existing condition, includes a portion southerly of Subarea A. A portion of this subarea will be developed as either museum/school or public park. The rest of this subarea will be developed as a medical center for Kaiser Permanente. The flow from this subarea will also drain to the existing 81" storm drain in Bellflower Boulevard. The subarea contains approximately 27.8 acres.

Subarea C also contains much of the same portion of the site as in the existing condition. Most of this subarea will be developed as retail buildings and parking lot with small portion being the office building. This subarea will drain via sheet flow to the catch basins, then to the proposed storm drain that runs westerly out to the existing 45" storm drain in Lakewood Boulevard. The subarea was modeled as commercial. The subarea includes approximately 29.3 acres.

Subarea D contains the largest subarea of the site and roughly contains the subareas D & H in the existing condition. The area includes approximately 65.9 acres, and drains southerly to Imperial Highway. The subarea D is divided into six smaller subareas. These six subareas drain via sheet flow to the proposed catch basins. The proposed storm drain that runs southerly out to the existing storm drain in Imperial Highway picking up runoffs from six subareas.

Subarea E & F contain the office buildings and parking lots, and are located in the southwesterly corner of the site. The site contains approximately 20.7 and 8.4 acres, respectively. These subareas, much like the rest of the site, will drain via sheet flow to the proposed catch basins. the catch basins will drain to the existing 81" storm drain in Clark Avenue via proposed storm drain laterals.

Portions of the project designated N.A.P. are not included in the drainage analysis. No development will occur and existing runoff conditions will be maintained on these parcels.

1.8 Summary

1.8.1 Hydrologic Summary Table

Summary of Existing and Proposed Hydrology

	EXIST.	PROP.	DIFF.
Q exiting site @ exist. storm drain in Bellflower (subareas A + B)	85.2 cfs	76.3 cfs	- 8.9 cfs
Q exiting site @ exist. storm drain in Lakewood (subarea C)	66.8 cfs	56.7 cfs	- 10.1 cfs
Q exiting site @ exist. storm drain in Imperial (subareas D)	122.4 cfs	140.8 cfs	+ 18.4 cfs
Q exiting site @ exist. storm drain in N'ly Clark (subarea E)	55.6 cfs	47.9 cfs	- 7.7 cfs
Q exiting site @ exist. storm drain in S'ly Clark (subarea F)	12.5 cfs	17.6 cfs	+ 5.1 cfs
Q total (all subareas)	342.5 cfs	339.3 cfs	- 3.2 cfs

1.8.2 Comparison of Existing and Proposed Flows

A 25-year hydrology analysis was completed for the site for an existing condition and proposed condition. The existing and proposed conditions were analyzed in order to document the changes in the storm water runoff that the proposed development will incur on the site. A summary of the hydrologic analysis is included in Table 1.

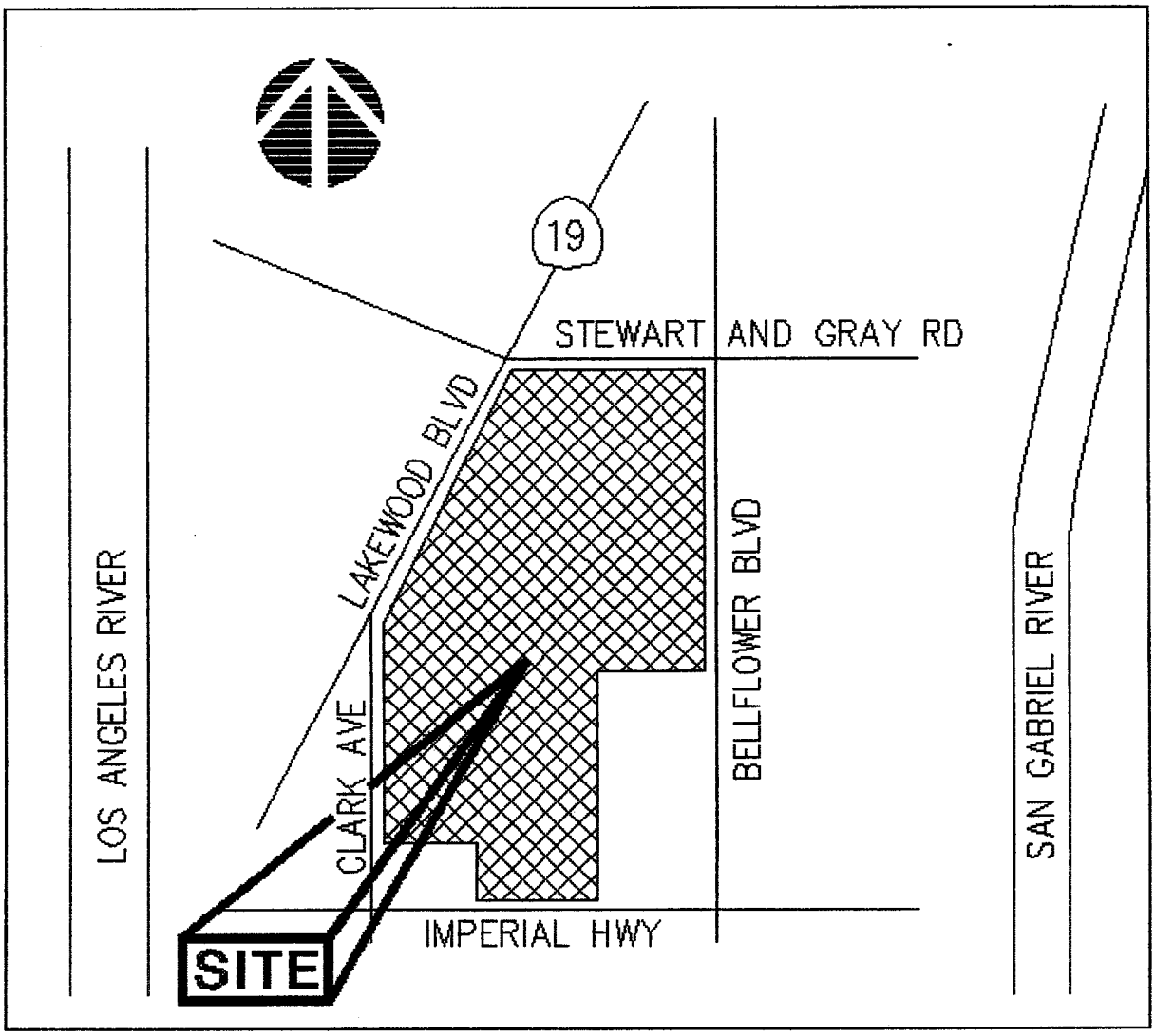
The Hydrology analysis indicates the total flow contributing to the existing storm drain along Bellflower Boulevard will decrease by approximately 10% (85.2 cfs to 76.3 cfs). This decrease can be attributed to the fact that a portion of subarea B will be developed as a public park, thus increasing the pervious area. The total flow contributing to the existing storm drain along Ardis Avenue, downstream of Imperial Highway and the project site, will increase approximately 2% (257.3 cfs to 263.0 cfs). This increase can be attributed to the proposed runoff routing of this subarea, which effectively increases the concentration of flows to one storm drain.

As shown in the above Table, the difference in the runoff for the entire site between existing and proposed conditions is 3.2 cfs or about 0.1%. With an increase in landscape areas and an addition of a public park, the overall pervious area increased under the proposed condition, thus reducing the runoff.

1.9 References

- Site Plan for the Storm Water Pollution Prevention Plan (SWPPP) prepared by Geocon.

2.0 SITE LOCATION MAP



3.1 25-YEAR (EXISTING CONDITION)

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (c) Copyright 1983-2001 Advanced Engineering Software (aes)
              Ver. 8.0  Release Date: 01/01/2001  License ID 1426

                              Analysis prepared by:

                               MCE CONSULTANTS, LLC
                             1100 S. COAST HWY., #318
                              LAGUNA BEACH, CA 92651
                                  (949) 376-6407

 ************************** DESCRIPTION OF STUDY **************************
* 25-YEAR STORM EVENT HYDROLOGY                                           *
* DOWNEY NASA SITE - EXISTING CONDITION                                   *
* JN 93.01                                                                *
 **************************************************************************

  FILE NAME: 9301-E.DAT
  TIME/DATE OF STUDY: 13:59 06/28/2001
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED TABLED RAINFALL USED*
  NUMBER OF [TIME,INTENSITY] DATA PAIRS = 20
   1)    5.000;  4.272
   2)    6.000;  3.800
   3)    7.000;  3.454
   4)    8.000;  3.191
   5)    9.000;  2.987
   6)   10.000;  2.806
   7)   11.000;  2.657
   8)   12.000;  2.534
   9)   13.000;  2.430
  10)   14.000;  2.340
  11)   15.000;  2.256
  12)   16.000;  2.183
  13)   17.000;  2.118
  14)   18.000;  2.060
  15)   20.000;  1.959
  16)   22.000;  1.868
  17)   24.000;  1.792
  18)   26.000;  1.726
  19)   28.000;  1.666
  20)   30.000;  1.614
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
```

NO.	WIDTH (FT)	CROSSFALL (FT)	IN- / OUT-/PARK- SIDE / SIDE/ WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)	FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE       1.10 TO NODE       1.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   550.00
  ELEVATION DATA: UPSTREAM(FEET) =    104.00  DOWNSTREAM(FEET) =    102.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.913
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.951
  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                  D       10.40      0.20       0.10    75   11.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =     27.43
  TOTAL AREA(ACRES) =     10.40   PEAK FLOW RATE(CFS) =     27.43

****************************************************************************
  FLOW PROCESS FROM NODE       1.20 TO NODE       1.30 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    98.20  DOWNSTREAM(FEET) =    96.80
  FLOW LENGTH(FEET) =   280.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.41
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     27.43
  PIPE TRAVEL TIME(MIN.) =   0.41    Tc(MIN.) =  12.32
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE       1.30 =   830.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE       2.10 TO NODE       2.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   275.00
  ELEVATION DATA: UPSTREAM(FEET) =    102.00  DOWNSTREAM(FEET) =    101.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.840
```

```
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.020
 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                 D        3.20      0.20       0.10    75    8.84
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =      8.64
 TOTAL AREA(ACRES) =      3.20   PEAK FLOW RATE(CFS) =      8.64

****************************************************************************
 FLOW PROCESS FROM NODE      2.20 TO NODE      2.30 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    97.00  DOWNSTREAM(FEET) =    94.85
 FLOW LENGTH(FEET) =   430.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  27.0 INCH PIPE IS  12.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.98
 GIVEN PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      8.64
 PIPE TRAVEL TIME(MIN.) =   1.44    Tc(MIN.) =  10.28
 LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.30 =   705.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.40 TO NODE      2.50 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   490.00
 ELEVATION DATA: UPSTREAM(FEET) =     99.50  DOWNSTREAM(FEET) =     97.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.409
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.745
 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                 D        5.80      0.20       0.10    75   10.41
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     14.22
 TOTAL AREA(ACRES) =      5.80   PEAK FLOW RATE(CFS) =     14.22

****************************************************************************
 FLOW PROCESS FROM NODE      2.60 TO NODE      2.70 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1150.00
 ELEVATION DATA: UPSTREAM(FEET) =     99.00  DOWNSTREAM(FEET) =     91.05

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.779
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.360
 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                   D       16.60      0.20      0.10     75   13.78
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =     34.96
  TOTAL AREA(ACRES) =     16.60   PEAK FLOW RATE(CFS) =     34.96

****************************************************************************
  FLOW PROCESS FROM NODE      2.70 TO NODE      2.80 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    87.05  DOWNSTREAM(FEET) =    86.45
  FLOW LENGTH(FEET) =   120.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  42.0 INCH PIPE IS  21.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.08
  GIVEN PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     34.96
  PIPE TRAVEL TIME(MIN.) =   0.28    Tc(MIN.) =  14.06
  LONGEST FLOWPATH FROM NODE      2.60 TO NODE      2.80 =  1270.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.10 TO NODE      3.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   360.00
  ELEVATION DATA: UPSTREAM(FEET) =    104.00  DOWNSTREAM(FEET) =    102.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.195
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.777
  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                  D        2.50      0.20       0.10     75   10.19
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      6.20
  TOTAL AREA(ACRES) =      2.50   PEAK FLOW RATE(CFS) =      6.20

****************************************************************************
  FLOW PROCESS FROM NODE      3.20 TO NODE      3.50 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    98.90  DOWNSTREAM(FEET) =    93.05
  FLOW LENGTH(FEET) =  1170.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   9.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.45
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      6.20
  PIPE TRAVEL TIME(MIN.) =   4.38    Tc(MIN.) =  14.58
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.50 =  1530.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.50 TO NODE      3.50 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
================================================================================
  MAINLINE Tc(MIN) =  14.58
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.291
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D       11.60      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =   11.60      SUBAREA RUNOFF(CFS) =   23.71
  EFFECTIVE AREA(ACRES) =    14.10   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =    14.10       PEAK FLOW RATE(CFS) =      28.82

********************************************************************************
  FLOW PROCESS FROM NODE      3.50 TO NODE      3.50 IS CODE =  10
--------------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
================================================================================

********************************************************************************
  FLOW PROCESS FROM NODE      3.30 TO NODE      3.40 IS CODE =  21
--------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   225.00
  ELEVATION DATA: UPSTREAM(FEET) =    103.80  DOWNSTREAM(FEET) =    101.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.893
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.491
  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                  D        2.30      0.20       0.10    75    6.89
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      7.18
  TOTAL AREA(ACRES) =      2.30   PEAK FLOW RATE(CFS) =      7.18

********************************************************************************
  FLOW PROCESS FROM NODE      3.40 TO NODE      3.50 IS CODE =  41
--------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    97.90  DOWNSTREAM(FEET) =    93.05
  FLOW LENGTH(FEET) =   970.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.75
  GIVEN PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      7.18
  PIPE TRAVEL TIME(MIN.) =   3.41    Tc(MIN.) =  10.30
  LONGEST FLOWPATH FROM NODE      3.30 TO NODE      3.50 =  1195.00 FEET.

********************************************************************************
  FLOW PROCESS FROM NODE      3.50 TO NODE      3.50 IS CODE =  81
--------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
================================================================================
```

```
 MAINLINE Tc(MIN) =  10.30
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.761
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN
 COMMERCIAL                  D       14.80      0.20        0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =    14.80      SUBAREA RUNOFF(CFS) =    36.52
 EFFECTIVE AREA(ACRES) =    17.10    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =    17.10        PEAK FLOW RATE(CFS) =     42.19

****************************************************************************
 FLOW PROCESS FROM NODE      3.50 TO NODE      3.50 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1      42.19  10.30     2.761   0.20( 0.02) 0.10     17.1        3.30
 LONGEST FLOWPATH FROM NODE      3.30 TO NODE      3.50 =  1195.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1      28.82  14.58     2.291   0.20( 0.02) 0.10     14.1        3.10
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.50 =  1530.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1      66.77  10.30     2.761   0.20( 0.02) 0.10     27.1        3.30
     2      63.78  14.58     2.291   0.20( 0.02) 0.10     31.2        3.10
   TOTAL AREA(ACRES) =      31.20

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       66.77  Tc(MIN.) =   10.299
 EFFECTIVE AREA(ACRES) =     27.06  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     31.20
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.50 =  1530.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.50 TO NODE      3.50 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      3.50 TO NODE      3.60 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    93.05  DOWNSTREAM(FEET) =    90.85
 FLOW LENGTH(FEET) =   440.00   MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.45
```

```
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     66.77
  PIPE TRAVEL TIME(MIN.) =   0.78    Tc(MIN.) =  11.08
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.60 =  1970.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.10 TO NODE      4.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
  ELEVATION DATA: UPSTREAM(FEET) =     98.70  DOWNSTREAM(FEET) =     95.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.862
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.865
  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                  D        2.80      0.20       0.10    75    5.86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      9.69
  TOTAL AREA(ACRES) =      2.80   PEAK FLOW RATE(CFS) =      9.69

****************************************************************************
  FLOW PROCESS FROM NODE      4.20 TO NODE      4.50 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    91.70  DOWNSTREAM(FEET) =    86.60
  FLOW LENGTH(FEET) =  1020.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.01
  GIVEN PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      9.69
  PIPE TRAVEL TIME(MIN.) =   3.39    Tc(MIN.) =   9.26
  LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.50 =  1220.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.50 TO NODE      4.50 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN) =   9.26
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.941
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        9.40      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     9.40      SUBAREA RUNOFF(CFS) =   24.71
  EFFECTIVE AREA(ACRES) =    12.20   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =    12.20       PEAK FLOW RATE(CFS) =      32.07

****************************************************************************
```

```
 FLOW PROCESS FROM NODE       4.50 TO NODE       4.50 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE       4.30 TO NODE       4.40 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1650.00
 ELEVATION DATA: UPSTREAM(FEET) =     99.00  DOWNSTREAM(FEET) =     90.75

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.985
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.119
 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                  D       21.50      0.20       0.10    75   16.99
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     40.61
 TOTAL AREA(ACRES) =     21.50   PEAK FLOW RATE(CFS) =     40.61

****************************************************************************
 FLOW PROCESS FROM NODE       4.40 TO NODE       4.50 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    86.75  DOWNSTREAM(FEET) =    86.60
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =  22.98
 PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     40.61
 PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =  17.01
 LONGEST FLOWPATH FROM NODE      4.30 TO NODE      4.50 =  1680.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE       4.50 TO NODE       4.50 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1      40.61  17.01    2.118  0.20( 0.02) 0.10    21.5        4.30
 LONGEST FLOWPATH FROM NODE      4.30 TO NODE      4.50 =  1680.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1      32.07   9.26    2.941  0.20( 0.02) 0.10    12.2        4.10
 LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.50 =  1220.00 FEET.

 ** PEAK FLOW RATE TABLE **
```

```
 STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae      HEADWATER
 NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
    1     62.85   9.26    2.941  0.20( 0.02) 0.10    23.9        4.10
    2     63.65  17.01    2.118  0.20( 0.02) 0.10    33.7        4.30
  TOTAL AREA(ACRES) =     33.70

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       63.65  Tc(MIN.) =   17.007
 EFFECTIVE AREA(ACRES) =     33.70  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     33.70
 LONGEST FLOWPATH FROM NODE      4.30 TO NODE      4.50 =  1680.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.50 TO NODE      4.50 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      4.50 TO NODE      4.80 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    86.60  DOWNSTREAM(FEET) =    83.85
 FLOW LENGTH(FEET) =   550.00   MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.72
 PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
 GIVEN PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     63.65
 PIPE TRAVEL TIME(MIN.) =   0.86    Tc(MIN.) =  17.86
 LONGEST FLOWPATH FROM NODE      4.30 TO NODE      4.80 =  2230.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.80 TO NODE      4.80 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  17.86
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.068
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        9.00      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =    9.00      SUBAREA RUNOFF(CFS) =   16.59
 EFFECTIVE AREA(ACRES) =    42.70   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =    42.70       PEAK FLOW RATE(CFS) =      78.70

 ** PEAK FLOW RATE TABLE **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae      HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1     81.96  10.12    2.788  0.20( 0.02) 0.10    32.9        4.10
     2     78.70  17.86    2.068  0.20( 0.02) 0.10    42.7        4.30
 NEW PEAK FLOW DATA ARE:
 PEAK FLOW RATE(CFS) =     81.96  Tc(MIN.) =  10.12
 AREA-AVERAGED Fm(INCH/HR) =  0.02  AREA-AVERAGED Fp(INCH/HR) =  0.20
```

```
 AREA-AVERAGED Ap =  0.10  EFFECTIVE AREA(ACRES) =     32.90

****************************************************************************
 FLOW PROCESS FROM NODE      4.80 TO NODE      4.80 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      4.60 TO NODE      4.70 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   540.00
 ELEVATION DATA: UPSTREAM(FEET) =     95.00  DOWNSTREAM(FEET) =     92.35

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.906
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.671
 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                  D        5.70      0.20       0.10    75   10.91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     13.60
 TOTAL AREA(ACRES) =      5.70   PEAK FLOW RATE(CFS) =     13.60

****************************************************************************
 FLOW PROCESS FROM NODE      4.70 TO NODE      4.80 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    88.35  DOWNSTREAM(FEET) =    83.85
 FLOW LENGTH(FEET) =   900.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  14.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.59
 GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     13.60
 PIPE TRAVEL TIME(MIN.) =   2.68    Tc(MIN.) =  13.59
 LONGEST FLOWPATH FROM NODE      4.60 TO NODE      4.80 =  1440.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.80 TO NODE      4.80 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  13.59
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.377
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        6.90      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     6.90     SUBAREA RUNOFF(CFS) =    14.64
 EFFECTIVE AREA(ACRES) =    12.60   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =    12.60       PEAK FLOW RATE(CFS) =      26.73
```

```
****************************************************************************
 FLOW PROCESS FROM NODE       4.80 TO NODE       4.80 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1      26.73  13.59     2.377   0.20( 0.02) 0.10     12.6        4.60
 LONGEST FLOWPATH FROM NODE       4.60 TO NODE       4.80 =  1440.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1      81.96  10.12     2.788   0.20( 0.02) 0.10     32.9        4.10
     2      78.70  17.86     2.068   0.20( 0.02) 0.10     42.7        4.30
 LONGEST FLOWPATH FROM NODE       4.30 TO NODE       4.80 =  2230.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1     105.34  10.12     2.788   0.20( 0.02) 0.10     42.3        4.10
     2     107.23  13.59     2.377   0.20( 0.02) 0.10     49.9        4.60
     3     101.93  17.86     2.068   0.20( 0.02) 0.10     55.3        4.30
   TOTAL AREA(ACRES) =      55.30

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      107.23  Tc(MIN.) =   13.589
 EFFECTIVE AREA(ACRES) =     49.89  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     55.30
 LONGEST FLOWPATH FROM NODE       4.30 TO NODE       4.80 =  2230.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE       4.80 TO NODE       4.80 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE       4.80 TO NODE       4.90 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    83.85  DOWNSTREAM(FEET) =    76.85
 FLOW LENGTH(FEET) =   700.00   MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =  11.14
 PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
 GIVEN PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =    107.23
 PIPE TRAVEL TIME(MIN.) =   1.05    Tc(MIN.) =  14.64
 LONGEST FLOWPATH FROM NODE       4.30 TO NODE       4.90 =  2930.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE       4.90 TO NODE       4.90 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
==========================================================================
 MAINLINE Tc(MIN) =  14.64
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.287
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        6.90      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =    6.90      SUBAREA RUNOFF(CFS) =   14.08
 EFFECTIVE AREA(ACRES) =    56.79   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =    62.20       PEAK FLOW RATE(CFS) =     115.85

**************************************************************************
 FLOW PROCESS FROM NODE      5.10 TO NODE      5.20 IS CODE =  21
--------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   380.00
 ELEVATION DATA: UPSTREAM(FEET) =    100.50  DOWNSTREAM(FEET) =     98.60

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.440
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.907
 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                  D       12.00      0.20       0.10    75    9.44
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     31.18
 TOTAL AREA(ACRES) =     12.00   PEAK FLOW RATE(CFS) =     31.18

**************************************************************************
 FLOW PROCESS FROM NODE      5.20 TO NODE      5.30 IS CODE =  41
--------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
==========================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    94.60  DOWNSTREAM(FEET) =    85.00
 FLOW LENGTH(FEET) =   960.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  20.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.81
 GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     31.18
 PIPE TRAVEL TIME(MIN.) =   1.82    Tc(MIN.) =  11.26
 LONGEST FLOWPATH FROM NODE      5.10 TO NODE      5.30 =  1340.00 FEET.

**************************************************************************
 FLOW PROCESS FROM NODE      5.30 TO NODE      5.30 IS CODE =  81
--------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
 MAINLINE Tc(MIN) =  11.26
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.625
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D       11.70      0.20       0.10    75
```

```
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =   11.70      SUBAREA RUNOFF(CFS) =   27.44
 EFFECTIVE AREA(ACRES) =   23.70   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =   23.70       PEAK FLOW RATE(CFS) =      55.57

****************************************************************************
 FLOW PROCESS FROM NODE      6.10 TO NODE      6.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   440.00
 ELEVATION DATA: UPSTREAM(FEET) =     95.50  DOWNSTREAM(FEET) =     93.70

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.421
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.743
 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                  D        2.20      0.20       0.10    75   10.42
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =      5.39
 TOTAL AREA(ACRES) =      2.20   PEAK FLOW RATE(CFS) =      5.39

****************************************************************************
 FLOW PROCESS FROM NODE      6.20 TO NODE      6.30 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    89.70  DOWNSTREAM(FEET) =    89.00
 FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.39
 PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
 GIVEN PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      5.39
 PIPE TRAVEL TIME(MIN.) =   0.53    Tc(MIN.) =  10.95
 LONGEST FLOWPATH FROM NODE      6.10 TO NODE      6.30 =   580.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      7.10 TO NODE      7.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   410.00
 ELEVATION DATA: UPSTREAM(FEET) =     95.50  DOWNSTREAM(FEET) =     93.45

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.732
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.855
 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                  D        2.80      0.20       0.10    75    9.73
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
```

```
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =      7.14
 TOTAL AREA(ACRES) =      2.80   PEAK FLOW RATE(CFS) =      7.14

****************************************************************************
 FLOW PROCESS FROM NODE      7.20 TO NODE      7.30 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    89.45  DOWNSTREAM(FEET) =    88.48
 FLOW LENGTH(FEET) =   130.00   MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.82
 PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
 GIVEN PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      7.14
 PIPE TRAVEL TIME(MIN.) =   0.37    Tc(MIN.) =  10.10
 LONGEST FLOWPATH FROM NODE      7.10 TO NODE      7.30 =   540.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      8.10 TO NODE      8.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   980.00
 ELEVATION DATA: UPSTREAM(FEET) =     94.60  DOWNSTREAM(FEET) =     92.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.654
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.208
 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                  D        3.30      0.20       0.10    75   15.65
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =      6.50
 TOTAL AREA(ACRES) =      3.30   PEAK FLOW RATE(CFS) =      6.50

============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

3.2 25-YEAR (PROPOSED CONDITION)

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                          Analysis prepared by:

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 ************************* DESCRIPTION OF STUDY *************************
* 25-YEAR STORM EVENT HYDROLOGY                                         *
* DOWNEY NASA SITE - PROPOSED CONDITION                                 *
* JN 93.01                                                              *
 *************************************************************************

  FILE NAME: 9301-P.DAT
  TIME/DATE OF STUDY: 14:27 06/28/2001
=========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED TABLED RAINFALL USED*
  NUMBER OF [TIME,INTENSITY] DATA PAIRS = 20
   1)   5.000;  4.272
   2)   6.000;  3.800
   3)   7.000;  3.454
   4)   8.000;  3.191
   5)   9.000;  2.987
   6)  10.000;  2.806
   7)  11.000;  2.657
   8)  12.000;  2.534
   9)  13.000;  2.430
  10)  14.000;  2.340
  11)  15.000;  2.256
  12)  16.000;  2.183
  13)  17.000;  2.118
  14)  18.000;  2.060
  15)  20.000;  1.959
  16)  22.000;  1.868
  17)  24.000;  1.792
  18)  26.000;  1.726
  19)  28.000;  1.666
  20)  30.000;  1.614
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ==================  ======  =====  ====  =====  =======
```

```
 1   30.0     20.0     0.018/0.018/0.020    0.67     2.00 0.0312 0.167 0.0150

 GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
   1. Relative Flow-Depth =  0.00 FEET
      as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
   2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
 *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
  OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
 *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
 FLOW PROCESS FROM NODE       1.10 TO NODE       1.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   580.00
 ELEVATION DATA: UPSTREAM(FEET) =    104.00  DOWNSTREAM(FEET) =    101.10

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.180
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.059
 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                  D        9.30      0.20       0.10    75   11.18
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     25.44
 TOTAL AREA(ACRES) =      9.30   PEAK FLOW RATE(CFS) =     25.44

****************************************************************************
 FLOW PROCESS FROM NODE       1.20 TO NODE       1.30 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    97.10  DOWNSTREAM(FEET) =    96.00
 FLOW LENGTH(FEET) =   220.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  22.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.36
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     25.44
 PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =  11.76
 LONGEST FLOWPATH FROM NODE      1.10 TO NODE       1.30 =   800.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE       2.10 TO NODE       2.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1080.00
 ELEVATION DATA: UPSTREAM(FEET) =    106.05  DOWNSTREAM(FEET) =    100.65

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.337
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.312
 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                  D       11.80      0.20       0.10     75   14.34
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     24.34
 TOTAL AREA(ACRES) =     11.80   PEAK FLOW RATE(CFS) =     24.34

****************************************************************************
 FLOW PROCESS FROM NODE      2.20 TO NODE      2.50 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    96.65  DOWNSTREAM(FEET) =    91.97
 FLOW LENGTH(FEET) =  1560.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  24.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.22
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     24.34
 PIPE TRAVEL TIME(MIN.) =   4.98    Tc(MIN.) =  19.31
 LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.50 =  2640.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.50 TO NODE      2.50 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      2.30 TO NODE      2.40 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   700.00
 ELEVATION DATA: UPSTREAM(FEET) =    101.80  DOWNSTREAM(FEET) =     98.30

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.054
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.528
 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                  D        4.50      0.20       0.10     75   12.05
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     10.16
 TOTAL AREA(ACRES) =      4.50   PEAK FLOW RATE(CFS) =     10.16

****************************************************************************
 FLOW PROCESS FROM NODE      2.40 TO NODE      2.50 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    94.30  DOWNSTREAM(FEET) =    91.97
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  14.52
 ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     10.16
 PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =  12.09
```

```
 LONGEST FLOWPATH FROM NODE      2.30 TO NODE      2.50 =   730.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.50 TO NODE      2.50 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)         (ACRES)     NODE
     1      10.16  12.09     2.525   0.20( 0.02) 0.10      4.5       2.30
 LONGEST FLOWPATH FROM NODE      2.30 TO NODE      2.50 =   730.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)         (ACRES)     NODE
     1      24.34  19.31     1.994   0.20( 0.02) 0.10     11.8       2.10
 LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.50 =  2640.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)         (ACRES)     NODE
     1      29.49  12.09     2.525   0.20( 0.02) 0.10     11.9       2.30
     2      32.34  19.31     1.994   0.20( 0.02) 0.10     16.3       2.10
   TOTAL AREA(ACRES) =      16.30

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      32.34  Tc(MIN.) =   19.314
 EFFECTIVE AREA(ACRES) =    16.30  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     16.30
 LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.50 =  2640.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.50 TO NODE      2.60 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    91.97  DOWNSTREAM(FEET) =    91.47
 FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  24.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.77
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     32.34
 PIPE TRAVEL TIME(MIN.) =   0.25    Tc(MIN.) =  19.56
 LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.60 =  2740.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.60 TO NODE      2.60 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      2.54 TO NODE      2.57 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
```

```
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1240.00
 ELEVATION DATA: UPSTREAM(FEET) =    106.05  DOWNSTREAM(FEET) =     99.85

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.151
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.245
 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                  D       13.00      0.20       0.10    75   15.15
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     26.03
 TOTAL AREA(ACRES) =     13.00   PEAK FLOW RATE(CFS) =     26.03

****************************************************************************
 FLOW PROCESS FROM NODE      2.57 TO NODE      2.60 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    95.85  DOWNSTREAM(FEET) =    91.47
 FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  16.87
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     26.03
 PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =  15.22
 LONGEST FLOWPATH FROM NODE      2.54 TO NODE      2.60 =  1310.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.60 TO NODE      2.60 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q     Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1     26.03  15.22    2.240  0.20( 0.02) 0.10    13.0        2.54
 LONGEST FLOWPATH FROM NODE      2.54 TO NODE      2.60 =  1310.00 FEET.

 ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM      Q     Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1     29.49  12.34    2.499  0.20( 0.02) 0.10    11.9        2.30
     2     32.34  19.56    1.981  0.20( 0.02) 0.10    16.3        2.10
 LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.60 =  2740.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q     Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1     53.05  12.34    2.499  0.20( 0.02) 0.10    22.4        2.30
     2     56.66  15.22    2.240  0.20( 0.02) 0.10    26.6        2.54
     3     55.34  19.56    1.981  0.20( 0.02) 0.10    29.3        2.10
   TOTAL AREA(ACRES) =     29.30

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      56.66  Tc(MIN.) =   15.220
 EFFECTIVE AREA(ACRES) =    26.65  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
```

```
  TOTAL AREA(ACRES) =     29.30
  LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.60 =  2740.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.60 TO NODE      2.70 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    91.47  DOWNSTREAM(FEET) =    90.85
  FLOW LENGTH(FEET) =   124.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  42.0 INCH PIPE IS  29.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.86
  ESTIMATED PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     56.66
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =  15.48
  LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.70 =  2864.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.70 TO NODE      2.70 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      2.70 TO NODE      2.70 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.04 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   775.00
  ELEVATION DATA: UPSTREAM(FEET) =    101.40  DOWNSTREAM(FEET) =     97.52

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   19.942
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  1.962
  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.)
  PUBLIC PARK                 D        8.10      0.20       0.85    75   19.94
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.85
  SUBAREA RUNOFF(CFS) =     13.06
  TOTAL AREA(ACRES) =      8.10   PEAK FLOW RATE(CFS) =     13.06

****************************************************************************
  FLOW PROCESS FROM NODE      3.04 TO NODE      3.05 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    93.52  DOWNSTREAM(FEET) =    93.27
  FLOW LENGTH(FEET) =    49.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  17.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.48
```

```
 ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     13.06
 PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =  20.09
 LONGEST FLOWPATH FROM NODE      3.03 TO NODE      3.05 =   824.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.10 TO NODE      6.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1530.00
 ELEVATION DATA: UPSTREAM(FEET) =    102.00  DOWNSTREAM(FEET) =     94.35

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.480
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.152
 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                  D       19.70      0.20       0.10    75   16.48
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     37.80
 TOTAL AREA(ACRES) =     19.70   PEAK FLOW RATE(CFS) =     37.80

****************************************************************************
 FLOW PROCESS FROM NODE      6.20 TO NODE      6.30 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    90.35  DOWNSTREAM(FEET) =    89.65
 FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  23.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.03
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     37.80
 PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =  16.61
 LONGEST FLOWPATH FROM NODE      6.10 TO NODE      6.30 =  1600.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.10 TO NODE      3.12 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   640.00
 ELEVATION DATA: UPSTREAM(FEET) =    101.13  DOWNSTREAM(FEET) =     94.73

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.124
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.788
 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                  D       14.20      0.20       0.10    75   10.12
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     35.37
 TOTAL AREA(ACRES) =     14.20   PEAK FLOW RATE(CFS) =     35.37
```

```
****************************************************************************
 FLOW PROCESS FROM NODE      3.12 TO NODE      3.40 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    90.73  DOWNSTREAM(FEET) =    83.35
 FLOW LENGTH(FEET) =  1475.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  26.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.81
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =  1
 PIPE-FLOW(CFS) =     35.37
 PIPE TRAVEL TIME(MIN.) =   3.61    Tc(MIN.) =  13.73
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.40 =  2115.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.40 TO NODE      3.40 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      3.20 TO NODE      3.22 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1135.00
 ELEVATION DATA: UPSTREAM(FEET) =    100.95  DOWNSTREAM(FEET) =    89.60

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.731
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.458
 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                 D        8.60      0.20       0.10     75   12.73
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     18.87
 TOTAL AREA(ACRES) =      8.60   PEAK FLOW RATE(CFS) =     18.87

****************************************************************************
 FLOW PROCESS FROM NODE      3.22 TO NODE      3.40 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    85.60  DOWNSTREAM(FEET) =    83.35
 FLOW LENGTH(FEET) =   150.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.10
 ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =  1
 PIPE-FLOW(CFS) =     18.87
 PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =  13.01
 LONGEST FLOWPATH FROM NODE      3.20 TO NODE      3.40 =  1285.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.40 TO NODE      3.40 IS CODE =  11
----------------------------------------------------------------------------
```

```
>>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
================================================================================

** MAIN STREAM CONFLUENCE DATA **
 STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
 NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
    1      18.87  13.01     2.429   0.20( 0.02) 0.10      8.6        3.20
LONGEST FLOWPATH FROM NODE      3.20 TO NODE      3.40 =  1285.00 FEET.

** MEMORY BANK #  1 CONFLUENCE DATA **
 STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
 NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
    1      35.37  13.73     2.364   0.20( 0.02) 0.10     14.2        3.10
LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.40 =  2115.00 FEET.

** PEAK FLOW RATE TABLE **
 STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
 NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
    1      53.30  13.01     2.429   0.20( 0.02) 0.10     22.0        3.20
    2      53.73  13.73     2.364   0.20( 0.02) 0.10     22.8        3.10
  TOTAL AREA(ACRES) =      22.80

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       53.73  Tc(MIN.) =   13.733
EFFECTIVE AREA(ACRES) =     22.80  AREA-AVERAGED Fm(INCH/HR) =  0.02
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
TOTAL AREA(ACRES) =     22.80
LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.40 =  2115.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE      3.40 TO NODE      3.40 IS CODE =  10
----------------------------------------------------------------------------
>>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
FLOW PROCESS FROM NODE      3.30 TO NODE      3.32 IS CODE =  21
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
INITIAL SUBAREA FLOW-LENGTH(FEET) =   700.00
ELEVATION DATA: UPSTREAM(FEET) =     99.10  DOWNSTREAM(FEET) =     92.10

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.493
*  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.732
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                 D       14.70      0.20       0.10     75   10.49
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
SUBAREA RUNOFF(CFS) =     35.89
TOTAL AREA(ACRES) =     14.70   PEAK FLOW RATE(CFS) =     35.89

****************************************************************************
FLOW PROCESS FROM NODE      3.32 TO NODE      3.40 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     88.10  DOWNSTREAM(FEET) =     83.35
  FLOW LENGTH(FEET) =   235.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.81
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     35.89
  PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =  10.82
  LONGEST FLOWPATH FROM NODE      3.30 TO NODE      3.40 =    935.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.40 TO NODE      3.40 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
   NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
      1      35.89  10.82    2.683  0.20( 0.02) 0.10    14.7        3.30
  LONGEST FLOWPATH FROM NODE      3.30 TO NODE      3.40 =    935.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
   STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
   NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
      1      53.30  13.01    2.429  0.20( 0.02) 0.10    22.0        3.20
      2      53.73  13.73    2.364  0.20( 0.02) 0.10    22.8        3.10
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.40 =   2115.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
   NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
      1      84.92  10.82    2.683  0.20( 0.02) 0.10    33.1        3.30
      2      85.77  13.01    2.429  0.20( 0.02) 0.10    36.7        3.20
      3      85.31  13.73    2.364  0.20( 0.02) 0.10    37.5        3.10
    TOTAL AREA(ACRES) =     37.50

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      85.77  Tc(MIN.) =   13.006
  EFFECTIVE AREA(ACRES) =    36.75  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     37.50
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.40 =   2115.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.40 TO NODE      3.40 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      3.40 TO NODE      3.40 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      3.40 TO NODE      3.60 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    83.35  DOWNSTREAM(FEET) =    82.35
  FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  35.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.67
  ESTIMATED PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     85.77
  PIPE TRAVEL TIME(MIN.) =   0.38    Tc(MIN.) =  13.39
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.60 =  2315.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.60 TO NODE      3.60 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
==========================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      3.50 TO NODE      3.52 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   880.00
  ELEVATION DATA: UPSTREAM(FEET) =     97.90  DOWNSTREAM(FEET) =     89.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.499
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.596
  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                  D        9.20      0.20       0.10    75   11.50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =     21.33
  TOTAL AREA(ACRES) =      9.20   PEAK FLOW RATE(CFS) =     21.33

****************************************************************************
  FLOW PROCESS FROM NODE      3.52 TO NODE      3.60 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    85.10  DOWNSTREAM(FEET) =    82.35
  FLOW LENGTH(FEET) =    18.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  22.06
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     21.33
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =  11.51
  LONGEST FLOWPATH FROM NODE      3.50 TO NODE      3.60 =   898.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.60 TO NODE      3.60 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
==========================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM      Q      Tc   Intensity   Fp(Fm)      Ap    Ae      HEADWATER
   NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
```

```
    1     21.33  11.51    2.594  0.20( 0.02) 0.10      9.2        3.50
 LONGEST FLOWPATH FROM NODE      3.50 TO NODE      3.60 =   898.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)     NODE
    1      84.92  11.21    2.631  0.20( 0.02) 0.10     33.1        3.30
    2      85.77  13.39    2.395  0.20( 0.02) 0.10     36.7        3.20
    3      85.31  14.12    2.330  0.20( 0.02) 0.10     37.5        3.10
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.60 =  2315.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)     NODE
    1     105.98  11.21    2.631  0.20( 0.02) 0.10     42.0        3.30
    2     106.36  11.51    2.594  0.20( 0.02) 0.10     42.8        3.50
    3     105.45  13.39    2.395  0.20( 0.02) 0.10     45.9        3.20
    4     104.45  14.12    2.330  0.20( 0.02) 0.10     46.7        3.10
   TOTAL AREA(ACRES) =      46.70

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      106.36  Tc(MIN.) =   11.513
 EFFECTIVE AREA(ACRES) =     42.76  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     46.70
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.60 =  2315.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.60 TO NODE      3.60 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      3.60 TO NODE      3.80 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    82.35  DOWNSTREAM(FEET) =    79.95
 FLOW LENGTH(FEET) =   480.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  51.0 INCH PIPE IS  39.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.08
 ESTIMATED PIPE DIAMETER(INCH) =  51.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =    106.36
 PIPE TRAVEL TIME(MIN.) =   0.88    Tc(MIN.) =  12.39
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.80 =  2795.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.80 TO NODE      3.80 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      3.70 TO NODE      3.72 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1510.00
```

```
 ELEVATION DATA: UPSTREAM(FEET) =     94.00  DOWNSTREAM(FEET) =     86.45

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.393
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.157
 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                 D       15.50      0.20       0.10    75   16.39
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     29.82
 TOTAL AREA(ACRES) =     15.50   PEAK FLOW RATE(CFS) =     29.82

****************************************************************************
 FLOW PROCESS FROM NODE      3.72 TO NODE      3.80 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    82.45  DOWNSTREAM(FEET) =    79.95
 FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  15.79
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     29.82
 PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =  16.45
 LONGEST FLOWPATH FROM NODE      3.70 TO NODE      3.80 =  1560.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.80 TO NODE      3.80 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1      29.82  16.45    2.154  0.20( 0.02) 0.10    15.5        3.70
 LONGEST FLOWPATH FROM NODE      3.70 TO NODE      3.80 =  1560.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1     105.98  12.09    2.524  0.20( 0.02) 0.10    42.0        3.30
     2     106.36  12.39    2.493  0.20( 0.02) 0.10    42.8        3.50
     3     105.45  14.27    2.317  0.20( 0.02) 0.10    45.9        3.20
     4     104.45  15.00    2.256  0.20( 0.02) 0.10    46.7        3.10
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.80 =  2795.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1     131.71  12.09    2.524  0.20( 0.02) 0.10    53.4        3.30
     2     132.40  12.39    2.493  0.20( 0.02) 0.10    54.4        3.50
     3     133.30  14.27    2.317  0.20( 0.02) 0.10    59.4        3.20
     4     132.95  15.00    2.256  0.20( 0.02) 0.10    60.8        3.10
     5     129.51  16.45    2.154  0.20( 0.02) 0.10    62.2        3.70
   TOTAL AREA(ACRES) =     62.20

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
 PEAK FLOW RATE(CFS) =      133.30  Tc(MIN.) =   14.273
 EFFECTIVE AREA(ACRES) =     59.40  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     62.20
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.80 =  2795.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.80 TO NODE      3.95 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    79.95  DOWNSTREAM(FEET) =    77.60
 FLOW LENGTH(FEET) =   470.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  57.0 INCH PIPE IS  41.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.69
 ESTIMATED PIPE DIAMETER(INCH) =  57.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =    133.30
 PIPE TRAVEL TIME(MIN.) =   0.81    Tc(MIN.) =  15.08
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.95 =  3265.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.95 TO NODE      3.95 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      3.90 TO NODE      3.92 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   540.00
 ELEVATION DATA: UPSTREAM(FEET) =     92.00  DOWNSTREAM(FEET) =     86.60

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.459
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.904
 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                 D        3.70      0.20       0.10     75    9.46
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =      9.60
 TOTAL AREA(ACRES) =      3.70   PEAK FLOW RATE(CFS) =      9.60

****************************************************************************
 FLOW PROCESS FROM NODE      3.92 TO NODE      3.95 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    82.60  DOWNSTREAM(FEET) =    77.60
 FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  15.40
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      9.60
 PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   9.51
```

```
 LONGEST FLOWPATH FROM NODE      3.90 TO NODE      3.95 =    590.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.95 TO NODE      3.95 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       9.60   9.51    2.894  0.20( 0.02) 0.10      3.7       3.90
 LONGEST FLOWPATH FROM NODE      3.90 TO NODE      3.95 =    590.00 FEET.

 ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1     131.71  12.92    2.438  0.20( 0.02) 0.10     53.4       3.30
     2     132.40  13.20    2.412  0.20( 0.02) 0.10     54.4       3.50
     3     133.30  15.08    2.250  0.20( 0.02) 0.10     59.4       3.20
     4     132.95  15.81    2.197  0.20( 0.02) 0.10     60.8       3.10
     5     129.51  17.27    2.102  0.20( 0.02) 0.10     62.2       3.70
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.95 =   3265.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1     124.86   9.51    2.894  0.20( 0.02) 0.10     43.0       3.90
     2     139.79  12.92    2.438  0.20( 0.02) 0.10     57.1       3.30
     3     140.39  13.20    2.412  0.20( 0.02) 0.10     58.1       3.50
     4     140.75  15.08    2.250  0.20( 0.02) 0.10     63.1       3.20
     5     140.22  15.81    2.197  0.20( 0.02) 0.10     64.5       3.10
     6     136.47  17.27    2.102  0.20( 0.02) 0.10     65.9       3.70
   TOTAL AREA(ACRES) =     65.90

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     140.75  Tc(MIN.) =   15.081
 EFFECTIVE AREA(ACRES) =    63.10  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     65.90
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.95 =   3265.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.95 TO NODE      3.96 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    77.60  DOWNSTREAM(FEET) =    76.85
 FLOW LENGTH(FEET) =   150.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  57.0 INCH PIPE IS  43.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.76
 ESTIMATED PIPE DIAMETER(INCH) =  57.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =    140.75
 PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =  15.34
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.96 =   3415.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.96 TO NODE      3.96 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
```

```
==========================================================================

**************************************************************************
 FLOW PROCESS FROM NODE      3.96 TO NODE      3.96 IS CODE =  12
--------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 2 <<<<<
==========================================================================

**************************************************************************
 FLOW PROCESS FROM NODE      4.10 TO NODE      4.20 IS CODE =  21
--------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   730.00
 ELEVATION DATA: UPSTREAM(FEET) =    101.83  DOWNSTREAM(FEET) =     94.53

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.671
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.706
 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                 D       12.40      0.20       0.10     75   10.67
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     29.98
 TOTAL AREA(ACRES) =     12.40   PEAK FLOW RATE(CFS) =     29.98

**************************************************************************
 FLOW PROCESS FROM NODE      4.20 TO NODE      4.50 IS CODE =  31
--------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    90.53  DOWNSTREAM(FEET) =    85.23
 FLOW LENGTH(FEET) =  1060.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  23.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.70
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     29.98
 PIPE TRAVEL TIME(MIN.) =   2.64    Tc(MIN.) =  13.31
 LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.50 =  1790.00 FEET.

**************************************************************************
 FLOW PROCESS FROM NODE      4.50 TO NODE      4.50 IS CODE =  10
--------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
==========================================================================

**************************************************************************
 FLOW PROCESS FROM NODE      4.30 TO NODE      4.40 IS CODE =  21
--------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   855.00
 ELEVATION DATA: UPSTREAM(FEET) =    100.95  DOWNSTREAM(FEET) =     92.40

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.367
```

```
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.612
 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                 D        8.30      0.20       0.10     75   11.37
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     19.36
 TOTAL AREA(ACRES) =      8.30   PEAK FLOW RATE(CFS) =     19.36

****************************************************************************
 FLOW PROCESS FROM NODE      4.40 TO NODE      4.50 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    88.40  DOWNSTREAM(FEET) =    85.23
 FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  12.64
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     19.36
 PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =  11.49
 LONGEST FLOWPATH FROM NODE      4.30 TO NODE      4.50 =   945.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.50 TO NODE      4.50 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
    1      19.36  11.49    2.597  0.20( 0.02) 0.10      8.3        4.30
 LONGEST FLOWPATH FROM NODE      4.30 TO NODE      4.50 =   945.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
    1      29.98  13.31    2.402  0.20( 0.02) 0.10     12.4        4.10
 LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.50 =  1790.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
    1      47.35  11.49    2.597  0.20( 0.02) 0.10     19.0        4.30
    2      47.87  13.31    2.402  0.20( 0.02) 0.10     20.7        4.10
   TOTAL AREA(ACRES) =     20.70

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      47.87  Tc(MIN.) =   13.308
 EFFECTIVE AREA(ACRES) =    20.70  AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     20.70
 LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.50 =  1790.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.50 TO NODE      4.50 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
```

```
==========================================================================

**************************************************************************
 FLOW PROCESS FROM NODE      4.50 TO NODE      4.60 IS CODE =  31
--------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    85.23  DOWNSTREAM(FEET) =    85.00
 FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  39.0 INCH PIPE IS  27.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.58
 ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     47.87
 PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =  13.41
 LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.60 =  1835.00 FEET.

**************************************************************************
 FLOW PROCESS FROM NODE      5.10 TO NODE      5.20 IS CODE =  21
--------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  1010.00
 ELEVATION DATA: UPSTREAM(FEET) =     97.90  DOWNSTREAM(FEET) =     92.85

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.958
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.344
 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                 D        8.40      0.20       0.10    75   13.96
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     17.57
 TOTAL AREA(ACRES) =      8.40   PEAK FLOW RATE(CFS) =     17.57

**************************************************************************
 FLOW PROCESS FROM NODE      5.20 TO NODE      5.30 IS CODE =  31
--------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    88.85  DOWNSTREAM(FEET) =    88.20
 FLOW LENGTH(FEET) =   130.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.86
 ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     17.57
 PIPE TRAVEL TIME(MIN.) =   0.37    Tc(MIN.) =  14.33
 LONGEST FLOWPATH FROM NODE      5.10 TO NODE      5.30 =  1140.00 FEET.

==========================================================================
==========================================================================
 END OF RATIONAL METHOD ANALYSIS
```

4.0 APPENDIX

4.1 Hydrology Map – Existing Condition

4.2 Hydrology Map – Proposed Condition