

**SANTA CRUZ METROPOLITAN TRANSIT DISTRICT  
BOARD OF DIRECTORS WORKSHOP MEETING AGENDA**

**February 11, 2000**

**Santa Cruz Holiday Inn**

**Redwood Room**

**611 Ocean St.**

**Santa Cruz, California**

**SECTION 1- REGULAR SESSION      8:30a.m.**

1. ROLL CALL
2. ORAL AND WRITTEN COMMUNICATIONS
3. ADDITIONAL DOCUMENTATION TO SUPPORT EXISTING AGENDA ITEMS
4. REGULAR AGENDA

Issue #1      Presentation and Discussion of Management Information System (MIS) Study

Consultant Findings: Attached

Presented by: Roger Boldt, Consultant

Issue #2      Presentation and Discussion of Issues Related to the MetroBase Project

- a. Drainage Ditch Relocation Project for the Site
- b. Drainage Ditch Setback Requirements' Affect on Design
- c. Project Schedule
- d. Choice of Fuel System (CNG, Diesel, Other)
- e. Articulated Buses vs. 40' Buses
- f. Discussion of Outreach Meeting (2000)

Staff Reports: Attached

Presented by: Les White, Mark Dorfman, Bryant Baehr, Celia Scott, WaterLeaf Architecture

Issue #3      Presentation and Discussion of Transit Service Development Issues

- a. Transit Service Expansion Capabilities
- b. Low Floor Buses vs. High Floor Buses

Staff Reports: Attached

Presented by: Bryant Baehr, Tom Stickel, David Konno

Issue #4      Presentation and Discussion of Financial Issues

- a. Five Year Capital/Operating Plan
- b. Reserves and Federal Operating Assistance
- c. Continued Use of Bus Advertising

Staff Reports: Attached

Presented by: Mark Dorfman, Elisabeth Ross, Kim Chin

\*FREE PARKING IS AVAILABLE IN THE REAR OF THE HOLIDAY INN

## **ADJOURNMENT**

### **NOTICE TO PUBLIC**

Members of the public may address the Board of Directors on a topic not on the agenda but within the jurisdiction of the Board of Directors or on the consent agenda by approaching the podium during consideration of Agenda Item #2 "Oral and Written Communications", under Section I. Presentations will be limited in time in accordance with District Resolution 69-2-1.

Members of the public may address the Board of Directors on a topic on the agenda by approaching the podium immediately after presentation of the staff report but before the Board of Directors deliberation on the topic to be addressed. Presentations will be limited in time in accordance with District Resolution 69-2-1.

When addressing the Board, the individual may, but is not required to, provide his/her name and address in an audible tone for the record.

The Santa Cruz Metropolitan Transit District does not discriminate on the basis of disability. The Holiday Inn is an accessible facility. If you wish to attend this meeting and require special assistance in order to participate, please contact Dale Carr at 426-6080 at least 72 hours in advance of the Board of Directors meeting.

# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

**DATE:** February 11, 2000  
**TO:** Board of Directors  
**FROM:** Terry Gale, MIS Manager  
**SUBJECT: PRESENTATION AND DISCUSSION OF MANAGEMENT INFORMATION STUDY**

## **I. SUMMARY OF ISSUES**

- During the past few years there has been significant turnover in the MIS department making it difficult to keep pace with the work load. This has resulted in hardships throughout the District as the Department has been unable to adequately support the existing applications or to add new solutions in a timely manner.
- The District retained the services of Roger Boldt, a consultant in the technology field specializing in public transit. He was hired to conduct a review and analysis of the MIS department.
- In November and December of 1999 Roger Boldt gathered data at SCMTD as part of the audit of the MIS department.
- As part of the engagement, Mr. Boldt met with members of the MIS staff, senior managers and other key computer system users and subsequently developed the attached report which addresses the issues outlined in the RFP and compares his findings against "best practice" in the Transit industry.

## **II. DISCUSSION**

Some fundamental recommendations that are made in the report are to change the department name to "Information Technology Services" (ITS) to better reflect the involvement required across the agency in technology involving data. He also recommends that a fourth position, Database Administrator, be added to the department and that the existing position definitions should be amended and the existing pay scales should be modified to be more competitive

A challenge in the technology area is the rapid pace of change, which requires on-going technical training for all users as well as for IT staff. This requires a sufficient budget allocation specifically for computer related training.

Mr. Boldt points out that the percentage of operating budget allocated for IT in typical transit agencies is typically between 3% and 5% of the total operating budget, whereas SCMTD expends less than 1.5%. If the recommended changes are implemented, the IT budget would still not exceed 2% of the total operating budget. Staff believes this will allow IT to provide an acceptable level of support for District activities.

### **III. FINANCIAL CONSIDERATIONS**

The financial implications of the recommendations in the report would increase the MIS budget by \$107,000.

### **IV. ATTACHMENTS**

**Attachment A:** Scope of Services for Engagement

**Attachment B:** Information Technology Review and Analysis report prepared by Roger Boldt Consulting.

**Attachment C:** Overheads for Presentation

Scope of Required Services – MIS REVIEW

Phase 1 - Initial Review and Assessment

This is intended to help identify key strategic issues facing the Santa Cruz Metropolitan Transit District and will help establish a foundation for a new strategic vision and plan. The Consultant will perform a broad assessment of the state of the IT investment and deployment across the whole enterprise. In order to execute this review effectively and efficiently, the following items should be provided by the consultant:

1.1.2 Review Current Situation

The consultant will be expected to review the current status of the MIS Department at the Santa Cruz Metropolitan Transit District. The District has just completed a major upgrade of its computer system and a move to a new facility. Since all MIS planning must support the larger strategic business direction of the District, it is essential to confirm that the capability exists in terms of hardware and personnel for this to occur.

1.1.3 Conduct a High Level Environmental Scan

The following areas are expected to be reviewed and assessed:

A. Evaluate the District's MIS organization

The Santa Cruz Metropolitan Transit District's MIS organizational structure will be evaluated, with internal and external reporting relationships, internal controls and accountability, and will be reviewed and compared against current practices in today's contemporary MIS organizational structure.

B. Assess Existing Technical Environment

An overview of the District's total technology environment, determining the current level of control, organizational equity and level of integration.

C. Review Existing Hardware Environment

All hardware platforms currently in place throughout the organization will be assessed. Particular attention will be paid to their use as data sharing devices and they will be compared to contemporary standards.

D. Assess Existing Software Applications Environment

All major existing software/applications systems will be evaluated as to their effectiveness in meeting the operating unit information delivery and processing needs. District's applications will be compared to state of the practice systems in place in the transit industry for systems the size of the Santa Cruz Metropolitan Transit District.

E. Review Existing Communication Systems

Special attention will be paid to data communication and transaction volumes on existing networks. Voice and data communications systems will be reviewed for their consistency with contemporary standards and the use of those information components throughout the organization.

F. Review Year 2000 Issues

Review the District's efforts to date, while focusing on the mission critical systems. Industry standards will be applied to evaluate the approaches taken to deal with the issues.

G. Roadmap for the Future

The Consultant will be expected to assist the District in developing a Strategic Business Plan for the MIS Department and a procedure for keeping it updated.

H. Personnel/Compensation

The Consultant will be expected to review the existing personnel and their qualifications for the expected role of the MIS Department into the future. The Consultant will be expected to review the current compensation levels of existing personnel and provide the General Manager with a candid assessment of the adequacy of the compensation levels and the skill set of the current staff to meet the Santa Cruz Metropolitan Transit District's current and future expectations.

1.2 Develop Assessment Overview

Using the information gathered from the MIS assessment and the environmental scan, the consultant will develop an overview of the "condition of health" of the whole MIS environment for the District. We expect this to be a candid assessment to make recommendations for future development of the MIS Department. This shall also include training recommendations.

1.3 Presentation to the General Manager

The prioritized list of strategic issues facing the District's MIS environment will be presented to the General Manager to develop a tactical and strategic approach.

# **Attachment B: Information Technology Review and Analysis**

# **Santa Cruz Metropolitan Transit District Information Technology Review and Analysis**

The objectives of this engagement were to help identify key information technology (IT) strategic issues facing Santa Cruz Metropolitan Transit District (SCMTD) and help establish a foundation for a new IT strategic vision and plan. Through a review of SCMTD documents, interviews with key management and MIS staff, a physical walk through of the facilities and benchmarking against industry standards, a broad assessment of the state of the IT investment and deployment across the whole organization was conducted.

As part of this high level environmental scan, the following areas were reviewed and assessed:

## ***A. The District's MIS Organization***

Evaluation of the District's MIS organization was conducted through extensive interviews with all three existing MIS staff, discussions with senior management regarding their assessment of MIS departmental performance and benchmarking against industry conditions and expectations.

SCMTD is a small agency that has stabilized itself after a difficult period following the natural disaster, financial recession and the FEMA investigation and findings. As part of its broader technical infrastructure, SCMTD needs to create and maintain an appropriate IT management group that can support the core businesses with contemporary skills, "best of breed" commercial off the shelf (COTS) software and current, flexible technology platforms in an equitable manner across the whole organization.

Fundamental to the IT management issue is how does a public entity like transit compete sufficiently to acquire and maintain competent committed staff? Unlike other parts of the transit business, IT personnel need to be viewed in the context of the larger IT environment, which has become enormously competitive and will, in all likelihood, become even more competitive in the future. Salaries and benefits for those with contemporary skills are very high and accelerating at an increasing rate. The Gartner Group has indicated that the disparity between the public and private sectors for IT professionals is now more than double and for those with "skills in demand" the ratio can be three or four times higher. Also, while the cultural/environmental differences between the public and private sectors has narrowed in recent years, there remain some public sector characteristics which can be attractive to IT professionals: security of employment, stability of the workforce and working environment, attractive benefits (in contrast to entrepreneurial attractions like stock options and aggressive performance based pay) and training.

It would appear that SCMTD needs to do several things to hire and retain appropriate IT staff:

- Maintain good benefits (clearly SCMTD has some of the best benefits in the industry and in the public sector generally).
- Be competitive with the public sector for its location (competitive needs to be defined based on Santa Cruz's public sector not San Jose's). SCMTD must be at least at a par, or slightly above par, with other similar-sized public sector IT organizations.
- Support and maintain excellent training opportunities to keep their personnel "up to speed" with contemporary and emerging technologies.
- Acquire sufficient IT resources through staff positions and outsourcing to create an environment where the work load is "reasonable" by public sector standards.

In section H (Personnel/Compensation) specific recommendations will be made regarding IT positions, position descriptions and compensation levels.

As regards the organization of IT at SCMTD, it is recommended that the department be renamed to be more consistent with contemporary usage and create the opportunity to improve the image and responsibility of that group. The department should be renamed the Information Technology Services (ITS) Department. This name reflects the change from management information systems (MIS) to the more contemporary term, information technology, and adds the term "services" which emphasizes the service nature of the organization.

It is further recommended that the MIS Manager should be re-titled the Manager of Information Technology but continue to report through the Assistant General Manager, because of the unique role that position plays at SCMTD. The new ITS Department's Manager of IT's salary should be increased to the level of senior management, who would be his direct peers. Also, it is recommended that an additional position be created to more appropriately cover agency IT needs and services and bring SCMTD in line with industry benchmarking which suggests that "best of breed" agencies are spending between 3 and 5% of total agency operating budget on IT operations. This envisioned new organization with a manager and three direct reports should remain a "flat" organization with no additional hierarchy. (See Section H for details.)

### ***B. Existing Technical Environment***

Because of the needs of interoperability, common architectures / standards / protocols and the integration of solutions, it is important to use a broad definition of IT which is inclusive of many "technologies" which have been outside the IT purview until recently. The current and future state of some fundamental industry technologies require that they be viewed in an IT context and deployed as part of an IT infrastructure. Radio technology is a perfect example in that it is now digital as well as voice and has become the

communications backbone / infrastructure which supports the movement of data like any other data gathering and data management technology and needs to be fully integrated into data architecture.

It is important that the whole organization adopt a definition of IT which is sufficiently broad and consistent with evolving contemporary standards. The definition of IT includes all those technologies that are information-based, generate data that have application across the enterprise and/or involve standard computing platforms running on common communications infrastructures. Minimum technologies would include:

1. All Computer Programs and Systems
  - Management Information Systems
  - Administration Computing
  - End User Computing
  - Central Control Systems
    - Databases
    - Operating systems
    - Application software
  
2. Personal Computers and Network Hardware/Software Operating systems
  14. Applications/software/hardware
  15. Local and Wide Area Networks (LANs and WANs)
  16. LAN server applications
  
3. Communications Technology
  - Telephones
  - Telecommunications Architecture
  - Voice, Data and Electronic Image Transmission
  - Radio Technology
  
4. Other Technologies, including
  - Bar Coding

- Cash Handling Technology Systems
- Command Center Technology
- Computer Assisted Design (CAD)
- Geographical Information Systems Technology (GIS)
- Global Positioning Systems Technology
- Intelligent Transportation Systems (ITS)
- Materials Management Technical Systems
- Revenue Control and Fare gate Technology
- Supervisory Control and Data Acquisition (SCADA) Systems
- Security Systems
- Signage Systems Technology
- Virtual Reality Systems

Currently at SCMTD, there is insufficient involvement of the ITS Department in the investment and deployment of technologies consistent with the above definition and a lack of control over the "technical" aspects of those investments. It is recommended that the ITS Department be an equal partner in all aspects of the investment and deployment process and that it control the core architectures and standards that will facilitate a coordinated and integrated technical environment at SCMTD.

### ***C. Existing Hardware Environment***

The District has just recently completed a major upgrade of its computer system and a move to a new facility, which has consolidated some of its administrative functions.

Based on the interviews with MIS staff, a physical walk through of the technical environment and documentation on the hardware systems, it is clear that SCMTD has moved aggressively and appropriately to a contemporary, supportable, technical infrastructure with upward migration which can support current and future applications and communications. NT has become the

industry's dominant technical architecture, with a predominance of COTS applications working in that environment.

While the District supports an inordinately high number of physical facilities (six) which require full connectivity, the network and LAN/WAN environment needed to support that is reasonably architected. Should data traffic increase or should there be customer dissatisfaction with the speed of data transfer, or should there be an introduction of real time systems like AVL, the existing communications infrastructure may need to be enhanced. It is important to recognize that the District's technical infrastructure is supporting an unusually disparate physical environment for the overall size of the property. Appended to this report are the Network Overview and the LAN/Wan Topology. (See Appendix 1 and 2.)

#### ***D. Existing Software Applications Environment***

The basic software standards / architectures of the District are sound and contemporary. Microsoft Office is the dominant office suite in use today. With the other standard software packages (see Appendix 1) the District has an excellent environment to support basic computing across the enterprise. With the establishment of these standards, it will be essential that there are reasonable controls in place (in capital planning and procurement) to assure that this architecture is maintained and supported. On the data base side, Informix is a reasonable standard although there is a need to replace or migrate some of the existing databases to the standard (see Appendix 3, Database Summary).

On the applications side, there is a need to replace old systems with new, contemporary COTS packages and to consider web-enabled technologies for some functional needs. There are very good COTS packages available in the industry and some very promising e commerce activities, which will have clear value for SCMTD, particularly in the areas of maintenance and materials.

Of greatest importance to the replacement of old systems and the investment in new ones, is to adopt an organization-wide IT investment strategy consistent with the definition in Section A. It is critical that IT investment is driven by business need and prioritization. In that regard, a request of IT projects has been issued (see Appendix 4, Request for IT Projects), a standard template has been developed to record all appropriate information about a potential project, including ROI (see Appendix 5, IT Project Profile), and specific strategic criteria need to be applied by senior management to prioritize IT projects as part of the capital program (see Appendix 6, IT Project Prioritization), and finally, this whole activity needs to be seen as an organization-wide investment process life cycle (see Appendix 7, IT Investment Process).

### ***E. Communication Systems***

The District has recently implemented increased Wide Area Network (WAN) support across the entire District. This is necessary to provide the capability for full corporate-wide data sharing. The configuration and planning should ensure that the throughput and network redundancy necessary for distributed client/server applications exists. Whether the processors are centrally housed or are housed in different locations and require access from many other locations, network performance and reliability will be critical to success. LAN support should be provided to all offices as needed and those office LANs should be connected to the backbone network. This is necessary to provide the capability for full data sharing across the entire District, from any location.

The purpose of these LANs is to improve efficiency within the organization. Specific benefits, in addition to data sharing and application integration, are expected to include standardization of applications and reduction of software costs; reduction in equipment needs (i.e., printers, faxes, modems, etc.), electronic transmittal of data information, mail, calendaring and scheduling; and the development and use of electronic forms. Software upgrades can also be distributed over the network.

The Windows NT server should be used as a remote communications server, allowing dial-in, with dial-back capability, through its Remote Access Service (RAS). RAS can also serve as a communications gateway by providing multi-protocol routing to other servers in the network.

TCP/IP is currently being used as the inter-network protocol, and this is the industry standard. As more District employees are given Internet access, providing and maintaining address information will become more important. The TCP/IP package should also support terminal emulation, SNMP network management, Microsoft's OLE (Object Linking and Embedding) for desktop application integration and MAPI (Messaging Application Program Interface) for enabling electronic mail.

Common security for e-mail is provided by the public domain encryption software PGP (Pretty Good Privacy) and by S/MIME (Secure Multipurpose Internet Mail Extension). IPSEC (Internet Protocol Extension) provides more security and is being implemented by some TCP/IP providers.

The cabling, bridges, routers and all other communication equipment used in the networks should allow for upgrades to 1000 Base-T Ethernet networks should that higher bandwidth be required in the future. At minimum, Category 5 cabling should be utilized. With the integration of voice and data networks under an automated vehicle location (AVL) investment, this is a likely scenario.

As regards data management, an open architecture implies user access to a wide range of data and some guidelines for the management of this data should be established. These guidelines include:

- **Compatibility**

A key concept of an open architecture is the ability to share data and information from a variety of databases across different platforms. A

significant amount of effort must be applied to establishing data standards so that data can be exchanged or easily converted to the proper format for exchange.

- **Security and Access**

Another major concern of data management is data integrity. Data must be managed just like other physical resources. The ability to access, change, update, add or delete must be closely monitored and managed.

**Ease of Use**

To the extent possible, data must be reasonably easy to maintain and access. This means a database management system that provides a Structured Query Language (SQL) capability. SQL provides an application-level standard method for data exchange between different computing platforms.

- **Scalability**

Chosen applications, and the database itself, should not be unduly limited by size and volume considerations. It is important that there be room for the systems to grow, especially if system usage throughout the District could spread to other offices.

Adherence to these guidelines is vital to achieving an effective open architecture based system since the success of the system is largely dependent on the effective sharing of data among the users. SCMTD's LAN/WAN Topology and network configuration have been attached in Appendix 2.

***F. Year 2000 Issues***

As part of the extended discussions with the MIS staff, the overall condition of Y2K preparedness was explored. It appeared that reasonable "due diligence" had been performed on the overall applications and technical environment with particular attention to mission critical systems. The remaining area of concern during my site visit of November 29 to December 3 was an updating of the Fleetmate and Bid/Dispatch software from Multisystems. While there is a well focused strategy to replace both the scheduling system directly with Giro and the

bid/dispatch with Multisystems, it was necessary to "patch in" Y2K changes to the existing software. Because of the lateness of this alert and the critical nature of the systems involved, I contacted the two individuals at Multisystems who were responsible for these products. Both Howard Ostroff and Bob Menhardt personally assured me that the "updates" that were being provided were well-tested and reliable fixes that would provide adequate product functions through and beyond the turn of the millennium.

### ***G. Roadmap for the Future***

Within every transit agency, information technology has become a critical factor to the cost-effective, safe, and reliable delivery of services. As such, information technology is viewed as part of the overall delivery infrastructure and should be assessed as other infrastructure components on its ability to contribute to delivering services. IT should be seen as a significant component for building the necessary infrastructure to facilitate the strategic business goals of an agency. The ability to create a more effective and efficient organization depends on the technology systems to support the business goals, such as:

- Improve service quality
- Maintain/enhance infrastructure
- Improve management and delivery of the capital program
- Increase cost effectiveness/revenues
- Enhance safety and security
- Improve regional mobility

Like other elements of the District's infrastructure, investment in information technology must be based on its ability to achieve these specific business objectives. These strategic objectives are supported by each of the primary areas that contribute a complete information architecture.

While SCMTD does not have a strategic business plan, interviews with key staff, discussions with the MIS Department, a review of the background documents and the consultant's broad experience with the industry identified a number of strategic issues which directly affect the IT environment. It is critical to the success of this information technology initiative that we understand the basic strategic issues and include them in our thinking. Similarly, it is important that this IT strategic assessment reflects the business structure and goals of the District.

Based on our environmental scan (interviews, discussions, document review and industry experience), the following strategic principles are recommended and should be a foundation for SCMTD's IT roadmap:

### **1. Support Key Business Goals**

The following are examples of industry goals linked to specific opportunities for IT:

- Cost Containment - With constrained revenues and growing competition for local resources, SCMTD must exercise a program of cost containment. Programs that improve efficiency and reduce costs at all levels of the organization must be actively promoted. Implications for cost containment include:
  - Increase employee efficiency through the use of automated tools.
  - Improve financial tools for accounting, budgeting and capital project planning.
  - Eliminate duplication of effort and shadow systems.
  
- Employee Productivity - Employee productivity is perceived as being below desired standards. Providing SCMTD personnel with well-conceived training and career development programs while creating appropriate

incentives will increase the productivity of the whole workforce. Implications for employee productivity include:

- Use automation and information technology to increase staff productivity.
  - Provide better, more integrated systems allowing data to be captured and entered only once and then accessible to all with the need to know and with proper security level.
  - Provide better management tools (performance measurement and executive information systems) to monitor and assess the ongoing activities of the District.
  - Acquire better mechanisms to train staff and facilitate development programs.
- Quality of Service - It is essential to maintain or improve quality if SCMTD is to continue to improve the services it provides to its (internal and external) customers and to continue to positively impact business in the region. Implications for quality of service include:
- Establish and monitor standards for quality performance to include both managers and staff.
  - Provide employees with the best tools to complete their work and eliminate unnecessary manual and redundant tasks.
  - Evaluate service quality frequently and provide immediate feedback.
  - Provide the hardware and software infrastructure necessary to support the businesses of SCMTD.
  - Provide leadership and direction for coordinated District technology initiatives.

## **2. Establish a District-wide Technology Investment Process.**

Using the established definition of IT, the District needs to move toward an enterprise-wide approach to the investment and deployment of IT. Toward that end, a call for IT projects has been issued, a single management prioritization process has been established, and the IT Department has been charged with the overall responsibility for deployment of IT across the whole organization. Such an approach will create a more cost effective, integrated and modular approach to the rollout of IT systems in the future.

### **3. Move Toward Software Packages Rather than Custom Development**

The District should take advantage of COTS software packages from vendors working in the industry rather than developing custom software from outside or in-house. This move assumes that there are adequate software packages existent in the industry and that SCMTD applications will reasonably fit those package solutions. Most, if not all, of the software—including business and operational software—required by SCMTD exists in the form of COTS products.

This will require a shift in philosophy by the District, which recognizes that SCMTD's business needs are essentially similar to those in other transportation and information organizations and that standard COTS packages generally meet those needs. By using standard packages, the District takes advantage of the research and development and broader user community input that has gone into vendor products and avoids expensive in-house development and continued need for in-house enhancement. This results in the District becoming a *user* of information technology solutions rather than an *inventor* of technology solutions. Thus, the District can take advantage of the development efforts of commercial solution providers and concentrate more fully on its core business of transportation. The more effectively the District can use existing vendor packages and move away from customization, the more cost effectively it can support overall technology needs, allowing District staff to concentrate on maintaining the SCMTD unique data and processes. These off-the-shelf application packages should then be maintained and supported by the vendors.

By eliminating extensive customization, vendor upgrades can be implemented as necessary to provide additional functionality or to keep systems current and supportable.

#### **4. Decentralize Access to Management Tools**

Managers throughout the organization are increasingly trained and conversant in the use of information technology tools day-to-day in their respective areas of responsibility. Managers can legitimately expect to have up-to-date microcomputers and peripherals available to them as standard components of their business environments. Working within the context of reasonable standards and architectures, the ITS Department must support management's need to acquire and use appropriate microcomputer hardware and software at their workstations with considerable independence.

#### **5. Centralize Control Over the IT Function**

As the necessary counterpart to decentralizing the tools of computing is the need to establish clear District-wide standards and architectures. ITS should assume centralized control over information technology to assure efficient and effective delivery of services. As the District moves toward greater decentralization of the usage of tools of computing, the need for centralized control in the following areas increases:

- Establish and manage a District-wide technology budget.
- Maintain standards for hardware and software.
- Develop, publish and disseminate consistent District-wide policies and procedures related to ITS Department.
- Protect the integrity of District data and all components of the operating environment.
- Reduce or eliminate unnecessary duplication of hardware, software and data.
- Eliminate multiple platforms that achieve the same goal.
- Provide maintenance and support for hardware and software.
- Evaluate technology projects for cost/benefits of alternate solutions.

## **6. Maximize Integrated Solutions**

While there is clear support for a decentralized workstation-based environment, there is a need for integrated enterprise-wide solutions and a need to reduce duplication of data and effort in the whole IT environment. Integrated solutions assume centralized control over the computing function/solution and an active process of assuring that appropriate data is made available across management activities. One of the primary functions of ITS is to oversee the acquisition of automation tools to facilitate *shared and integrated* usage. A key ingredient to success is an effective methodology to facilitate *cooperation* between the District's offices and ITS to define, acquire and implement integrated technological solutions in a timely, cost effective manner

## **7. Use Automation to Facilitate Future Expansion of the District**

Automation should be seen as a central mechanism to facilitate District growth and expansion. If automation is to be used effectively, it needs to be deployed across the organization in a consistent and equitable manner. This assumes that there is a *single* point of oversight for technology investment and a District-wide project planning process. As technologies are increasingly integrated, information-based, and effectively cross over office boundaries, there is a need to exercise District-wide control over their acquisition, access and deployment. Automation and information technology decision-making must be efficiently planned and coordinated throughout the entire District.

## **8. Facilitate the Use of Data as a Resource**

From the environmental scan, the District was seen as "data rich but information poor." Data owner-ship, rather than data sharing, is the current general *de facto* policy within the District. There is a need to begin to see all data generated throughout the District as a resource for all management. If all data is viewed as

a District-wide resource, its integrity and availability can be better assured, duplication and redundancy of input can be reduced, and better communication across office lines can be fostered. The concept of “data as a resource” is fundamental to decentralizing the tools of computing and centralizing control over the means of computing. Data security needs to be considered in concert with the availability of data. Business systems should be integrated in such a way as to create a “data warehouse” and the tools and training required to effectively use it across the entire District should be established.

### **9. Avoid Research and Development/Prototype Systems**

In the process of planning for and deploying information technology, it is important to avoid prototypical solutions. Since SCMTD's environment emphasizes financial efficiency and service effectiveness, it is crucial to acquire and deploy “proven” technologies that are well established and existent in the transportation industry. Necessary equipment can be acquired in anticipation of need and consistent with end-user requirements. The District should avoid obtaining “bleeding edge” applications by shifting priorities and delaying procurement until a commercially available and industry tested product exists.

### **10. Migrate Toward Open Architecture**

We recommend that the District migrate toward a full “open architecture” technical environment due to many user requirements for access to data and the multiplicity of current computers.

Vendors with open architectures, as opposed to those with proprietary architectures, publish the specifications to their products and openly encourage other vendors to use hooks and interfaces provided within those architectures for their use. Open architecture vendors encourage interconnectivity and use of their features and facilities. Microsoft is among the most prominent open architecture vendors.

An open architecture also enables interconnectivity between information systems and allows for the access, transfer and manipulation of data, to the greatest extent possible, by authorized users throughout the organization using the widest selection of tools. An open architecture requires the coordination of computing facilities, operating systems, and communication abilities. This architecture should be used as the overall guideline for developing the information resources to meet the information needs of the District and drive the growing investment in “smart” technologies. The requirement for open architecture should be part of the standard requirements for all District technology-based RFPs.

#### **11. Develop Cooperation Between all Offices and ITSD**

A central assumption of the District is the concept of a single enterprise working together toward a common goal. With support for all District information technology consolidated within ITS, it is imperative that ITS foster cooperation with all offices and become a full business partner with them. Similarly, with all systems and data belonging to the District rather than to specific offices, ITS will have the responsibility of fostering cooperation between all offices.

An important step in developing this desired cooperation is the formulation of a methodology for the delivery and support of IT within the District, specifically including the skills necessary to provide technological leadership and effective and timely business consulting skills.

#### **12. Deliver Timely, Cost Effective Technology Solutions**

The entire District, including ITS and the business units, should recognize the need for implementing technology solutions quickly. Management should encourage the cooperation required to develop functional system requirements. The requirements should be used as the basis for creating application RFPs and

for evaluating the subsequent vendor proposals. ITS should provide the technology guidance and facilitation necessary to accomplish this goal.

### **13. E-Commerce**

Transit has just begun to take advantage of the internet/intranet and web enabled technologies, but because these have such a potentially revolutionary effect on computing itself (hardware platforms and LAN/WAN infrastructures), e-commerce needs to be considered a near-term technology solution. If, in fact, e-commerce becomes the principal mechanism for acquiring goods and services and the internet/intranet becomes the dominant communications vehicle, the effect on the technical infrastructure is profound. The need for powerful PCs or other “internal” computing devices and robust LAN/WAN infrastructures becomes potentially unnecessary or redundant in the world of e-commerce.

E-commerce is a dynamic set of technologies, applications, and business processes that link enterprises, consumers, and communities through electronic transactions and the electronic exchange of goods, services and information. High-tech companies, banks, consumer-packaged-goods companies, insurance providers, educational institutions, manufacturing firms and even health-care providers are cutting costs and enhancing business relationships by utilizing the Internet and its offshoots, intranets and extranets.

A recent survey by the Extraprise Group found that 40 percent of firms already use their Intranets to support e-commerce. Forrester Research estimates that e-commerce between businesses in the United States could reach \$327 billion by 2002, and the International Data Corporation pegs the amount at more than \$400 billion.

Electronic commerce is not just about using the Web as a “storefront”. It involves shortening the supply chain, streamlining distribution processes, improving product delivery, reducing inventory-carrying costs, and many other measurable

activities. In the business-to-business realm, e-commerce strategies allow businesses to leverage electronic alliances to speed the delivery of products and services to market. Companies set up electronic linkages to work more closely with their suppliers and save money on inventory and distribution costs.

A recent inventory of transit industry suppliers indicates that they are e-commerce ready with electronic catalogs and order supply technology. SCMTD should continue to monitor the status and evolution of e-commerce activity in the industry.

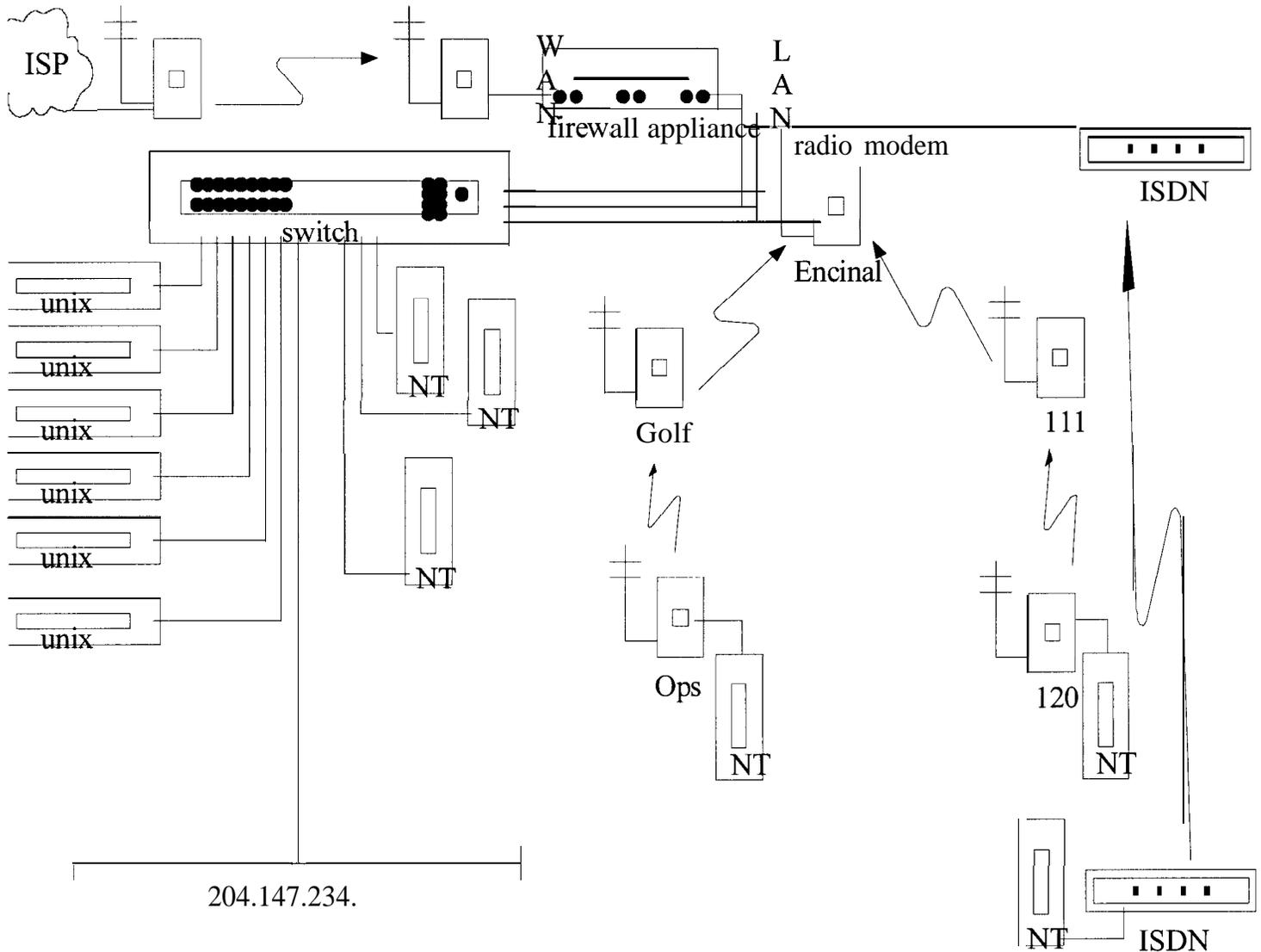
### ***H. Personnel/Compensation***

Consistent with the discussion of the MIS organization section and the strategic issues raised in the Roadmap for the Future section , four new staff position descriptions have been developed to better and more appropriately populate the IT environment through the next several year period. These position descriptions are more consistent with the current and emerging IT environment at SCMTD, reflect general contemporary trends in IT and, with the one additional position, bring the District into a range of "best of breed" based on recent benchmarking in the transit industry (see TRB Synthesis # SG-08, "Information Technology Systems: State of the Practice Update"). The four new position descriptions have been appended (see Appendix 8, IT Job Descriptions) as well as the recommended IT salary ranges (see Appendix 9) for those job positions .

## **APPENDIX 1: Network Overview**

# SCMTD Network Overview

11/99 Drawing by W. Willis



There are six buildings at SCMTD;

1. **Administration:** 370 Encinal St. Admin, Finance, Legal, MIS and Human Resources are in this building. It is within    mile from all other buildings except Metro Center. 30+ users and 33 terminals or PCs. 8 printers.
2. **Operations:** 1200 River St. Drivers are dispatched from here, scheduling, driver timekeeping, scheduling and driver training are here. This connects via Radio-link modem to Golf Club Drive, minor maintenance. About 20 users, 12 terminals, 5 printers.
3. **Minor Maintenance:** Golf Club Drive, line of sight to Operations. This has one Radio link modem connecting to Operations and another connecting to Encinal. All Radio link modems are supposed to be up to 2mb transmission speeds. 3 terminals, 1 printer, 1 full-time user.

4. **Fleet Maintenance shop:** 111 Dubois. Connected to Encinal via 1 radio link modem and to 120 Dubois via another. Mechanics and 2 parts clerks on three terminals, 1 printer.
5. **Fleet Maintenance Admin:** 120 Dubois. Connected to 120 (about 100 feet) via 1 radio link modem. Purchasing , some parts, work order entry and F.M. Mgr or 9 users on 10 terminals, 2 printers.
6. **Metro Center:** 920 Pacific. Planning, Marketing, Customer Service. One manager, and 11 users on 10 terminals, 3 printers. About 1 mile from Encinal. Networked via 24 hour 112Kb dedicated ISDN connection.

## **Supported Hardware**

### **Unix Servers:                      Description & Usage**

- |                   |   |
|-------------------|---|
| - scmetro (scmtd) | Sun Netra (Sparc 5) Solaris 2.5, DNS, public server, mail relay   |
| - scmsunl         | Sun Ultra 1, Solaris 2.6, mail hub, boot for Xterms at Encinal, database server. All users log in here. |
| - scmsun2         | Sun Ultra 1, Solaris 2.6. Backup to scmsunl and CTS calendar server.                                    |
| - some1           | Sun Ultra 1, Solaris 2.7 Scheduled to become scmsunl and scmsunl to become scmetro.                     |
| - mips            | Mips 3230, mips 4.52. Still has some databases on it as well as uniplex files. Scheduled to be retired. |
| - mbakup          | Has tape drive to back mips up. Serves as possible hot backup if mips fails.                            |

### **NT Servers:                      Description & Usage**

- |                 |  |
|-----------------|--|
| - mis           | Dual P200. NT TS 4.0. PDC Used by MIS only. At Encinal.  |
| - transit       | Dual P450. NT TS 4.0. BDC. 25 possible users for Microsoft Office Suite, email, graphics, etc. At Encinal. |
| - flyer         | Dual P200. NT SQL Server. Also will probably become intranet server.                                       |
| - enterprise    | Dual P300. NT server and boot machine for operations.  |
| - theborg       | Dual P300. NT server and boot machine for Fleet Maintenance.   |
| - pacific       | Dual P200. NT server and boot machine for Metro Center.  |
| - newenterprise | Dual P300. Being reconfig'ed to fix some problems with Enterprise.   |

### **Other Hardware:                      Description & Usage**

- |                     |   |
|---------------------|---|
| - Firewall          | Sonic Systems firewall appliance                  |
| - Radio Link modems | Breezenet radio link modems.                      |
| - Workstations      | 69 Tektronix XP2 17 or NC2 17 thin client devices |
| - PC workstations   | 5 various PCs                                     |
| - laptops           | 5 laptops for diagnostics or take home use.       |
| - 3com linkswitches | 3 linkswitches                                    |
| - 3com hubs         | about 15 3com intelligent hubs                    |

- print servers                    12 or so Lantronix print servers
- dot matrix printers            about 15, mostly Okidata 32 1
- laser printers                    6 Lexmark, one Data products

**NT Software:                    Description & Usage**

- Microsoft Office                Word, excel, power-point, access, publisher
- Filemaker Pro                    Simpler to use database
- Ultrabac                          Backup software for NT
- Diskeeper                        NT disk defrag
- Adobe Pagemaker                Only 1 license
- Eudora Pro 4.0                    email software
- McAfee Netshield                anti-virus
- NT SQL server 7.0                Will be used with new Accounting, purchasing, Dispatch & Runcutting packages

## **APPENDIX 2: LAN/WAN Topology**

# SCMTD LAN/WAN TOPOLOGY

## Scope:

This document describes the topology of the LAN configuration within The Santa Cruz Metropolitan Transit District (SCMTD). The District's connection to its Internet Service Provider (ISP) is also described.

## Definitions:

LAN, Local Area Network, is defined for this document as a network topology to include the main facility at 370 Encinal St. (Administration, MIS, Finance, Facilities Maintenance, HRD, Legal), the Pacific Avenue facility (Metro Center, Transit Planning, Marketing, Customer Service), the River St. facility (Operations), the 120 Dubois facility (Fleet Maintenance), the 111 Dubois facility (Major Maintenance Facility) and the Golf Club Dr. facility (Minor Maintenance Facility).

## General Topology:

The District's general LAN topology is one of a star with the Encinal St. facility as its center, and is effectively a single lan with remote sites at local **10mbit** speeds connected to the central network at speeds of 2mbit (radio-link-modem) or 112kbit (ISDN). What follows is a **bulleted** description of how the satellite offices connect to Encinal.

- Connectivity to The District's ISP is via a pair of radio modems, one unit at the ISP and one at Encinal.
- MMF connects to Encinal via radio modem.
- Operations connects to MMF via radio modem.
- MOF connects to Facilities Maintenance via radio modem
- Facilities Maintenance connects to Encinal via radio modem.
- Metro Center connects to Encinal via ISDN.
- Dialup access to the LAN is provided via 19.2K or 56K modems for RAS or character based connections.
- Dialup connection to the County for final payroll entry.

## **Intranetworking:**

As described above, the Encinal facility connects to the ISP via radio modems. The modem at Encinal connects to the WAN port on a **firewall** appliance. All traffic destined for the LAN passes through the **firewall** subject to security and content filtering. The firewall's LAN port is connected to The District's local area network at a 10/100 Base T switch. The switch provides connections to additional switches and hubs co-located in the communications lab. All user (workstation) connections are brought into the **comm** lab to patch panels. Drop cables from the patch panels to the switches and hubs complete the LAN.

## **Servers:**

This section describes server functionality within The District. Principally this functionality exists within computing machinery at Encinal.

Functionally, the **firewall** could be described as a security server. This server protects against **DoS** (Denial of Service) attacks and enforces a rules base for access to the LAN.

A pair of SMTP servers provides **email** services. The mail relay server handles message routing, name service lookup and SPAM control. It relays messages destined for the LAN to the **hub** for deposit in the user's mail spool area.

A POP3 server exists to interact with a pop client (the user's **email** reader application) to *pop* or deliver **email** messages to the user's desktop.

The DNS server provides Domain Name Service. An additional name server is located at The District's ISP.

Additional server functionality at Encinal include, database servers, a calendar server and license service for licensed applications.

All printers are networked, either possessing internal **NICs** or via Lantronix print servers.

Within the environment of Microsoft NT there exists an NT domain. The Primary Domain Controller (PDC) runs on an NT server located at Encinal. Every other NT server located either at Encinal or at a satellite facility acts as a Backup Domain Controller (BDC) for the NT domain.

**Supported Devices:**

For slightly more than 100 users, we have 69 thin-client terminals, 4 PCs (and 5 laptops), 6 unix servers (two to be retired), 7 dual-pentium NT servers, 7 laser printers, 1 color laser-jet, multiple networked hubs, linkswitches, and other devices. There are generally less than ½ the users logged in at any one time.

**Protocols:**

TCP/IP protocol is used throughout The District. NETBUI is used by NT for security verification, and device sharing. IPX/SPX is required to connect to the County via modem to enter payroll information.

**Domain Registration:**

SCMTD has registered its internet domain (scmtd.com) with Internic. The District is the primary site for name service and mail exchange (MX) records with its ISP as the secondary record holder.

Author: Wil Willis  
Sr. Systems Analyst  
SCMTD  
Date: 11/3/99

## **APPENDIX 3: Database Summary**

## SCMTD DATABASE SUMMARY

Updated 11/22/99 T.Gale

---

<b>absences*</b>	Tracks driver absences over time to be able to satisfy the MOU. Used primarily by Operations.
<b>assets*</b>	Scheduled to be replaced with one of USL Financials modules.
<b>dispatch/personnel*</b>	All personnel screens, tables and reports including EEOC reports Also all scheduling, dispatch, timekeeping screens tables and reports. Personnel tables are tightly secured to the field level. Used by Personnel, Operations, and Management.
<b>finance</b>	Primary current use is to generate 1099s and some billing letters. 1099 will be replaced with USL and billing letters moved to scops.
<b>purchasing*</b>	For purchase requisition and purchase order entry, approval, printing etc. To be replaced by USL Financials which runs as Access clients to NT SQL server.
<b>plant*</b>	Various tables and reports used to schedule, track and report on work such as bus stop and facilities maintenance. Used by Facilities Maintenance. Possible plan to replace. Needs to be converted off of Mips.
<b>public*</b>	Was originally intended to have several functions but only the contract tracking is still in use. Will probably move to another DB on conversion. Available for use by all groups.
<b>ridechk*</b>	For Section 15 data collection and reporting.
<b>risk*</b>	Tracks accidents, complaints, law suits, etc. Used by Legal, Operations, Security and Management.
<b>scops*</b>	Driver ridership data is entered here and reports are generated to bill UCSC, Cabrillo, etc. Used by Revenue, Finance and Management. Still on mips.

## SCMTD DATABASE SUMMARY

Updated 11/22/99 T.Gale

---

<b>absences*</b>	Tracks driver absences over time to be able to satisfy the MOU. Used primarily by Operations.
<b>assets*</b>	Scheduled to be replaced with one of USL Financials modules.
<b>dispatch/personnel*</b>	All personnel screens, tables and reports including EEOC reports Also all scheduling, dispatch, timekeeping screens tables and reports. Personnel tables are tightly secured to the field level. Used by Personnel, Operations, and Management.
<b>finance</b>	Primary current use is to generate 1099s and some billing letters. 1099 will be replaced with USL and billing letters moved to scops.
<b>purchasing*</b>	For purchase requisition and purchase order entry, approval, printing etc. To be replaced by USL Financials which runs as Access clients to NT SQL server.
<b>plant*</b>	Various tables and reports used to schedule, track and report on work such as bus stop and facilities maintenance. Used by Facilities Maintenance. Possible plan to replace. Needs to be converted off of Mips.
<b>public*</b>	Was originally intended to have several functions but only the contract tracking is still in use. Will probably move to another DB on conversion. Available for use by all groups.
<b>ridechk*</b>	For Section 15 data collection and reporting.
<b>risk*</b>	Tracks accidents, complaints, law suits, etc. Used by Legal, Operations, Security and Management.
<b>scops*</b>	Driver ridership data is entered here and reports are generated to bill UCSC, Cabrillo, etc. Used by Revenue, Finance and Management. Still on mips.

**Abs** Acucobol program, no source. Current unix accounting package. To be replaced by March with USL Financials.

**fleet** Acucobol program. Tracks parts inventory, and work orders. Have budget to replace but do not have time to find replacement.

**\* Databases on use Informix standard engine. Have source for all.**

**APPENDIX 4: Request for IT Projects**

## **MEMO**

To: Senior Staff

From: Les White

Date:

Re: Request for IT Projects

In order to fully understand and program the future information technology (IT) needs of the District, I am asking senior management to conduct a comprehensive assessment of needs in their respective areas. The intent of this assessment is to identify all IT needs by specific project that you perceive will be required to conduct or improve your business.

The form that has been attached (electronically) is intended to help you compile the information. You will note that the form is asking for a lot of information you may not possess. You should fill out only the information you currently have and we will fill in additional pieces of information as we move forward.

As you know from the consultant's presentation on Friday, December 3, 1999, specific strategic business criteria will need to be established by senior management for ranking all IT projects and linking them to the District's capital program. Sample strategic criteria and a ranking form will be brought to a future senior management meeting for discussion and adoption.

## **APPENDIX 5: IT Project Profile**

**SCMTD**  
**Information Technologies Project Profile**

**Project Name:**

**Description:**

**Primary User Departments:**

**Potential Impact on Other Affected Departments:**

**Current Automated Systems:**

**costs:**

**Approximate Recurring Costs:**

**Approximate One-time Costs:**

**Benefits/ROI:**

**Project Time Table:**

<b>Resource Reaquirements:</b>	<b>Number of FTEs</b>	<b>Time Frame</b>
The District's Resources:		
MIS		
Department Users		
External Resources:		

**Funding Source:**

## **APPENDIX 6: IT Project Prioritization**

**SCMTD  
INFORMATION TECHNOLOGY PROJECT  
PRIORITIZATION WORKSHEET**

**Reviewer:** \_\_\_\_\_

**Project Name & Number:** \_\_\_\_\_

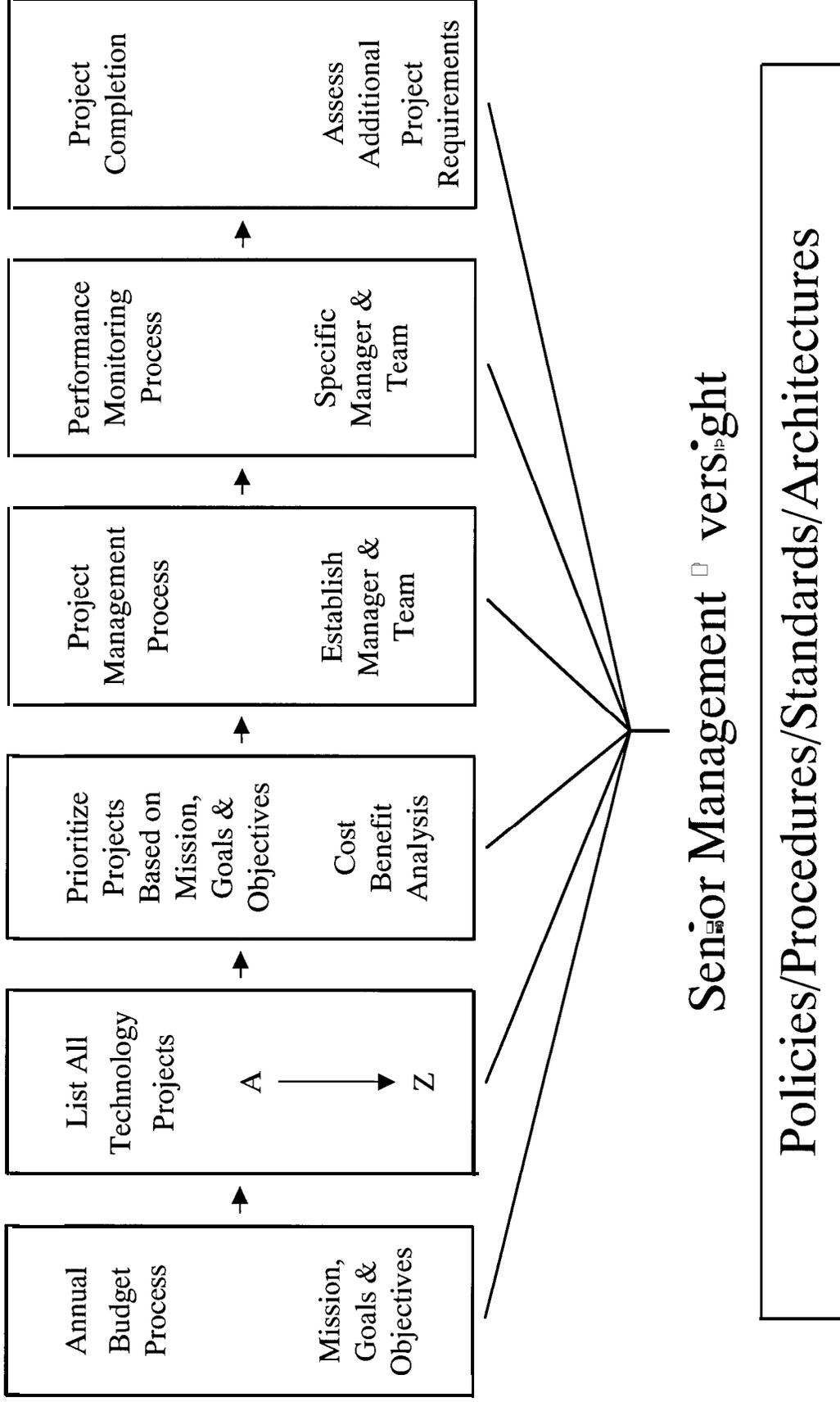
**Evaluation Criteria:**

<b>Support District-wide Business Goals</b>	<b>(15)</b>	<b>—</b>
<b>Maintain/Enhance Technology Infrastructure</b>	<b>(15)</b>	
<b>Increase Synergy Between Departments</b>	<b>(15)</b>	<b>—</b>
<b>Generate Revenue/Reduce Cost</b>	<b>(15)</b>	<b>—</b>
<b>Provide Timely/Accurate Data</b>	<b>(10)</b>	<b>—</b>
<b>Consistent with District Standards</b>	<b>(10)</b>	<b>—</b>
<b>Promote Equity Among Users</b>	<b>(10)</b>	<b>—</b>
<b>Replace Older/Non-supported Systems</b>	<b>(10)</b>	<b>—</b>
<b>Total Points</b>	<b>(100)</b>	<b>—</b>

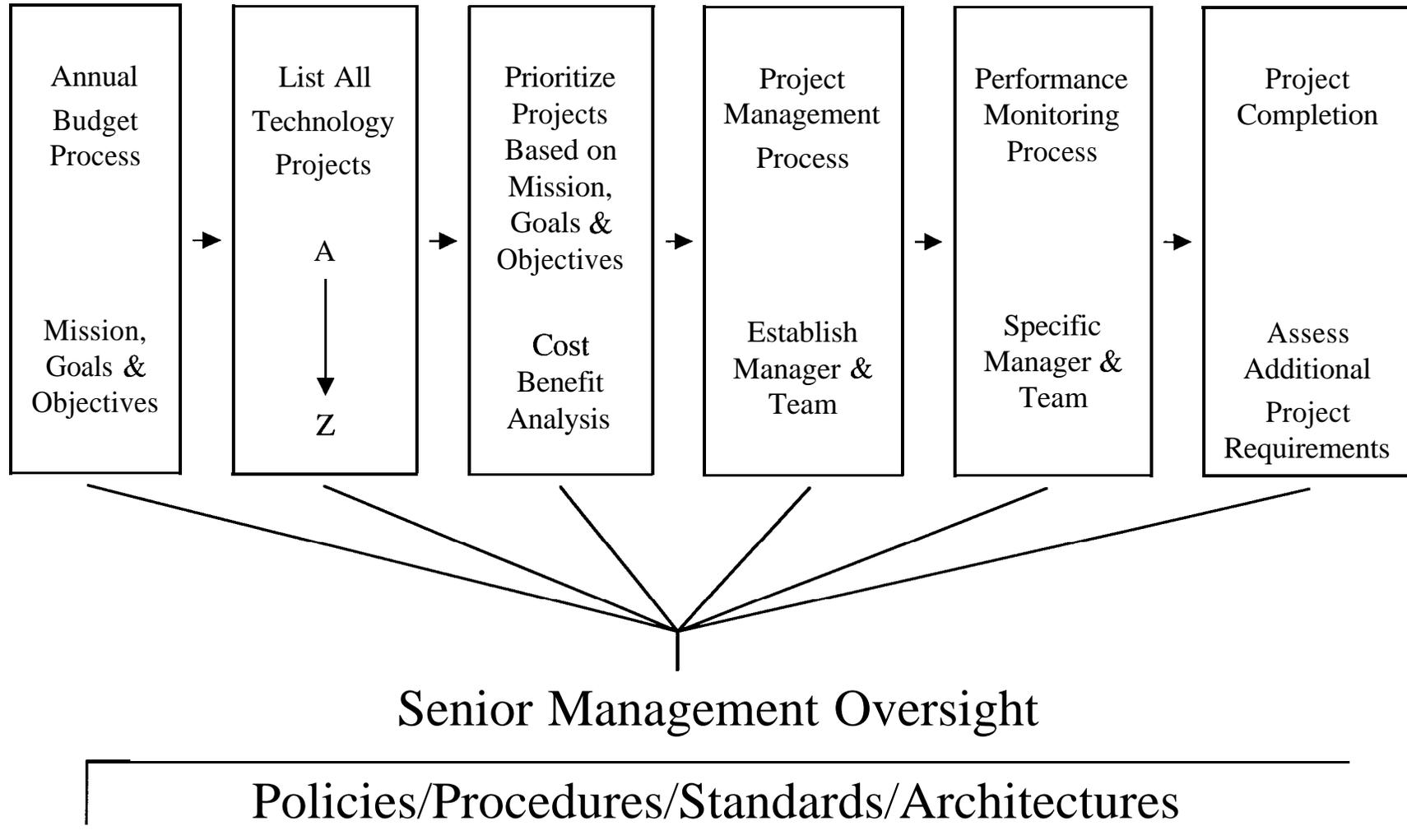
**COMMENTS:**

## **APPENDIX 7: IT Investment Process**

# Technology Investment Process



# Technology Investment Process



## **APPENDIX 8: Position Descriptions**

In the following section are recommended job descriptions for four recommended positions, Manager of IT, Database Administrator, Systems Administrator, and Information Technology Technician. There are currently three incumbents in the department. It is recommended that the current MIS Manager be designated the Manager of IT, the current Senior Systems Analyst fill the Sr. Systems Administrator position and the current MIS Technician fill the IT Technician position. The Database Administrator position would be advertised.

## **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT MANAGER OF INFORMATION TECHNOLOGY SERVICES**

### **DEFINITION**

As the manager of IT, this individual needs to lead the agency and the ITS Department in the overall investment in and deployment of information technology, consistent with a broad, enterprise-wide definition of information technology. As a leader, he/she is expected to work collegially with his/her peers and all users across the organization and help set the pace for technological change at the District. Under direction from the Assistant General Manager, the Manager of IT plans, organizes and directs the programs and activities of the ITS Department, including upgrades, repair, maintenance, databases and other custom programs as required.

### **EXAMPLES OF DUTIES**

- Directs, analyzes, develops and maintains the information technology environment, including operating systems, application software, computer hardware and peripherals and data communication hardware and software.
- Reviews overall performance of District's computer needs and recommends long-term improvements based on formal and informal needs assessment.
- Prepares written reports to staff, Board of Directors and makes presentations.
- Represents the District at various meetings.
- Manages the ITS Department budget.
- Recommends and/or approves District's purchases for computer related equipment and software.
- Directs and participates in the process of needs assessment and analysis of business problems to formulate data processing applications including identification and evaluation of computer processing alternatives, preparation of testing new or revised systems, developing modifications to programs to simplify work flow, reduce processing time and costs and insuring accuracy.
- Directs and participates in the installation, maintenance, development and programming of software programs.
- Confers with users to assist in determining the feasibility of developing specific applications, resolving procedural difficulties, formulating software objectives and establishing problem definitions.
- Prepares and maintains program development records, program documentation and operational procedures.
- Develops, directs and participates in providing employees with training programs in data access and data entry by using new software products and advanced programming techniques.
- Coordinates the formulation of policies which govern the development and operations of the Management Information System and assist in the development of user procedure manuals.
- Prepares studies with recommendations regarding current and proposed software and hardware. Develops appropriate software and hardware specifications necessary to support specific projects.
- Supervises and trains ITS Department personnel.
- Supervises the work of computer contractors and evaluates and negotiates contract change orders.
- Ensures the security of information, equipment, access to data files and develops recovery and back-up procedures for software systems.

## **EMPLOYMENT STANDARDS**

### **Knowledge of:**

- IT administration, including Unix style operating systems.
- PC server operating systems such as Windows NT.
- Information system design and analysis techniques.
- The design and operation of data processing hardware and software, specifically data communications hardware and Unix Operating Systems.
- SQL relational databases (Informix and NT SQL), PC Hardware and multi-user computers and some knowledge of programming in "C" language.
- The operation and capabilities of mini and micro computer hardware and software, including advanced technologies.
- The principals and methods of technical writing and basic statistical reporting.
- The principles of supervision.

### **Ability to:**

- Analyze, evaluate and develop systems and procedures for data Coordinate work activities with District staff and management and maintain effective working relationships with others.
- Supervise, train and evaluate the work of subordinates.
- Ability to work independently on various projects simultaneously under deadline conditions.
- Assess District's IT needs based on experience and conferences with users.
- Effectively supervise staff and interface with computer users.

## **TRAINING AND EXPERIENCE:**

### **Any combination of training and experience equivalent to:**

Bachelor's degree from an accredited college in computer science, mathematics, business administration or related field (experience which demonstrates substantial knowledge abilities pertinent to specific job functions may be substituted for the required education on a year-for-year basis).

### **and**

Five years professional level experience in related computer fields and management, which should include system administration, computer programming and technical administration.

(1/1 3/00 ITmgr.doc)

**SANTA CRUZ METROPOLITAN TRANSIT DISTRICT  
DATABASE ADMINISTRATOR  
SENIOR DATABASE ADMINISTRATOR**

**DEFINITION**

Under direction of the Manager of IT, administers databases on unix and NT systems, including performance, security and user configuration. Makes program changes to Informix, Access and NT SQL databases and creates custom reports. Closely coordinates with Sr. Management and other users to define District-wide database requirements. Recommends approaches to satisfy these requirements. Performs other related duties as required.

**DISTINGUISHING CHARACTERISTICS**

The difference between the Database Administrator and the Sr. Database Administrator depend on knowledge of and hands-on experience with operating systems, databases, troubleshooting, networking and systems security. The junior person may only have familiarity with one operating system and limited database experience and will require more direction, training, and experience. The senior person will have experience in multiple operating systems and in-depth experience with multiple database environments and be able to independently troubleshoot and solve complex problems and have more knowledge of database programming and design techniques.

**EXAMPLES OF DUTIES**

- Establishes user permissions to databases, collects and analyzes performance statistics, including security.
- Develops, modifies and writes database reports as required.
- Prepares specifications, records and tests new or modified applications.
- Formulates and implements procedures to ensure data security, coordinates with the Systems Administrator to verify correct database backup/recovery.
- Confers with users and management to determine requirements for improved reports and database applications.
- Reviews database related products; recommends modifications and improvements; consults with contractors to resolve programming and technical problems.
- Provides training and technical assistance to employees in the use of database applications.
- Installs, configures, maintains, and repairs database engines, tables and applications.
- Implements/manages multi-database warehousing.

## **EMPLOYMENT STANDARDS**

### **Knowledge of:**

- Unix, xenix, ultrix, or other similar operating system.
- NT 4.0, NT 4.0 Terminal Server or windows 98.
- Standard unix utilities available through Bourne, C, or Kom shells.
- Computer applications design and analysis techniques.
- The operation and capabilities of mini and personal computer hardware and software including data communications.
- In depth knowledge of relational database architecture.
- Working knowledge of programming with SQL/ESCL/C/4GL
- Working knowledge of NT SQL administration, including table structures, defining permissions, and backup strategies.

### **Ability to:**

- Install and maintain database applications.
- Write user instructions, procedures, and programming documentation.
- Analyze hardware and software problems, as related to databases.
- Work with users to generate complete database requirements to be applied to the bidding process.
- Establish and maintain cooperative working relationships with the public, District employees, and others.
- Design, develop, modify and implement complex relational database systems.

### **Training and Experience:**

Any combination of training and experience equivalent to:

- Bachelor's degree from an accredited college in computer science or a related field and two years professional level experience in database administration on unix or NT. Experience which demonstrates substantial knowledge and abilities pertinent to specific job functions may be substituted for the required education on a year-for-year basis.
- Two years professional level experience in designing, developing and enhancing relational databases (preferably Informix or NT SQL), including experience programming with SQL/ESQL/C/4GL in unix or NT environment. (Sr. DB Admin)

An incumbent in the Sr. Database Administrator position will fulfill all of the above requirements at an expert level while a more junior person may fulfill only a subset and with a lesser degree of expertise.

**SANTA CRUZ METROPOLITAN TRANSIT DISTRICT  
UNIX/NT SYSTEMS ADMINISTRATOR  
UNIX/NT SENIOR SYSTEMS ADMINISTRATOR**

**DEFINITION**

Under the direction of the Manager of IT, this individual administers unix and NT systems and analyzes and resolves system operation problems at all levels. These can include security, user accounts, networking, and computer hardware problems. Performs other related duties as required.

**DISTINGUISHING CHARACTERISTICS**

The differences between the Systems Administrator and the Sr. Systems Administrator depend on knowledge of and hands-on experience with operating systems, performance tuning, troubleshooting, networking and systems security. The junior person may only have familiarity with one operating system and will require more direction, training and experience. The senior person will have a more thorough knowledge and experience in multiple operating systems and variations and be able to independently research and solve complex problems.

**EXAMPLES OF DUTIES**

- Installs, maintains new hardware and software.
- Develops, modifies and writes shell scripts, collects data and analyzes system usage.
- Prepares specifications records and tests new or modified applications.
- Formulates and implements procedures to ensure data security, maintains database and system backup/recovery.
- Confers with users to determine the feasibility of implementing applications, resolving procedural difficulties and formulating software objectives.
- Reviews computer products, and recommends modifications and improvements; consults with contractors to resolve programming and technical problems.
- Provides training and technical assistance to employees in the use of software applications.
- Installs, configures, maintains, and repairs computer hardware, peripheral equipment, and data communication links and/or provides direction to technician.
- Acts in a back up capacity to the Database Administrator for essential tasks.
- Configure and troubleshoot **email** and **sendmail** and internet connectivity.
- Evaluate requirements and apply system level patches to operating systems and firmware.

## **EMPLOYMENT STANDARDS**

### **Knowledge of:**

- Unix, xenix, ultrix, or other similar operating system.
- Standard unix utilities available through Bourne, C, or Korn shells.
- NT 4.0, NT Terminal Server or Windows 2000.
- Microsoft Office applications.
- General relational database principles.
- Computer applications design and analysis techniques.
- The operation and capabilities of personal computer hardware and software including.
- TCP/IP networking, including hubs, routers and firewalls.
- Statistics, technical reporting, documentation, and instructions for computer software and hardware.

### **Ability to:**

- Analyze hardware and software problems in maintenance of equipment, and utilize manual dexterity to perform repairs to computer components.
- Write user instructions and procedures.
- Analyze hardware and software problems, and maintain computer and networking equipment.
- Install hardware, software and system upgrades.
- Establish and maintain cooperative working relationships with the public, District employees, and others.
- Install hardware, software and system upgrades.

### **Training and Experience:**

Any combination of training and experience equivalent to:

Bachelor's degree from an accredited college in computer science or a related field and two years professional level experience in **unix**, NT or similar operating system environment for the Systems Administrator I position. Experience which demonstrates substantial knowledge and abilities pertinent to specific job functions may be substituted for the required education on a year-for-year basis.

An incumbent in the Senior Systems Administrator position will fulfill all of the above requirements at an expert level while a more junior person will fulfill only a subset with a lesser degree of expertise.

**SANTA CRUZ METROPOLITAN TRANSIT DISTRICT  
INFORMATION TECHNOLOGY TECHNICIAN  
SENIOR INFORMATION TECHNOLOGY TECHNICIAN**

**DEFINITION**

Under supervision of the Manager of IT, this individual performs system backups; resolves user's technical support questions; receives, tests, and installs networked and personal computers and related equipment; performs maintenance, troubleshooting and repair of computer hardware; performs other related duties as assigned.

**DISTINGUISHING CHARACTERISTICS**

The differences between the IT Technician and the Senior IT Technician depend on knowledge of and hands-on experience with operating systems, hardware, applications, troubleshooting, and networking. The junior person may only have familiarity with one operating system and fewer applications and will require more direction, training and experience. The senior person will have experience in multiple operating systems and variations and be able to more independently troubleshoot and solve problems.

**EXAMPLES OF DUTIES**

- Performs and manages daily tape backup; maintains an organized tape library and tape log.
- Resolves problems with printers, terminals, and tape backups; performs routine hardware and equipment repair and troubleshooting;
- Helps configure user's environment; teaches basic procedures including login and e-mail; assesses routine computer user problems, and provides help over the phone and in person; assists in developing and writing user procedures manuals.
- Assists with rewiring and associated network documentation; prepares documentation and maintains records for assigned projects; assists with inventory control of computer parts, and maintains supplies inventory.
- Performs configuration of networked and personal computers and printers, including assisting with the assembly and testing of new systems, under direction.
- Assists in the unloading, asset tagging, documentation and installation of computer equipment; assists in removal, storage, and disposition of obsolete computer equipment.
- Under direction, install system hardware and software upgrades and new application software.
- Under direction, troubleshoot varying levels of network problems.

## **EMPLOYMENT STANDARDS**

### Knowledge of:

- MS Windows, Word, Excel, and MS NT.
- Microsoft Office application software.
- IBM -style PC hardware.
- UNIX OS.
- Networking principles and basic hardware.
- Current hardware technology.
- Record keeping techniques.
- Workplace safety issues related to the use of computers.

### Ability to:

- Operate standard office equipment, including computers and peripheral equipment.
- Clearly and effectively present technical information, both orally and in writing, to both technical and non-technical users.
- Read and interpret technical manuals, procedures and instructions.
- Troubleshoot and repair basic system and application functions and maintain system operation.
- Understand and follow oral and written directions.
- Establish and maintain cooperative working relationships with the public, District employees, and others.

### Training and Experience

Any combination of training and experience equivalent to:

Two years full-time experience involving a variety of computer applications for the IT Technician position. Education equivalent to completion of a one year Certificate of Proficiency in computer science or related field may be substituted for the required experience.

An incumbent in the Senior IT Technician position will fulfill all of the above requirements at an expert level while a more junior person may fulfill only a subset and with a lesser degree of expertise.

## **APPENDIX 9: Recommended IT Salary Ranges**

## Recommended IT Salary Ranges

created 1/9/2000

	<u>non-exempt/Seiu IT Technician</u>		<u>non-exempt/Seiu Sys Admin</u>		<u>exempt/Mgt DB Admin</u>		<u>exempt/Mgt Manager of IT</u>	
	<i>Annual hourly</i>		<i>Annual hourly</i>		<i>Annual hourly</i>		<i>Annual hourly</i>	
Step 1	\$31,981	\$15.38	\$46,194	\$22.21	\$49,748	\$23.92		
Step 2	\$33,580	\$16.14	\$48,504	\$23.32	\$52,235	\$25.11		
Step 3	\$35,259	\$16.95	\$50,929	\$24.48	\$54,847	\$26.37		
Step 4	\$37,022	\$17.80	\$53,475	\$25.71	\$57,590	\$27.69		
Step 5	\$38,873	\$18.69	\$56,149	\$26.99	\$60,469	\$29.07		
	<u>Sr. IT Technician</u>		<u>Sr. Sys Admin</u>		<u>Sr. DB Admin</u>			
Step 1	\$37,022	\$17.80	\$53,476	\$25.71	\$57,589	\$27.69	\$64,239	\$30.88
Step 2	\$38,873	\$18.69	\$56,149	\$26.99	\$60,469	\$29.07	\$67,451	\$32.43
Step 3	\$40,816	\$19.62	\$58,957	\$28.34	\$63,492	\$30.53	\$70,824	\$34.05
Step 4	\$42,857	\$20.60	\$61,905	\$29.76	\$66,667	\$32.05	\$74,365	\$35.75
Step 5	\$45,000	\$21.63	\$65,000	\$31.25	\$70,000	\$33.65	\$78,083	\$37.54

## **Attachment C: Overheads for Presentation**

# **SCMTD**

## **INFORMATION TECHNOLOGY REVIEW AND ANALYSIS**

**Presentation to SCMTD Board**  
**February 11, 2000**

# **Roger Boldt**

## **Background & Credentials**

- **20 plus years of Information Technology and Strategic Planning in the Transit Industry.**
- **Conducted IT Strategic Plans for many transit agencies in the US, including WMATA, PA of Allegheny County, PA of NY & NJ, LACMTA, CTA, BART, OCTA, MARTA, etc.**
- **Conducted an Assessment (1994) and Update (1999) of the State of the Practice of IT in the Transit Industry for TRB/TCRP.**
- **Benchmarked critical IT indicators for clients using a peer group that included SCMTD.**

# **Roger Boldt**

## **Background & Credentials** (continued)

- **Developed, with the APTA IT Committee, a Web-based industry questionnaire to assess the condition of IT in transit (10/99).**
- **Developed detailed IT investment strategies for the replacement of core applications and technical platforms.**
- **Gathered and assessed “state of the art” RFPs from industry leaders.**
- **Assessed industry-specific vendors, providing COTS.**
- **Trained in all core IT and strategic planning methodologies while with Ernst & Young.**

## Purpose of Engagement

- **Broad diagnostic assessment of the state of IT**
- **Use comprehensive definition of IT, including operational technologies**
- **Use industry benchmarking to evaluate SCMTD**
- **Review the overall condition of IT investment and deployment**
- **Review the IT organization**
- **Recommend changes that will better position SCMTD to take advantage of existing and emerging technologies**

# **As a Board Member, Why Should You Care About IT?**

- **The future of the transit industry will increasingly be driven by technology.**
- **Most transit properties are investing far too little in IT**
- **More importantly, most transit properties are doing IT badly**
- **There are very significant institutional obstacles to effective IT investment and deployment**
- **There are good examples from the private and public sectors, including transit**

# Definition of IT

**IT needs to be broadly defined and include all those technologies that are information based, generate data that have applications across the enterprise, and/or involve standard computing platforms running on common communications Infrastructures.**

# **IT Definition Depends upon an Enterprise-Wide Approach to Infrastructure, Investment and Deployment**

- **Architecture -- Common technical platforms, software and data base environment**
- **Standards -- Consistent protocols for the movement of data**
- **Interoperability -- IT solutions that apply across the whole enterprise**
- **Integration -- Systems need to be acquired with planned integration**
- **Data Base Management -- Data entered once at the point of ownership and made available to all users**

# Technology Examples

## Computer Systems:

- Management information systems
- Administrative computing
- End User computing
- Central control systems
  - Database architecture and databases
  - Operating systems
  - Application software
- Personal Computing and Local Area Networks
  - Operating Systems
  - Applications, software and hardware

# Technology Examples (continued)

## Communication Technology:

- Telecommunications architecture
- Data communications architecture
- Wide Area Networks (WAN)
- Radio technologies
- Telephones

# Technology Examples (continued)

## Other Technologies:

- Train/Bus control systems
- Geographical Information Systems (GIS)
- ITS (APTS) architectures, including:
  - Farebox technology
  - Customer information services
  - AVL/AVM
- Materials management technical systems
- Cash handling technology systems
- Bar coding technologies

# Changes in Information Technology

**IT has changed dramatically in the last decade and at an ever accelerating pace:**

- **Mainframe, mid-range to PCs to Internet/Intranet**
- **Full emergence of commercial off-the-shelf products**
- **Open architecture, client server, Windows-based**
- **Powerful, robust, cheaper connectivity**

# Findings

**Based on interviews with IT staff and key users, document review and industry benchmarking:**

- **Initiated an aggressive strategy to replace older computing platforms with a single UNIX/NT environment**
- **Acquired new financial system**
- **Upgraded core operations systems: Hastus and Bid/Dispatch**
- **Tied together the disparate locations with a single contemporary LAN/WAN communications infrastructure**

# Recommendations

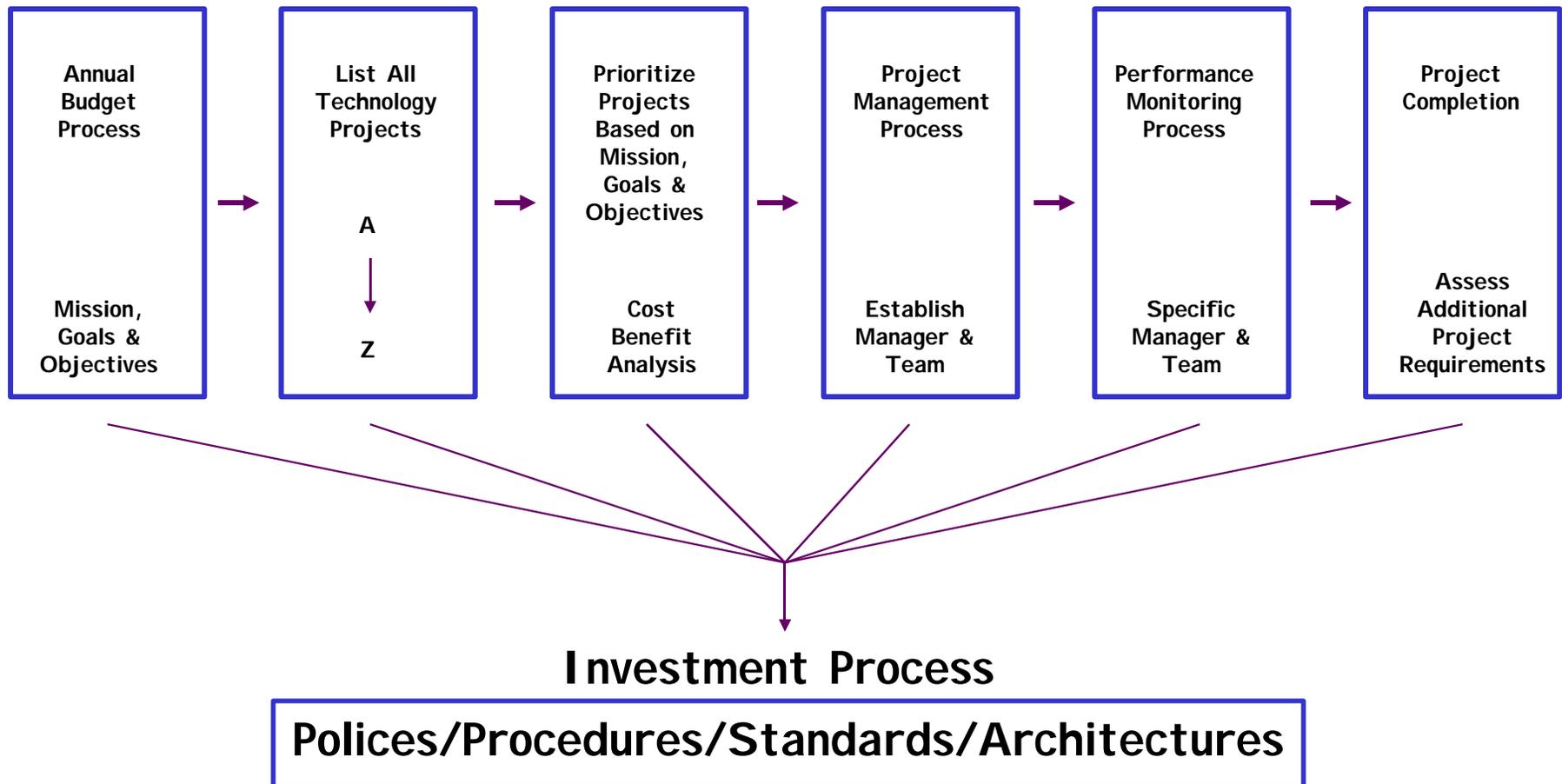
**With the growing technology demands on the industry:**

- **Bring SCMTD in line with “best practices”**
  - Increase IT by one new position
  - Attract and retain IT professionals by making pay structure more competitive
- **Develop a single enterprise-wide technology investment and deployment strategy using clear business priorities**
  - Define IT broadly
  - Institute an IT prioritization process

## **Recommendations** (continued)

- **Incrementally replace remaining core systems with COTS solutions with “best of breed” vendors (e.g., Giro and Multisystems)**
- **Continue to evaluate new technology opportunities like ITS and Internet without taking risk**

# Technology Investment Process



# IT Infrastructure - COTS+

## Database LAN/WAN

- Operations
- Scheduling
- Dispatch
  - CIS

- Payroll
- Finance
- Human Resources
- Procurement

- Maintenance
- Materials Management
- Inventory

Architectures & Standards

# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

**DATE:** February 11, 2000  
**TO:** Board of Directors  
**FROM:** Leslie R. White, General Manager  
**SUBJECT: METROBASE SITE- DITCH RELOCATION**

## **I. SUMMARY OF ISSUES**

- In 1995, the Board of Directors selected the Lipton property at Delaware and Swift Streets in Santa Cruz as the preferred site for the construction of the MetroBase facility.
- In 1996, the Board of Directors adopted a negative declaration for the MetroBase project based upon an initial study conducted for the Lipton property.
- In 1998, the Board of Directors adopted an amended negative declaration for the MetroBase project based upon a revised site configuration plan for the Lipton property.
- In 1998, the Board of Directors authorized staff to begin discussions with the Lipton company to acquire the property necessary for the MetroBase project.
- The Lipton property has a drainage ditch running through the center which renders the property unusable.
- The Lipton Company has submitted an application to the City of Santa Cruz to relocate the drainage ditch based upon an initial study and a negative declaration.
- The City of Santa Cruz Zoning Board will consider the Lipton ditch application relocation on February 10, 2000.
- Lipton Property is not usable for the MetroBase project if the ditch is not able to be relocated.

## **II. DISCUSSION**

Prior to 1989, Santa Cruz Metro operated from two major facilities located at each end of the county. In October 1989, the Loma Prieta earthquake destroyed beyond continued use the Watsonville Maintenance and Operations Facility. The 1989 Loma Prieta earthquake also damaged the River Street operating facility in Santa Cruz so that fueling capability was eliminated. From 1989 until the present time, a lack of maintenance and operating facilities has severely hampered the ability of Santa Cruz Metro to provide the quality and quantity of service that the community needs.

The Board of Directors engaged the services of Gannet Flemming, Inc. to evaluate potential sites for the construction of the Consolidated Maintenance facility for Santa Cruz Metro. In 1995, the result of the site evaluation process was the identification of the Lipton Property at Delaware and Swift as the preferred location for a new operating base. The Lipton Property was preferred on the basis of size, zoning, availability and the lack of relocation requirements. Santa Cruz Metro conducted an initial study when the Board of Directors adopted a negative declaration with regard to the Consolidated Operating facility in 1995. In 1998, land sale activity resulted in the site being reconfigured to take all of the Lipton property as the previously considered Mission Linen property was no longer available. In 1998, the Board of Directors amended the initial study, reconsidered environmental considerations and litigation actions and adopted an amended negative declaration with regard to the Consolidated operating facility project. In 1999, the project was redesignated as the MetroBase project and the architectural firm of Waterleaf Architecture and Interiors, Portland, Oregon, was engaged to design the facility.

In 1998, the Board of Directors authorized staff to begin discussions with Lipton and Union Pacific to acquire the necessary property for the implementation of the MetroBase project. Negotiations for the Union Pacific right-of-way have been completed and an agreement reached for that component of the necessary property. Discussions with regard to the Lipton property have not proceeded due to issues with regard to the drainage ditch which bisects the property. For the property to be usable, the drainage ditch must be relocated from the center of the property to the location in the approximate area where the ditch was originally located. This would allow the MetroBase project to consume the entire 20 acres currently for sale by Lipton. In order to relocate the drainage ditch, it is necessary for the Lipton company to secure a permit from the City of Santa Cruz. The Lipton Company has completed an initial study and issued a negative declaration with regard to the relocation activity. On February 10, 2000, the City of Santa Cruz Zoning Board will consider the issuance of a permit for the relocation of the drainage ditch. Attachment A to this report is the staff report which the zoning board will receive. As a part of the negative declaration process, a 30 day comment period was provided in which comments were received from James McKenzie, Linda Wilshusen, and the California Coastal Commission. The comments with regard to the Lipton negative declaration are attached as Attachment B to this report.

At the present time, the relocation of the ditch is the major obstacle blocking the acquisition of the Lipton property by Santa Cruz Metro. It is necessary for the ditch to be relocated for the property to be usable for the MetroBase project. The process to date for acquiring this necessary right-of-way has been extremely slow. It is conceivable that concerns raised by the California Coastal Commission or other concerns with regard to the Lipton property could further delay the completion of right-of-way acquisition. Funding for the MetroBase project will not be available for use indefinitely. The first funding that is in jeopardy is \$6 million dollars received from the Santa Cruz County Regional Transportation Commission (SCCRTC) under USB45 Project Selection Process. These funds, if not extended by the California Transportation Commission, must be under contract for construction by June 30, 2001 or their availability will expire. Currently, it is anticipated that the projects schedule contain sufficient time to avoid loss of funding. However, if we are not able to proceed with right-of-way acquisition by a reasonable time table, the entire MetroBase project will be in jeopardy.

The site selection study carried out by Gannett Flemming clearly indicated that there are no other sites available in Santa Cruz County which would accommodate a complete consolidation of operations. The savings achieved by consolidating operations are critical components in providing the level of service identified as the preferred strategy by the SCCRTC in the major transportation investment study process. If there is not an ability to provide this level of service, it is important that Santa Cruz Metro inform SCCRTC at the earliest possible time so that alternate strategies for future transportation investments can be considered.

Currently, the cost escalation rate for construction of the MetroBase project is approximately \$80,000 per month. The current budget was adopted by the Board of Directors in December 1999. It anticipates certain milestones to be achieved in 2000 and 2001. As we move past these milestones, we will continue to inform the Board to the impact of cost escalation on the construction of the MetroBase project. Additionally, the passage of time has caused the value of the Lipton property to rise appreciable. At this point in time, the increased value can be accommodated in the current MetroBase project budget. However, another significant increase in land value could jeopardize the ability of the project to finance the necessary land acquisition.

### **III. FINANCIAL CONSIDERATIONS**

At the present time, the MetroBase project is able to be executed within the current budget. A cost escalation rate of \$80,000 per month for completion delay will begin to be a sign to the project that the schedule is not able to be adhered to.

### **IV. ATTACHMENTS**

**Attachment A:** City of Santa Cruz staff report Zoning Board, February 10, 2000 meeting

**Attachment B:** Lipton Negative Declaration comments

ATTACHMENT A  
GENERAL PLAN  
Zoning Board  
February 10, 2000  
PUBLIC HEARING

Address: 2200 Delaware Avenue

Application No. 99-200

Recommendation: That the Zoning Board approve the proposed Design and Coastal Permits associated with a grading permit application to relocate an on-site drainage channel on the Lipton property.

Project Data:

Property Owner: Conopco, Inc./dba Lipton APN: 003-111-05, 003-171-18,  
003-022-14, 003-032-01,  
003-081-01, 003-121-01

Application Type: Design and Coastal Permits associated with a grading permit application to relocate an existing drainage channel.

Zoning: IG (General Industrial)

Project Consistency: Consistent

General Plan: Industrial

Project Consistency: Consistent

Land Use - existing: Vacant  
- proposed: Vacant  
- in area: Industrial & Professional Offices, Live-work Studios

Lot Area: 13.5 acres

Coastal Zone: Coastal Commission Appeal Jurisdiction

Environmental Review: Negative Declaration

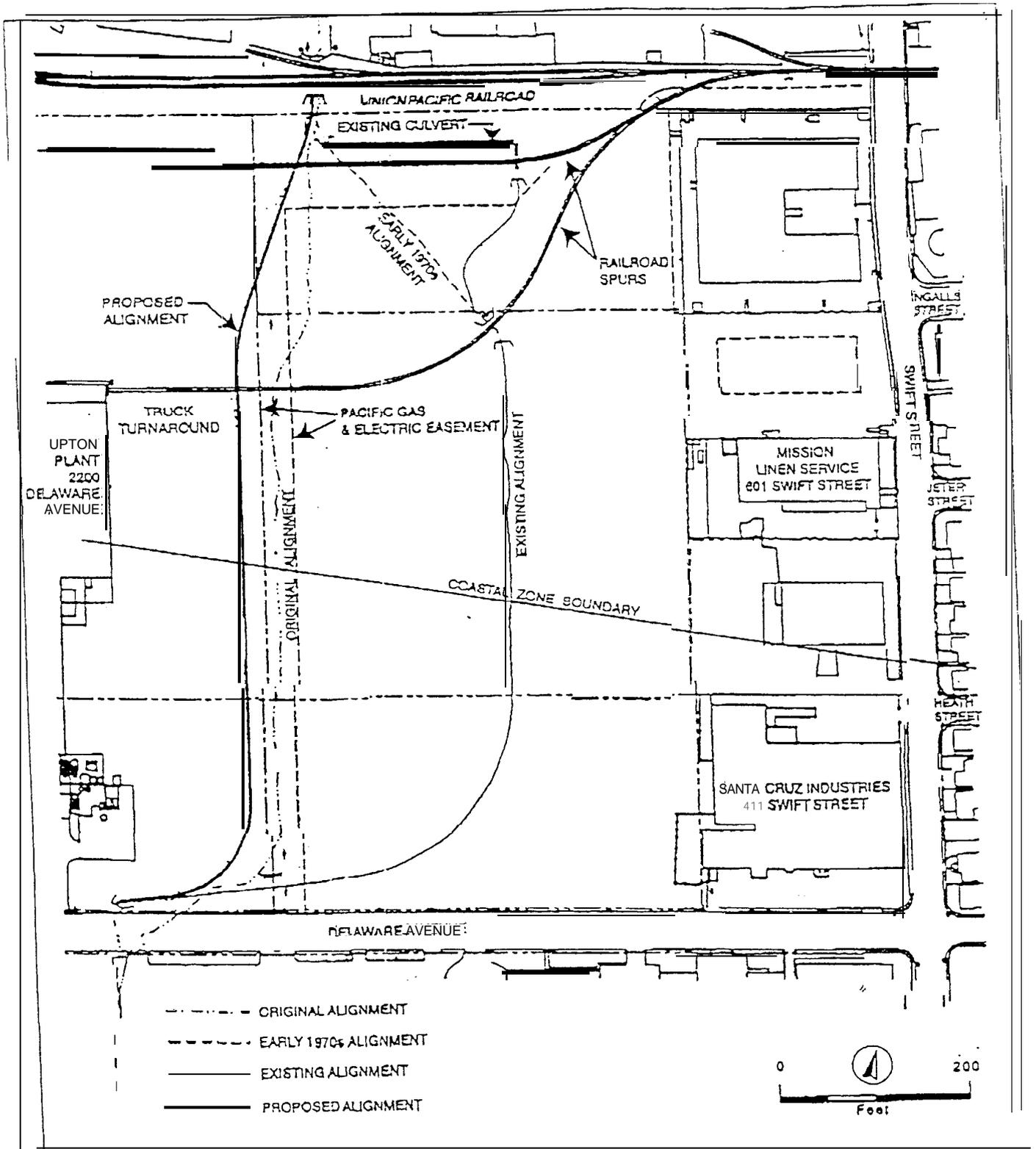
Mandatory Action Date: 5/10/00

Planning Staff: PM

Project Description/Setting

This application is for Design and Coastal Permits associated with a grading permit to relocate an existing drainage channel on a 19.5 acre parcel which is part of the 53 acre Lipton property. The new drainage channel will be relocated to approximately its original location along the western property line (See attached map 1-A). The project has the following goals: to create habitat values in the channel where none presently exist; improve water quality in the channel by reducing nutrient and sediment loads; and establish native plants and riparian vegetation in the channel. The proposed grading plans show a total of 14,700 cubic yards (c.y.) of cut and 14,700 c.y. of fill. Should the Design and Coastal Permits be approved, the final grading and drainage plan would be acted upon by the Chief Building Official.

6A



SOURCE: Robert Dewitt & Associates



LIPTON PROPERTY CHANNEL RELOCATION PROJECT  
 FIGURE 2: PAST, EXISTING, AND PROPOSED DRAINAGE ALIGNMENTS

60A-16

The project site is located on the north side of Delaware Avenue, between Swift Street and Swanton Boulevard. It abuts industrial offices and a live-work development on the west side of Swift Street: the Union Pacific Railroad tracks to the north, Delaware Avenue and Industrial offices to the south, and the Lipton plant to the west.

The Lipton plant and related development occupies roughly the western half of the approximately 53-acre site. The eastern half of the Lipton property, which includes the 19.5 acre project site, contains a Pacific Gas & Electric easement that runs north-south across the site, two below-grade railroad spurs that enter the site from the northeast corner and cross the site to the west, and the subject drainage channel. The new channel would be located approximately 150' east of the existing Lipton plant.

This project has been referred from the Zoning Administrator to the Zoning Board.

### Background

The existing drainage channel, which is part of the Arroyo Seco drainage basin, enters the site from the north through a culvert under the Union Pacific railroad tracks. It enters another culvert immediately north of the northern rail spur and travels east for about 300', then south under the northern rail spur. From there, it flows as an open, unlined channel to a culvert below the southern rail spur. The channel continues open and unlined from this point to the south, where it bends to the west and enters a culvert below Delaware Avenue near the Lipton plant.

The channel was originally constructed between 1946 and 1954. Historical maps from 1902 to 1936 indicate that no channel existed on the site before this time. Evidence suggests that the intermittent flow of the Arroyo Seco drainage north of the site probably crossed the site as sheet flow prior to construction of the channel. The original channel approximately followed the alignment of the Pacific Gas & Electric easement, as shown on Figure 2. The alignment was moved to the east during the construction of the Lipton plant in the early 1970s to accommodate the construction of the southern railroad spur serving the Lipton plant. This realignment of the channel was intended, at least in part, to facilitate the potential expansion of the Lipton plant. This alignment was similar to the existing alignment; however, the northern portion of the channel was adjusted to the east in 1976 when the 300-foot culvert along the northern rail spur was constructed.

The purpose of the project would be to relocate the channel closer to its original location just west of the Pacific Gas & Electric easement. While the applicant has stated that the primary purpose of moving the channel back to its original location is to improve habitat on the site, the project will also make the eastern portion of the property more developable for future uses. Moving the channel closer to the plant would involve removing the rails and ties from the two railroad spurs on site. The privately owned railroad spurs have not been used in years. Excavated soil from the new channel, in addition to stockpiled soil adjacent to the Lipton plant, would be used to fill a portion of the below-grade spurs. In addition, the existing drainage

VA-17

channel will be partially filled which will result in a swale about 3' deep throughout the entire length of the existing channel alignment. This swale will continue to drain the eastern portion of the property and will discharge into the new channel.

In constructing the new channel, habitat value would be created where presently none exists. The new habitat would be enhanced compared to the habitat of the existing channel, which is of limited value. A Resource Management Plan calls for the creation of a riparian zone between the new channel and upland areas (see the attached Initial Study and Creek Management Plan for additional information on the proposed creek restoration work).

#### Environmental Review

In accordance with CEQA and the City's environmental review procedures, an Initial Study has been completed for the project. The Initial Study has identified five potentially significant impacts along with mitigation measures which will reduce such impacts to less than significant levels. A summary of the potential impacts and mitigation measures from the Initial Study/Negative Declaration are outlined in Table 1 below. For a complete discussion of site-specific impacts and associated mitigation measures, please see the attached Initial Study and Negative Declaration/Mitigation Monitoring Program. For a complete discussion of site-specific impacts and associated mitigation measures, please see the attached Initial Study and Negative Declaration/Mitigation Monitoring Program.

6A-184

**Table 1: Summary of Potential Impacts and Mitigation Measures for the Lipton Channel Relocation Project**

<p><u>Impact 1</u>          Potential for alteration to existing drainage patterns on site and surrounding area.</p>	<p><u>Mitigation 1</u>          A flow control structure will be installed at the downstream end of the channel to allow it to act as a detention basin which will insure that post-project runoff does not exceed pre-project levels. The existing drainage channel will be partially filled which will result in a swale about 3' deep throughout the entire length of the existing channel alignment. This swale will continue to drain the eastern portion of the property and will discharge into the new channel.</p>
<p><u>Impact 2</u>          Potential for soil erosion sediment transport during construction and operations.</p>	<p><u>Mitigation 2</u>          The slope design and landscaping would prevent erosion of the channel walls, thereby ensuring that minimal siltation would occur downstream following completion of the project. A flow control structure would be installed at the downstream end of the channel to allow it to act as a detention basin, thereby regulating flow to the downstream reaches, and preventing erosive flows downstream from the site. Erosion control measures are included as part of the project, including scheduling construction to avoid wet months when feasible and implementing a biotechnical slope protection program.</p>
<p><u>Impact 3</u>          Potential impacts to the red-legged frog and burrowing owl.</p>	<p><u>Mitigation 3</u>          A qualified wildlife biologist will be on site to monitor all construction and filling activities in accordance with U.S. Fish &amp; Wildlife Service protocol to assure that no red-legged frogs are present on site. A pre-construction survey will be conducted for the Burrowing Owl in accordance with State Department of Fish and Game protocol to assure that no owls are present on site during construction. Should any owls be located, construction activities will only be allowed to take place in accordance with accepted mitigation measures approved by Fish and Game staff.</p>
<p><u>Impact 4</u>          Potential for noise impacts on adjacent land uses during construction.</p>	<p><u>Mitigation 4</u>          Construction activities shall be subject to all noise-related performance standards as set forth in the Zoning Ordinance to minimize impacts upon neighboring land uses.</p>
<p><u>Impact 5</u>          Potential for air quality impacts during construction.</p>	<p><u>Mitigation 5</u>          Active construction areas will be watered at least twice daily to minimize fugitive dust. During construction, vehicle travel speeds on unpaved areas would be limited to 15 miles per hour. If visible soil were carried off the construction site, it will be swept from neighborhood streets. When construction is complete, disturbed areas will be revegetated as proposed in the Resource Management Plan.</p>

6/12/19

Analysis

*Grading and Reclamation Plan.* The project involves the grading of a new channel along the western property line. The designated bed width of the created channel will be approximately 8' wide and bordered on either side by a high flow terrace: each approximately 10' wide which will support riparian vegetation adjacent to the channel bed. (See attached cross-section of channel 5-A) The high flow terrace will then continue up to the existing grade at a 2 to 1 slope. This slope and the top bank will be planted with native shrubs and grasses. An 8' wide area from the top bank will be planted with upland grasses. This results in a total of 30' from the centerline of the channel to edge of the planted area along the bank. The 30' of vegetation from the centerline is the maximum width of planting that may be supported by the amount of drainage water that flows through the channel.

*Drainage.* The proposed project would alter the drainage pattern across the site by moving the existing channel to the western property line. Surface drainage across the site, other than in the existing channel, is by overland flow. This condition would remain after the construction of the new channel. The new, wider, terraced channel would enter and leave the site at the same culverts as the existing channel, but would be relocated on the site. The slope design and landscaping would prevent erosion of the channel walls, thereby ensuring that minimal siltation would occur downstream following completion of the project. A flow control structure would be installed at the downstream end of the channel to allow it to act as a detention basin, which will insure that post-project runoff does not exceed pre-project levels. Although much of the existing channel will be filled to form a 3' deep swale, it will continue to function as a drainage way for the eastern half of the site. The project will be conditioned to retain the drainage swale on-site for drainage purposes.

*Consistency with General Ph.* The project site has an "Industrial" land use designation in the City's General Plan. Roughly the southern half of the project site is located within the coastal zone. General Plan and Local Coastal Plan policies which are relevant to the project are outlined below in *italics*, followed by a discussion of the project's conformance with such policies:

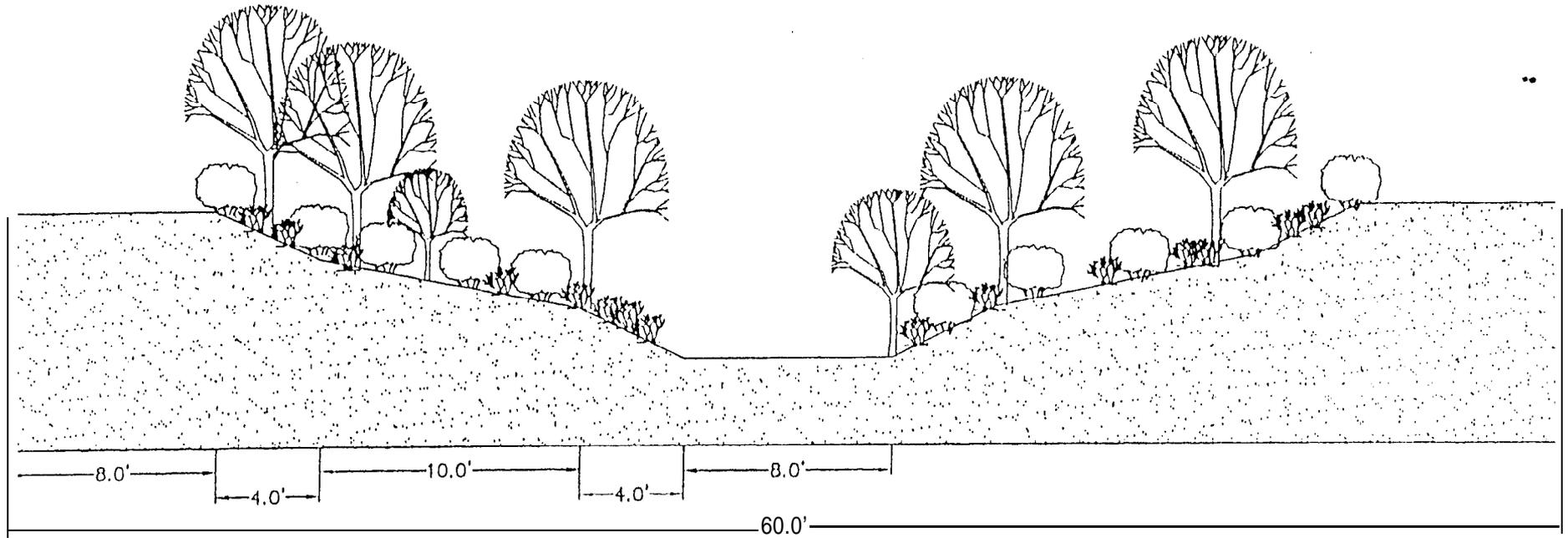
*Policy EQ 4.2:*

*Preserve and enhance the character and quality of riparian and wetland habitats, as identified on Maps EQ-8 and EQ-11, or as identified through the planning process or as designated through the environmental review process.*

The project will result in the relocation of the existing creek channel to the western property line. The project will include the restoration of the channel, which presently does not contain any riparian vegetation. The project, therefore, will result in a net gain in riparian vegetation on the site and enhance the character and quality of the on-site drainage.

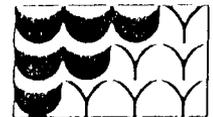
6A-20

S-A



6A-2

Figure 12. Cross-section of proposed drainage channel.



Wetlands Research Associates, Inc.

*Policy EQ 4.2.1:*

*Develop, adopt and implement management plans for City-owned wetland and riparian areas. . Require management plans for sites not owned by the City in connection with development... The need for management plans for other significant environmental resource systems in the Coastal Zone, where ownership is fragmented, will be evaluated on a case-by-case basis when identified in the planning process. When a management plan is prepared, mechanisms will be adopted to implement the plan through permit conditions and other measures to enhance the natural resource.*

The project seeks to move the channel nearer to its original location. A Resource Management Plan has been prepared for the project and will be implemented as a condition of approval. The intent of the Plan is to increase biological values over past and present conditions by establishing a 30' wide riparian zone between the new channel and upland areas on both sides of the channel. As a result, the preparation of such a management plan is consistent with Policy EQ 42.1.

*Policy EQ 4.2.2:*

*Minimize the impact of development upon riparian and wetland areas through setback requirements of at least 100 feet from the center of a watercourse for riparian areas and 100 feet from a wetland. Include all riparian vegetation within the setback requirements, even if it extends more than 100 feet from the watercourse or if there is no defined watercourse present.*

Map EQ-11 (Streams) of the *General Plan and Local Coastal Program* does identify the drainage channel as being part of the Arroyo Seco corridor which drains from the hillsides near UCSC to the coast. The channel in this location is not a naturally occurring stream; it was constructed on dry land between 1946 and 1954 and was reconfigured twice during the 1970s. Although the channel in its present state does not contain any riparian vegetation or meet the Coastal Commission definition of a wetland, the creek is subject to the Policy 4.2.2 since it is identified a mapped watercourse on Map EQ-11. The intent of including the channel on the stream map was not necessarily tied to its *existing* resource value, but because of its potential resource value as part of the overall Arroyo Seco drainage. This drainage system does have the ability to be restored as an integrated creek. While Policy 4.2.2 does require a 100' setback, Policy 4.2.2.1 below does allow development within the setback if a management plan is prepared and implemented. In addition, Policy 4.2.6 does allow certain stream alterations in the Coastal Zone if such alterations result in habitat improvement. Coastal Commission staff, in their letter dated September 17, 1995, determined that the implementation of the streambed channel project back to its original location may be supportable on this site as a "habitat improvement project" as set forth in City General Plan policy EQ 42.6.

6A-22

*Policy EQ 4.2.2.1*

*Require that all development within 100' of these areas be consistent with the applicable management plan provisions under EQ 4.2.1 and L 3.4, if one has been established.*

A Resource Management Plan has been prepared for the project and will be implemented as a condition of approval, as Policy EQ 4.2.1 calls for in certain cases. The plan would be intended to increase biological values over past and present conditions by establishing riparian vegetation adjacent to the proposed new channel.

*Policy EQ 4.2.2.3:*

*Prohibit uses such as construction of main or accessory structures; grading or removal of vegetation within riparian and wetland resource and buffer areas and allow permitted uses . . . that are consistent with the environmental quality policies of the Plan, Section 30222 of the Coastal Act, and adopted management plans. Development in wetlands can be undertaken only where there is no feasible, less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects. If any exceptions to this policy are to be considered, it shall be within the context of a resource management plan which plan shall be approved by the Coastal Commission as an amendment to the Land Use Plan.*

The biological report prepared for the project concludes that the existing creek channel does not contain any riparian vegetation. In addition, the wetlands consultant has indicated that the creek channel does not meet the definition of a wetland as defined by the Coastal Act since it meets the criteria of a man-made ditch. Despite the lack of riparian vegetation and the fact that the streambed does not currently constitute a wetland, the streambed is identified on Map EQ-11 as a part of the Arroyo Seco corridor, the entire length of which is mapped on Map EQ-11. It does not appear as if an LCP Amendment would be required for the development activities within 100' of the existing channel in light of Policy 4.2.6 below since the project will result in habitat enhancement. Based upon Coastal Commission staffs letter dated January 27, 2000 responding to the proposed Negative Declaration for this project, any future development within 100' of the riparian plantings to be established in the new channel would be subject to General Plan policy 4.2.2.3 and would require a 100' setback from the new channel. A revision to the Resource Management Plan to allow any development within 100' of the creek would need to be approved as an LCP Amendment by the Coastal Commission. The City, however, is in the process of preparing a city-wide Creek Management Study in cooperation with the Coastal Commission. As an alternate approach to requiring an individual LCP Amendment

UA-22

for future development on the site, the property owner may choose to enter into a cooperative land use agreement with the City whereby the property owner agrees to implement ail restoration criteria to be established for the Arroyo Seco corridor by the City-wide Creek Management Study. Should the City-wide Creek Management Study not be adopted by the City, an individual LCP Amendment would be required pursuant to General Plan policy 4.2.2.3.

*Policy EQ 42.6:*

*River or stream alterations must be consistent with the natural characteristics of the stream and limited to those allowed under Coastal Act Section 30236, which includes those necessary for water supply, flood control and habitat improvement projects.*

The proposed channel relocation would be consistent with Policy EQ 42.6 because it would improve the existing habitat on the site. The proposed landscaping and planting plans would enhance the wildlife habitat by providing better habitat for terrestrial, avian, invertebrate, and aquatic species associated with riparian areas. In the long-term, the project would also improve water quality by reducing sediment discharges into the channel. In their September 17, 1998 letter responding to the Initial Study for the Transit District, Coastal Commission staff indicated that the channel relocation project may be supportable on this site since it would enhance habitat on the site.

*Policy L 3.4:*

*Develop, implement and maintain updated management plans for the protection and enhancement of natural areas throughout the City. . Management plans should address the following.. description of the resow-ce, preservation objectives, strategies to fulfill the objectives, and the means to carry orrt those strategies (e.g. timeline, funding, authorities).*

A Resource Management Plan has been prepared for the project and will be implemented as a condition of approval. The plan would be intended to increase biological values over past and present conditions by establishing riparian vegetation adjacent to the proposed new channel.

*Consistency with Zoning Ordinance.* The Zoning Ordinance restricts construction, grading, and removal of vegetation within 100' of intermittent and perennial streams. These streams are identified on the largest scale U.S. Geological Survey topographic map by either a solid line or a dash-and-dot symbol and Map EQ-11 of the *General Plan and Coastal Land Use Plan*, or in riparian areas as designated by Map EQ-8 in the plan and refined by the environmental revien process. The subject drainage channel is shown on Map EQ-11 (Streams) as part of the Arroyo Seco drainage corridor. Construction of main or accessory structures, grading, and removal of vegetation is not permitted in any designated riparian area or within 100' from the center of a

10A-74

watercourse. Section 24.14.080(4) of the Zoning Ordinance, however, does permit certain development activities within 100' of these areas in limited instances. One of the permitted activities listed includes activities necessary for habitat preservation and restoration. The proposed channel relocation project with its proposed restoration plan would fit into this allowed use category.

*Future Site Development.* The Santa Cruz Metropolitan Transit District has considered acquiring the undeveloped portion of the project site for use as a consolidated operations facility. City staff is aware of some sentiment in the community that the channel relocation project and the larger Transit District consolidation project should be treated as a single larger project. Neither the City of Santa Cruz nor Lipton nor the Transit District, however, has committed to the development of the consolidated operations facility at the site. A review of CEQA case law clearly reveals that the mere fact that a single project may in some way be related to a potential future project does not necessarily make the two projects a single, larger project. Where a project arguably might be part of a larger scheme but nevertheless has independent utility in and of itself, the project can be processed separately because, even if a later related project is denied, the first project will serve a valid and useful purpose. The City has determined that approval of the channel relocation project is separate and distinct from any future development of the larger, Lipton site because (i) approval of the environmentally benign channel relocation project would not *cause* or render in any way inevitable a subsequent development approval, and (ii) the relocation project has "independent utility," even if the City denies any future development proposal for the larger property.

A more detailed discussion of the City's treatment of the creek relocation project and the Transit District project as separate projects is included in the 'Mandatory Findings of Significance' section of the attached Initial Study. The Initial Study also includes a discussion of the potential cumulative impacts of the channel relocation project combined with the possible Transit District development.

### Summary / Recommendation

Staff is recommending that the Zoning Board (1) adopt the proposed Negative Declaration and Mitigation Monitoring Program prepared for the project; (2) approve the Design and Coastal Permits for the channel relocation.

### Findings

#### Design Permit, Section 24. 05.430

- The proposed channel relocation project is consistent with the physical development policies of the General Plan, Local Coastal Program and Zoning Ordinance. (1)
- With implementation of conditions of approval, the project will not impact other neighboring land uses. (4)

VP-25

- The site consists of predominantly non-native vegetation. The project will result in the filling of the existing creek channel and the creation of a new channel along the western property line. The existing creek channel does not contain any riparian vegetation. The new creek channel will be revegetated with native species and riparian species as part of the Resource Management Plan for the project. The grading for the new channel will utilize natural land forms to the extent feasible and will restore and enhance the visual quality of visually degraded areas. (5, 6)
- As identified in the Initial Study prepared for the project, the project will not result in a significant increase in traffic on local roadways during construction. (7)
- The project has been conditioned to protect surrounding properties during construction by requiring that all construction activities adhere to noise regulations set forth in the Zoning Ordinance. (10).

Coastal Permit, Section 24.08.250

- The channel relocation project will not impact views between the sea and the first public roadway parallel to the sea. (1)
- The project will result in the creation of riparian habitat on the property which presently does not exist. As such, the project will be consistent with the policies of the City's LCP. (2, 3)
- The project will not impact any public access to the coast and will not impact any visitor-serving needs or coastal development uses (4, 5).

Attachments:

- Conditions of Approval;
- Negative Declaration/Initial Study/Creek Restoration Plan;
- Mitigation Monitoring Program;
- Letters from Public Agencies on the Proposed Negative Declaration;
- Letters from the public on the Proposed Negative Declaration.

7-2-09

January 26, 2000

Patrick Murphy  
 Planning and Community Development  
 809 Center Street  
 Santa Cruz, CA 95060

RECEIVED

JAN 27 2000

CITY PLANNING DEPT

Dear Mr. Murphy,

I have reviewed the Notice of Intent to Issue a Negative Declaration for case number 99-200--the grading, design, and coastal permits for the relocation of an existing drainage channel on a 53-acre parcel owned by the Lipton Company. I believe that a Negative Declaration/Initial Study is inadequate and does not comply with CEQA for the following reasons:

On page 5 it is stated that "Although the City has acknowledged that the Metropolitan Transit District Headquarters project could be seen as a reasonably foreseeable project for purposes of analyzing cumulative impacts, the City has not treated that potential future project as part of the project being analyzed in this Initial Study." The action to approve the relocation of the drainage ditch is necessary for the SCMTD project to proceed. In fact, the plans available on the website of the SCMTD show the project with the ditch relocated.

On pages 35 to 37 under XVII. Mandatory Findings of Significance it is noted that ". . . neither the City of Santa Cruz nor Lipton nor the Transit District has committed to this project." SCMTD has engaged in discussions with Lipton regarding the sale, and the relocation of the ditch is a contingency for SCMTD to acquire the site. Three members of the Santa Cruz City Council sit on the Transportation Advisory Board of the SCMTD and have given support for this site by authorizing the hiring of an architectural firm to engage in additional design for the site and begin discussions with those in adjacent areas. These three City Council members also approved a resolution to seek additional funding for this site. Given these actions, which are on the public record, to say the City has not committed to this site is a gross misrepresentation of the facts. SCMTD's discussions with Lipton and the fact that the sale is contingent on this action also lend credence to a commitment.

On pages 36 and 37 under the section noted above, regarding Biological Resources and Hydrology and Water Quality, there are no cumulative impacts reported. Given the SCMTD's site layout, and the support of the three City Council members on the advisory board, the impact of a diesel fueling station holding tens of thousands of gallons of fuel must be taken into account under these sections. There has been no study of the impacts of locating this amount of fuel on this site from either a biological or water quality perspective. Any spills can have an impact on the local area and Monterey Bay. To say that the relocation of the drainage ditch has no cumulative impact is absurd without additional study in these areas given the current design of the site and political support for placing the project in this location. Additionally, the impact of diesel emissions on these biological resources, water, and air quality must also be taken into account. If the SCMTD eventually converts its bus fleet to CNG or other fuel(s) that require storage of highly combustible substances under very high pressure, impacts from this eventual change in use must also be considered.

Because of all the circumstances cited above, I request that a full environmental impact report (EIR) be performed for this project. I also request a written response to this letter from the planning director.

Sincerely,



Jim MacKenzie  
 1747 King Street  
 Santa Cruz, CA 95060

# SCCRTC

SANTA CRUZ COUNTY REGIONAL TRANSPORTATION COMMISSION  
1373 PACIFIC AVENUE, SANTA CRUZ, CALIFORNIA 95060-3911 (831) 460-3200 FAX (831) 460-3215 OR (831) 471-1290

SERVICE AUTHORITY  
FOR FREEWAY  
EMERGENCIES  
SAFE

January 26, 2000

CONGESTION  
MANAGEMENT  
AGENCY

Patrick Murphy  
City of Santa Cruz Planning Department  
809 Center Street, Rm 206  
Santa Cruz, CA 95060

RECEIVED  
JAN 27 2000  
CITY PLANNING DEPT.

COMMUTE  
SOLUTIONS

RE: #99-200, Lipton Channel Relocation Project Negative Declaration

Dear Mr. Murphy:

TRANSPORTATION  
POLICY COMMITTEE

Santa Cruz County Regional Transportation Commission (SCCRTC) staff has reviewed the Negative Declaration for the proposed relocation of the Lipton Channel. The SCCRTC has allocated state and federal funds toward the Santa Cruz Metropolitan Transit District (SCMTD) Consolidated Facility at the proposed site and therefore supports this channel relocation so that the Metrobase project can move forward.

RAIL OVERSIGHT  
COMMITTEE

Thank you very much for the opportunity to review this document. Please call me at 460-3200 if you have any questions.

BUDGET &  
ADMINISTRATION  
PERSONNEL  
COMMITTEE

Sincerely,



Linda Wilshusen

INTERAGENCY  
TECHNICAL  
ADVISORY  
COMMITTEE

Executive Director

cc: Commissioners Beiers, Fitzmaurice, Wormhoudt  
Regional Transportation Commission  
N. Papadakis, AMBAG

BICYCLE COMMITTEE

ENVIREVULETTERS\LIPTON.WPD

ELDERLY & DISABLED  
TRANSPORTATION  
ADVISORY COMMITTEE

**CALIFORNIA COASTAL COMMISSION**

CENTRAL COAST DISTRICT OFFICE  
 715 FRONT STREET, SUITE 300  
 SANTA CRUZ, CA 95060  
 (831) 427-4863

**RECEIVED**

JAN 3 2000

January 27, 2000



Patrick Murphy  
 Associate Planner  
 Planning and Community Development Department  
 City of Santa Cruz  
 809 Center Street, Room 206  
 Santa Cruz, Ca 95060

ORIG:	
CC:	Les, Mark, Peggy
FILE TO:	

Subject: **Notice of Intent (NOI) to Issue a Negative Declaration (ND) for the Relocation of a Portion of the Arroyo Seco Stream Corridor (SCH# 99122089)**

Dear Mr. Murphy,

Thank you for the opportunity to review this CEQA document. In general we are very supportive of efforts to improve urban stream corridor habitat, and that restoration of the degraded stream corridor on the Lipton property is being proposed. Restoration at this location has the potential to restore the physical and biological integrity of a portion of the Arroyo Seco stream corridor ecosystem.

After review of the Negative Declaration (ND) we have identified several aspects of the proposal that require further clarification. The following comments are based upon the proposed ND and the ND-incorporated Resource Management Plan.

Applicable Local Coastal Program Policies

The portion of the proposed project nearest Delaware Avenue is located in the coastal zone and is subject to the provisions of the City's certified Local Coastal Program (LCP). We have stated in our previous comments for the proposed transit district project, that the City's LCP generally supports habitat improvement projects. This project could improve the four components of the stream ecosystem most frequently adversely affected by urbanization, including catchment hydrology, water quality, floodplain ecology (i.e. riparian elements), and instream ecology.

The relocation of a stream, though, is a major undertaking with many resource and resource policy implications. The portion of the Arroyo Seco stream corridor proposed for relocation is identified as an intermittent stream by USGS and LUP map EQ 11 (Streams). Accordingly, although degraded and devoid of riparian vegetation, the subject stream reach is protected by the requirements of LCP policies EQ 4.2, EQ 4.2.1, EQ 4.2.2, EQ 4.2.2.1, EQ 4.2.2.3, L 3.4, and Section 24.14.080.<sup>1</sup>

The primary purpose of the proposed project is the improvement of habitat. As such, it is consistent with LCP policies EQ 4.2 and EQ 4.2.6. These policies require the preservation and enhancement of riparian and wetland habitats, and LCP Policy EQ 4.2.6 sets forth the circumstances upon which the alteration of river or stream habitats may take place. However, the proposed project raises questions of consistency with LCP policies EQ 4.2.1, EQ 4.2.2, EQ 4.2.2.1, EQ 4.2.2.3, L 3.4, and Part 1 of Chapter 24.14 (Conservation Regulations) of the LCP's zoning setback requirements for wetlands and watercourses, prohibited development within such areas, and the requirement for management plans.

Although no development is currently proposed (other than habitat restoration) within the LCP's

<sup>1</sup> The SD also concludes that the existing channel could not be termed a wetland under City LCP and Coastal Act standards. Absent direct evidence to the contrary, though, it would appear that wetlands, as defined by the Coastal Act and LCP, may be found in the vicinity of the Arroyo Seco stream corridor

required 100-foot setback, the ND and the ND's resource management plan do not adequately address the issue of future development in these LCP-protected areas. The LCP also requires the development of management plans for the City's wetlands and streams (LUP Policy L 3.4 specifically identifies this requirement for the Arroyo Seco Corridor). Any development within setback areas must be consistent with these plans. LCP policy EQ 4.2.2.3 requires an amendment to the Land Use Plan for such plans.

In this case, since a corridor would be relocated within an otherwise vacant landscape, the City should ensure that General Plan and LCP goals and objectives for such corridors are pursued. In other words, we suggest that the City pursue appropriate measures to protect buffer areas adjacent to the relocated channel from intrusion by future development. Such measures could include legal instruments such as deed restrictions and/or easements covering this buffer area. We note that no such provisions are currently proposed.

In response to the 100-foot setback requirement of LCP Policy EQ 4.2.2, the ND acknowledges that while the policy requires the setback, Policy EQ 4.2.2.3 allows development within the setback when a management plan has been created. **This** policy further requires that the plan contain the provisions called for under LCP Policies EQ 4.2.1 and L 3.4. Under LCP Policy EQ 4.2.2.3 the resource management plan can allow a limited number of permitted uses allowed within 100-foot buffer areas, consistent with the maintenance of habitat values at such locations.

In this case a resource management plan is being proposed for the new channel. This plan shows an overall stream corridor of 200 feet. This plan contains inadequate provisions for the area within the 200-foot (100-feet on each side) corridor required by the General Plan and LCP. Moreover, the ND-incorporated management plan does not provide for any foreseeable mechanisms to ensure that buffer requirements are met. If this plan is meant to be the EQ 4.2.2.3 required plan, then it is not adequate. While the ND-incorporated resource management plan may address the present development proposal, it does not address future potential for development within the 100-foot buffer.

Specifically, the ND-plan pertains only to the physical and biological components of the stream corridor. However, if future development is to be contemplated within the 100-foot buffer of the new channel, then LCP Policy EQ 4.2.2.3 clearly requires the preparation of a management plan that also includes a land use element. As the policy states, "if any exceptions to this policy," (i.e. setback), "are to be considered, it shall be within the context of a resource management plan which shall be approved by the Coastal Commission as an amendment to the Land Use Plan."

As you are aware, the City of Santa Cruz has been awarded grant monies by the Coastal Commission to be used for the preparation of citywide creeks and wetlands management plans. These plans would be adopted by the Commission and provide the site specific context and management goals and objectives for each corridor – including the Arroyo Seco stream corridor. We are encouraged that the City is pursuing such plans and suggest the pursuance of an effort by which the proposed project could take full advantage of this funded planning opportunity.

We would recommend that a management plan be submitted as an LCP amendment for this proposal. Additionally, the submission should also amend LCP map EQ-11 (streams) so as to accurately delineate changes in the channels location.

#### Other Questions/Suggested Modifications

Our previous understanding of the proposal was that the entire existing channel was to be filled in tandem with the corridor relocation. It appears from the ND that this is not the case and only a portion of the existing channel would be so filled. Will the existing channel be filled at a future date? The ND states that a portion of the existing channel is being retained as a detention

basin. Please clarify what runoff would be detained; why it would be so detained, where such a basin would be on the site, and how it would function.

Also, we suggest that the new channel should be relocated to its true historic location, and also utilize the existing grade. The current proposal is close to the historic location. While we are unable to determine if it utilizes the existing grade.

In terms of comments upon the proposed resource management plan we suggest the following modifications that are specific to the restoration components of the plan only:

1. Monitoring and maintenance of habitat improvement should be extended from the proposed three (3) years to at least five (5), and if feasible up to seven or ten years. In addition, monitoring reports should be submitted at least annually in order to ensure that plant establishment success and performance criteria have been achieved.
2. The resource management plan should establish explicit performance standards for vegetation, hydrology, and wildlife, and a clear schedule and procedure for determining whether they are met should be provided. Any such performance standards should include; identification of minimum goals for each herbaceous species, by percentage of total plantings and by percentage of total cover when defined success criteria are met; and specification of the number of years active maintenance and monitoring will continue after ten years once success criteria are met. All performance standards should state in quantifiable terms the level and extent of the attributes necessary to reach the goals and objectives. Sustainability of the attributes should be part of every performance standard. Each performance standard should identify: (1) the attribute to be achieved; (2) the condition or level that defines success; and (3) the period over which success must be sustained. The performance standards should be specific enough to provide for the assessment of riparian habitat performance over time through the measurement of attributes of riparian habitat and functions including, but not limited to, vegetation, hydrology, and wildlife abundance. In conjunction with such standards, the plan should include measures to address those portions of the restoration that are unsuccessful and specify methods to remedy them.
3. We suggest that check dams (w/woody debris or other material) be used to create a curvilinear flow in channel bottom, and to create rifle-pool regime for enhanced habitat productivity.

#### Appealability

The proposed development would be appealable to Coastal Commission under Section 30603 (a)(2) of the Coastal Act since it lies within 100 feet of a stream. This section and subsections of the Act state,

*(a) After certification of its' local coastal program, an action taken by a local government on a coastal development permit application may be appealed to the commission for only the following types of developments:*

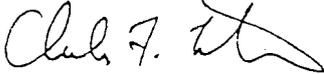
*(2) Developments approved by the local government not included within paragraph (1) that are located on tidelands, submerged lands,, public trust lands, within 100 feet of any wetland, estuary, or stream, or within ZOO fee: of the top of the seaward face of any coastal bluff.*

Conclusion

Thank you for the opportunity to comment in the development stage of this project. As you move forward with your project analysis and environmental review, the issues identified above, as well as any other relevant coastal issues identified upon further review or due to project modifications, should be considered in light of the visions of the Coastal Act and the certified conditions regarding this matter, please contact me or Kevin Colin of my staff at (831) 427-4863.

development stage of this project. As you move forward with your project analysis and environmental review, the issues identified above, as well as any other relevant coastal issues identified upon further review or due to project modifications, should be considered in light of the visions of the Coastal Act and the certified conditions regarding this matter, please contact me or Kevin Colin of my staff at (831) 427-4863.

Sincerely,



Charles Lester  
District Manager  
Central Coast District Office

cc: John Dixon, Senior Biologist, California Coastal **Commission**  
Cannel Babich, California Department of Fish and Game  
Rob Lawrence, U.S. Army Corps of Engineers  
Tim Testa, Esq., Attorney for Lipton  
Leslie P. White, General Manager, SCMTD

# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

**DATE:** February 11, 2000

**TO:** Board of Directors

**FROM:** Leslie R. White, General Manager

**SUBJECT: METROBASE PROJECT- DRAINAGE DITCH SETBACK**

## **I. SUMMARY OF ISSUES**

- The Board of Directors has identified the Lipton property as the preferred site for the MetroBase project.
- The Lipton property currently contains a drainage ditch which bisects the property in the center.
- For the property to be usable for construction of the MetroBase facility, it is necessary for the drainage ditch to be relocated away from the proposed property.
- In 1998, the Board of Directors authorized staff to commence discussion with the Lipton Company for the purpose of acquiring the necessary right-of-way for the MetroBase project.
- The current plans in place at the City of Santa Cruz require a 100-foot set back on either side of the center line of a Riparian corridor.
- The City of Santa Cruz is responsible for assuring that setback requirements are met.
- On February 10, 2000 the City of Santa Cruz Zoning Board will hear a proposal from the Lipton company for a relocation permit to be issued to relocate the ditch utilizing a 30 foot from center line setback.
- The amount of property relinquished to set back requirements directly impacts the size of fleet which can be accommodated in the MetroBase project.

## **II. DISCUSSION**

In 1995, based upon a Gannet-Flemming evaluation, the Board of Directors identified the Lipton property on the West side of Santa Cruz as the preferred location for the construction of a consolidated operating facility which has become known as MetroBase. The Lipton property is approximately 20 acres in size, zoned industrial, serviced by major utilities, and meets the requirements necessary for the size of fleet envisioned to be operated by Santa Cruz Metro. All functions of Santa Cruz Metro would be consolidated into this facility. The annual budgetary savings of this consolidation were estimated by Gannet-Flemming to be approximately \$2.1 million dollars per year in 1995 dollars. In 1998, the Board of Directors authorized staff to begin discussions with the Lipton company for the purpose of acquiring the necessary right-of-way for

the MetroBase project. The major issue which has slowed with regard to right-of-way acquisition relates to the location of the drainage ditch which bisects the property at the center.

For the property to be usable for MetroBase, it is necessary for the drainage ditch to be relocated off the proposed property. The Lipton Company has applied to the City of Santa Cruz for the relocation permit which would place the ditch in the vicinity of its original location and create a Riparian corridor as a habitat improvement component of the project. Currently, the City of Santa Cruz general plan requires that a Riparian corridor have a 100-foot set back from center line. The initial study and negative declaration and management plan submitted to the City of Santa Cruz by the Lipton Company envisions a 30 foot from center line set back. Currently, the Zoning Board of the City of Santa Cruz is proposing to review this request on Thursday, February 10, 2000.

The setback requirements regarding a Riparian corridor and applied to the relocated ditch impact the MetroBase project in two possible ways. The conceptual design for the MetroBase project envisioned a 50-foot from property line set back which would accommodate the current easement requirements of PG&E. A setback requirement beyond this size would begin to constrain the ability of this site to accommodate a bus fleet the size that Metro anticipates developing. If the proposal by the Lipton company is approved by the City of Santa Cruz, and sustained, the center line of the Riparian corridor would be 30 feet away from the property line of MetroBase. As a part of advancing the MetroBase project, it would be necessary for Santa Cruz Metro to request a variance in the setback requirements if development would propose to be put closer than 100 feet from center line. It is conceivable that a LCP amendment would be necessary to accommodate this encroachment into the 100-foot zone. An LCP amendment could delay the MetroBase project substantially resulting in increased costs and questionable project liability.

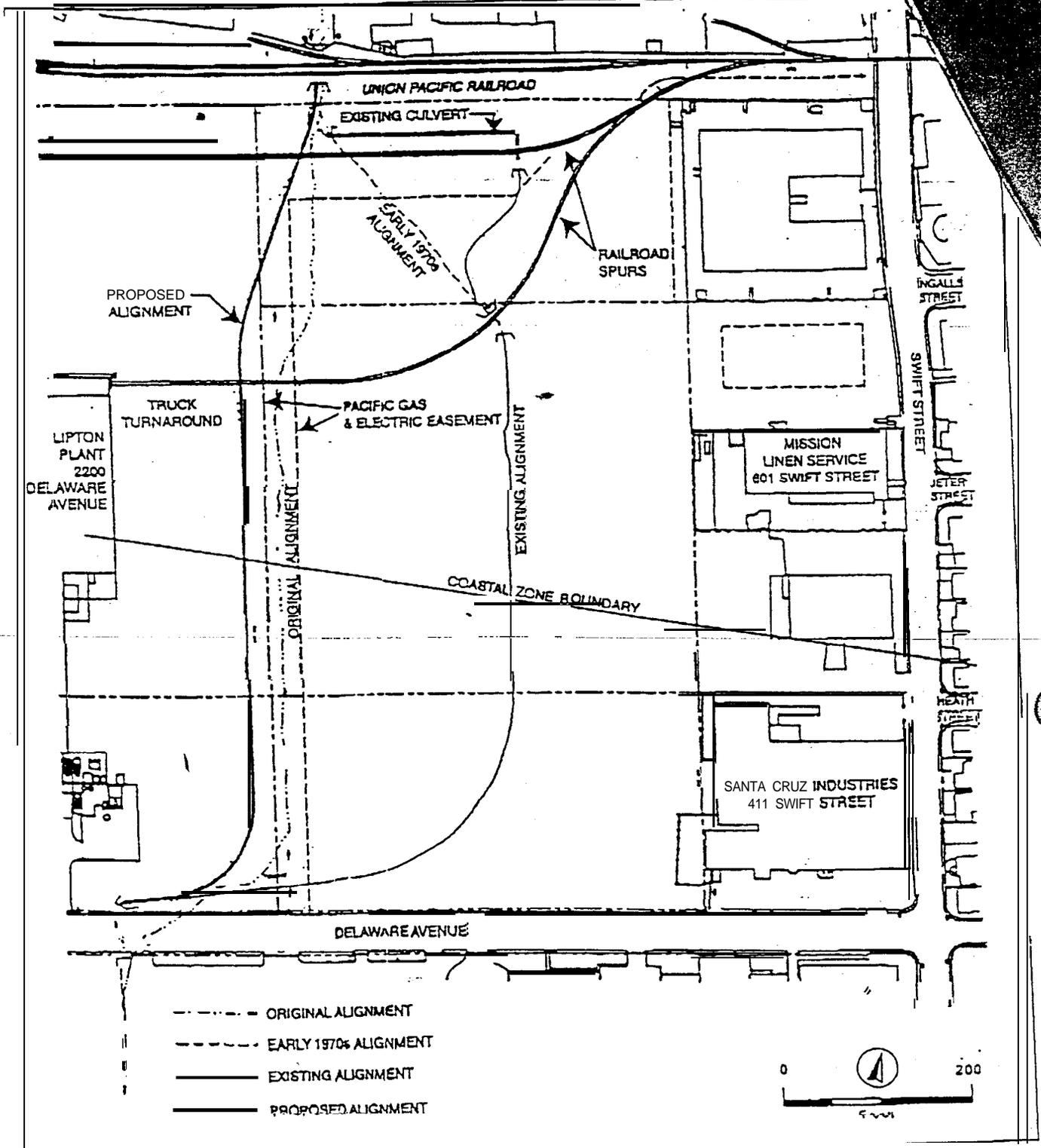
As the current Lipton proposal anticipates the corridor center line 30 feet into their property and as the conceptual design for MetroBase anticipates a 50 foot setback into Metro property, the difference to accommodate a full 100 foot strategy would be 20 feet of additional set back. If Metro and its design team crafted a project, utilizing a 70 foot from property line set back, it would not be necessary for any variance from the current 100 foot standard outlined in the general plan. It is possible that this approach would facilitate moving the project forward. It is also possible that the appraised value derived from this expanded setback would be unacceptable to the Lipton Company. In this case, it is conceivable that a condemnation strategy in order to comply with the 100 foot set back requirement might be necessary.

### **III. FINANCIAL CONSIDERATIONS**

Currently, the MetroBase project is on schedule and fundable within the existing budget. It is estimated that once occupancy and completion dates begin to erode, a cost of \$80,000 per month in construction escalation will be incurred. At that time, it is unlikely that additional funding can be secured to support the project. This would result in a compromise at project capacity and capability in the design and construction process.

**IV. ATTACHMENTS**

**Attachment A:** Lipton Channel Relocation Map



SOURCE: Robert Dewitt & Associates



LIPTON PROPERTY CHANNEL RELOCATION PROJECT  
 FIGURE 2: PAST, EXISTING, AND PROPOSED DRAINAGE ALIGNMENTS

67X-16

# SANTA CRUZ METROPOLITAN TRANSIT DISTRICT

**DATE:** February 11, 2000  
**TO:** Board of Directors  
**FROM:** Les White, General Manager  
**SUBJECT: METROBASE – PROJECT SCHEDULE**

## I. SUMMARY OF ISSUES

- In 1998, the Board of Directors executed a contract with WaterLeaf Architecture & Interiors for the design of the MetroBase project.
- As part of the contract with WaterLeaf Architecture & Interiors, a schedule was developed which resulted in the MetroBase project being completed and occupied in November 2002.
- Current budget estimates and funding strategies identify costs associated with a November 2002 completion date.
- Slower than anticipated right-of-way acquisition activities are causing concern that the proposed schedule can be adhered to.

## II. DISCUSSION

In December 1998, the Metro Board of Directors executed a contract with WaterLeaf Architecture & Interiors of Portland, Oregon, for the design of the MetroBase consolidated operating facility project. As a part of the contract with WaterLeaf Architecture & Interiors, a schedule identifying a project completion of November 2002 was adopted. Additionally, a budget revision was adopted which identified a cost increase of the project to a level of approximately \$39 million, with \$2 million to be removed from the project through design savings. Additional funding necessary to achieve a \$37 million project level was identified through a combination of land sale proceeds, additional federal formula funds directed to the project, the addition of FEMA proceeds and an additional Federal Discretionary Earmark. The achievement of the funding level of \$37 million was identified as an achievable, but difficult goal to reach. Currently, the MetroBase project is operating on a schedule which will accommodate a completion of construction by November 2002. However, issues related to right-of-way acquisition, including the relocation of the ditch which bisects the property, are slowing this phase of the project. The design team will soon be at a juncture where it is necessary to firmly identify the site upon which the building is to be constructed in order for engineering to take place. If it is not possible to firmly identify the Lipton property as the site upon which MetroBase will be built, the design process will slow and ultimately stop. At this point in time, the completion date of the project will begin to erode and costs will begin to accelerate at a rate of \$80,000 per month. The ability of Metro to acquire additional funding beyond \$37 million to accommodate the delay and project completion is severely limited.

Currently, the MetroBase project contains \$6 million in funds received from the Santa Cruz County Regional Transportation Commission through the SB 45 selection process. These funds must be obligated in a construction contract by June 30, 2001, unless an extension is received from the California Transportation Commission.

The current level of delay which the project has experienced cannot continue prospectively if this project is to remain viable. I have attached a copy of the schedule which outlines major milestones and events for your review. It is increasingly critical that we adhere to this schedule as much as possible if we are to be successful in implementing the MetroBase project.

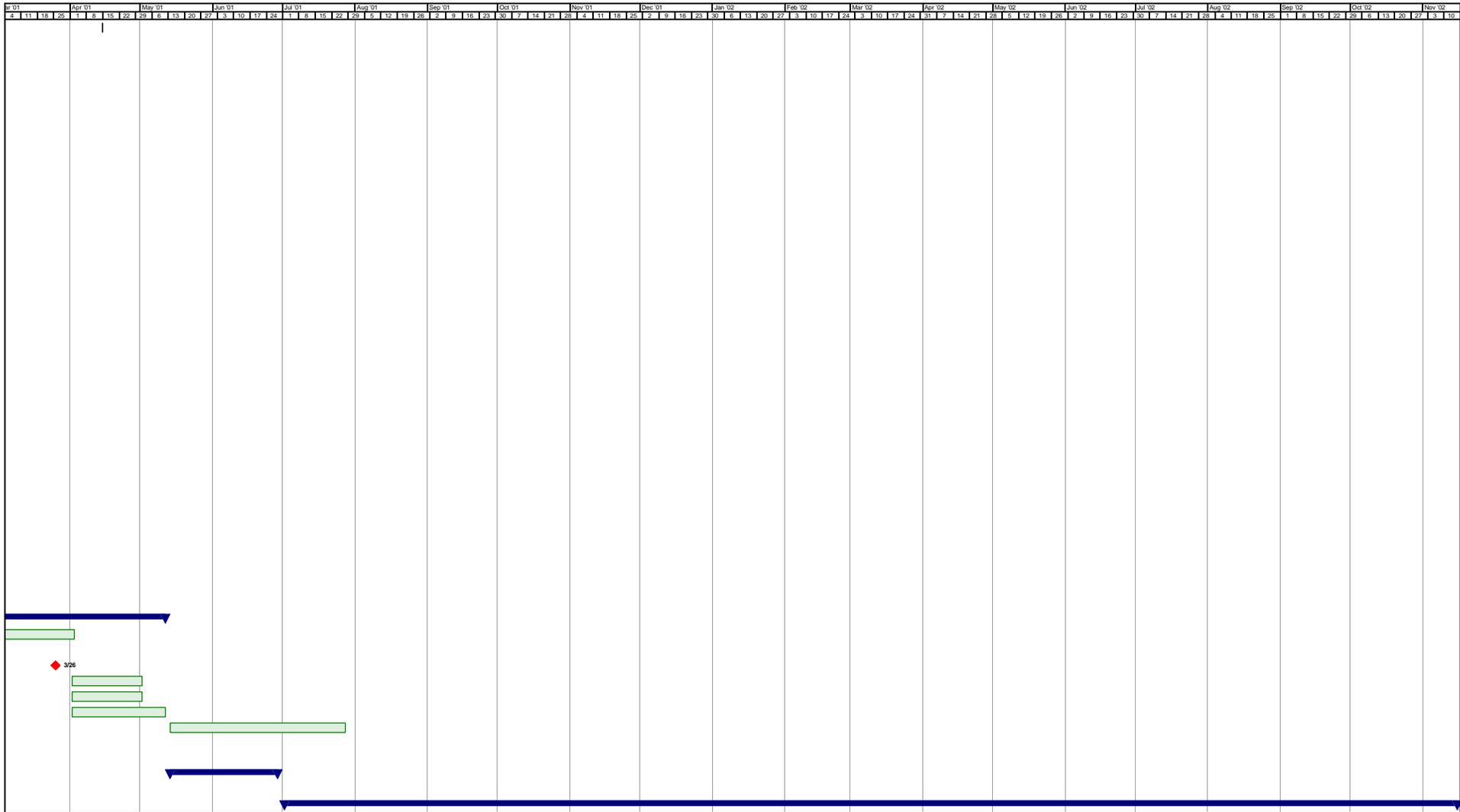
### **III. FINANCIAL CONSIDERATIONS**

Once the design process slows and stops and the project completion date erodes, a cost escalation of approximately \$80,000 per month will accrue. If construction contracts are not in place by June 2001, and no extension has been granted by the California Transportation Commission, up to \$6 million in SB 45 funds will be lost to the project.

### **IV. ATTACHMENTS**

**Attachment A:** Project Schedule





# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

**DATE:** February 11, 2000

**TO:** Board of Directors

**FROM:** Les White, General Manager  
Mark Dorfman, Assistant General Manager

**SUBJECT: PRESENTATION AND DISCUSSION OF CHOICE OF FUEL SYSTEM**

## **I. SUMMARY OF ISSUES**

- The District currently primarily operates a diesel powered bus fleet.
- In 1993 the District undertook an Alternative Fuel Study.
- One of the recommendations made when the Board adopted the Study was to reconsider the use of Alternative Fuels when a new facility was being designed and it was economically and technologically feasible.
- With the hiring of Waterleaf Architecture and Interiors to design MetroBase, the timing is appropriate to examine this issue.
- The State of California Air Resources Board has proposed strict regulations which would have a long-term requirement for zero or near-zero bus emissions in California.
- There are different alternatives to diesel fuel that are available or are being developed.
- There are no clear views as to the operating costs of CNG versus Diesel.
- Should the Board wish to change to CNG, a strategy to move to CNG will need to be developed.

## **II. DISCUSSION**

Diesel is the primary fuel source for the District's fleet of buses. The only exception to this is the four (4) smaller Champion buses out of a fleet total of 110 buses. The District in 1993 contracted with the firm of Booz-Allen & Hamilton, Inc. to conduct an investigation of alternative fuels. At that time the results of the study were that the District was not in a position to move to alternative fuels. This was primarily due to the fact that the District did not have a fuel site for diesel fuel, the operating budget was under tight constraints, and the cost for the capital was not available. When the Board of Directors adopted the report, the Board added a recommendation to reconsider the use of alternative fuels when a new facility was being designed and it was economically and technologically feasible.

In November of 1999 the District hired the firm of Waterleaf Architecture and Interiors to design the new MetroBase Project. As we proceed through the initial design process, one of the basic

questions that needs answering is the choice of fuel system for the facility. Should a decision be made to pursue a CNG option, there are required changes that must be made to the facility to be compatible with CNG. In addition the fueling system is different for CNG. In order to give the design firm direction on this issue a policy decision needs to be made by the Board of Directors.

As a backdrop for the decision, the California Air Resources Board has proposed strict regulations which would have a long-term requirement for zero or near-zero bus emissions in California. The ARB proposal is structured to encourage transit agencies to voluntarily purchase cleaner alternative-fuel buses in order to reduce emissions of NO<sub>x</sub> and PM. The proposed rule allows transit agencies to choose between two compliance paths, either the diesel path or the alternative-fuel path. The alternative-fuel path provides immediate NO<sub>x</sub> and PM emissions benefits, although the two paths have been structured to provide approximately equivalent NO<sub>x</sub> emissions over the lifetime of the requirements. The alternative-fuel path will provide greater PM emission benefits due to inherently low in-use PM emissions from alternative-fuel buses. Transit agencies on the diesel path would be responsible for being the first to implement higher cost low-emission and zero-emission buses.

Attached to this staff report are copies of the California Air Resources Board Staff Report: Initial Statement of Reasons (Attachment A) and the California Air Resources Board Proposal for Cleaner Transit Buses (Attachment B).

The California Air Resources Board in August of 1998 identified Particulate Matter (PM) from diesel-fueled engines as a toxic air contaminant (Attachment L). As a result of this determination the above rules were promulgated.

There are multiple sides to this issue, as the technology is still evolving. To provide some balance, staff has enclosed a copy of a report done by the Harvard Center for Risk Analysis entitled "Fueling Heavy Duty Trucks: Diesel or Natural Gas?" (Attachment C). This report finds that the choice is not straight forward as there are policy trade-offs between the different fuel types.

Additionally, results on the operating costs for CNG are mixed. Attachment E and F are provided from Sacramento Regional Transit in which they indicate a very successful CNG program. They indicate that they are experiencing a maintenance cost per mile of \$0.650 per mile for their diesel fleet and \$0.548 for their CNG Fleet. There are also transit systems that have experienced problems on conversion to CNG. One of the main variables would appear to be the commitment made at the time of the change. The entire transit system would have to be convinced of the change and fully embrace it for it to succeed. There would need to be an extensive training program for all employees. Normally this type of decision has two components, capital costs and operating costs. The capital side of the equation involves buses and facility costs. Normally facility costs involve expensive retrofits in order to be able to utilize CNG. In the District's situation with a facility project being designed, this is the appropriate time to make this decision.

On the bus capital side, each bus costs approximately \$50,000 above a traditional diesel bus. Possibly, over time this cost will come down. The District currently has funding in place for the purchase of 24 diesel powered buses. No action on the procurement has been made as there has been discussion on the low-floor vs. high-floor issue, and whether to pursue an articulated bus strategy (60-foot size). Ten of the buses were to be articulated. With the question of fuel system, one additional variable is up for consideration. If a CNG strategy was decided upon, and we were to standardize on 40-foot buses, we could still purchase approximately 23 CNG buses. They could be bid now, to keep the costs as low as possible, and we could schedule a delivery time to coincide with the opening of MetroBase, so that there we would have fueling capacity. This would mean that these 23 buses and all future bus purchases would be CNG. Other than the 30 1998 New Flyer low-floor buses and the ten Gillig buses being rehabilitated, we would have a CNG fleet. As these diesels would have engine replacement needs over this timeframe, the District could commit to rebuild the engines with the lowest emitting diesels available at the time the work is done. Also, the District could commit to low-sulfur fuel at MetroBase when it is available to further reduce emissions. A further action the District could take is that no actions would be taken to extend the life of these vehicles beyond their useful life, 12 years for the New Flyers and 7 Years for the Gilligs. This would mean a CNG only fleet by 2010.

There are other possible actions that could be taken to accelerate this schedule such as the early retirement of the remaining diesel buses. Unless another agency could be located to assume the buses, there would be a reimbursement required to the federal government to cover the remaining life of the vehicles. Also, as the financial projections will show later in the Workshop, there are no funds currently available for an accelerated purchase plan.

Some of the issues related to the use of CNG as a fuel choice include:

- Higher vehicle weight due to fuel tanks:
  1. Shorter brake life
  2. Shorter suspension life
  3. Shorter tire life
  4. Vehicle stability
- New training requirements for service and repair personnel
- High pressure equipment, up to 5,000 psi compression equipment, 3,600 psi tank, line, and fitting pressures
- Unknown long term health effects from emissions of CNG-fueled vehicles
- Higher explosion and fire hazard
- Shorter operating range due to fuel capacity

Diesel fuel, under the new regulations will also have some issues, such as:

- Increased cost of low-sulfur fuel
- Increased costs for aftertreatment technology
- Cost of retrofits for compliance with new regulations
- Cost of implementing zero-emission vehicles sooner

CNG is not the only choice of alternative fuel available. Liquefied Natural Gas (LNG) is another choice that could be made. Hybrid-Electric vehicles are starting to be produced in limited quantities, both CNG-Electric and Diesel-Electric. On the longer term horizon, the Hydrogen Fuel Cell appears to be the best solution but there are only demonstration buses available at this time. Attached to this report is a series of information regarding some of the alternatives. Also included is a letter the District received regarding Vegetable Oil and a response by the then Manager of Fleet Maintenance regarding the use of Biodiesel as a fuel.

Lastly, staff has included some information from the Monterey Bay Unified Air Pollution Control District .

### **III. FINANCIAL CONSIDERATIONS**

Should a decision be made to pursue a CNG Fuel strategy, each transit bus would cost about \$50,000 addition over diesel, and the implication to the MetroBase Project would be over \$2.0 million dollars, which is provided for in the current project budget..

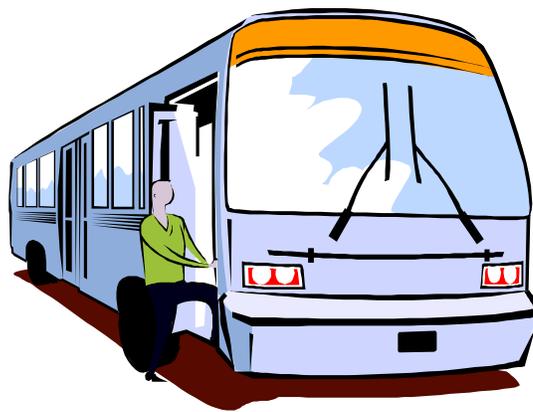
### **IV. ATTACHMENTS**

- Attachment A:** California Air Resources Board Staff Report: Initial Statement of Reasons
- Attachment B:** California Air Resources Board Proposal for Cleaner Transit Buses
- Attachment C:** Proposed Urban Transit Bus Fleet Rule Requirements and Emission Standards
- Attachment D:** Fueling Heavy Duty Trucks: Diesel or Natural Gas?
- Attachment E:** Sacramento Regional Transit Bus Maintenance Department Monthly Status Report
- Attachment F:** Sacramento CNG Brochure
- Attachment G:** California Fuel Cell Partnership
- Attachment H:** Hybrid Buses Equipped with Electrosorce Batteries Complete Year-Long Revenue Service-Test in New York City
- Attachment I:** MTA New York City Transit to Demonstrate Johnson Matthey CRT Particulate Filter for Lowest Possible Emissions from Diesel Buses
- Attachment J:** July 14, 1999 Letter from Bob DeBolt on Vegetable Oil
- Attachment K:** July 26, 1999 Memorandum from Hayward Seymore, Manager of Fleet Maintenance on Biodiesel
- Attachment L:** Monterey Bay Unified Air Pollution Control District – Emissions from Diesel Exhaust
- Attachment M:** Monterey Bay Unified Air Pollution Control District – Bus Emissions in Urban Transit Service

**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY**  
**AIR RESOURCES BOARD**

**STAFF REPORT: INITIAL STATEMENT OF REASONS**

**PROPOSED REGULATION FOR A PUBLIC TRANSIT BUS FLEET RULE AND  
EMISSION STANDARDS FOR NEW URBAN BUSES**



This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Date of Release: December 10, 1999  
Scheduled for Consideration: January 27, 2000

## TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	1
I. INTRODUCTION.....	5
II. BACKGROUND.....	6
A. California’s Air Quality Status.....	6
B. Urban Buses and Emission Standards.....	6
C. Federal Urban Bus Retrofit/Rebuild Program.....	8
D. Regulatory Focus on Urban Buses.....	9
E. Definitions.....	10
III. NEED FOR CONTROL.....	11
A. Ozone.....	11
B. Particulate Matter.....	12
IV. SUMMARY OF PROPOSED REGULATIONS.....	12
A. Applicability.....	13
B. Emission Standards.....	13
C. Transit Bus Fleet Rule.....	16
V. TECHNOLOGICAL FEASIBILITY.....	24
A. Currently-Available Technology.....	24
B. Retrofit Technology.....	27
C. New Technology.....	28
VI. ISSUES.....	32
A. Compressed Natural Gas Urban Bus Fleets.....	32
B. Funding Sources.....	33
C. School Buses.....	34
D. Long-Term Viability of Natural Gas Fleets.....	35
E. Natural Gas Availability.....	35
F. Safety Issues.....	35
G. Ridership Issues.....	36
H. Statement of Principles.....	36
I. Settlement Agreements.....	36
J. Buses Designated as Alternative-Fuel Buses.....	37
K. Zero-emission Bus Demonstration Projects.....	37
L. Composite Buses.....	38
VII. REGULATORY ALTERNATIVES.....	38
A. Do Not Adopt Transit Bus Fleet Rule and Amend California Urban Bus Standards.....	38

B.	Adopt Low-Emission Standards Requiring Alternative-Fuel Use.....	38
C.	Adopt A Fleet Average Rule.....	39
D.	Adopt Public Workshop Proposal Dated September 23, 1999.....	39
VIII.	ECONOMIC IMPACTS.....	40
A.	Legal Requirement.....	40
B.	Affected Businesses.....	40
C.	Potential Impacts on Business.....	40
D.	Potential Impact on Business Competitiveness.....	41
E.	Potential Impact on Employment.....	41
F.	Potential Impact on Business Creation, Elimination, or Expansion.....	41
G.	Potential Costs to Local and State Agencies.....	41
IX.	ENVIRONMENTAL IMPACTS.....	45
X.	COST-EFFECTIVENESS.....	47
XI.	SUMMARY AND STAFF RECOMMENDATION.....	48
A.	Summary of Staff's Proposal.....	48
B.	Staff Recommendation.....	49
XII.	References.....	50

APPENDIX A:       REGULATION

## TABLES

Table 1	California and Federal Urban Bus Engine NOx Emission Standards.....	7
Table 2	California and Federal Urban Bus Engine PM Emission Standards.....	8
Table 3	Proposed Emission Standards for 2007 and Subsequent Model Year Urban Bus Engines.....	14
Table 4	Proposed Emission Standards for 2004-2006 Model Year Diesel or Dual-Fuel Urban Bus Engines.....	15
Table 5	Existing California Required and Optional, Reduced-Emission Standards.....	15
Table 6	Proposed Emission Standards for Urban Buses.....	16
Table 7	Comparison of Fleet Rule Requirements .....	21
Table 8	Proposed Fleet Rule Reporting Requirements .....	22
Table 9	1999 Model Year Urban Bus Engines Certified to ARB's Optional, Reduced-Emission NOx Standards.....	26
Table 10	Funding Scenario for Alternative-fuel Buses and Infrastructure.....	34
Table 11	Average Annual Cost of PM Retrofit Requirements.....	43
Table 12	Estimated Incremental Costs to Transit Agencies Of New Buses.....	44
Table 13	Emission Benefits of Proposed Regulation.....	47
Table 14	Estimated Cost-Effectiveness of Proposed Regulation .....	48

## EXECUTIVE SUMMARY

The Air Resources Board's (ARB) major goal is to provide clean, healthful air to all the citizens of California. The staff's proposal for clean public transportation is an important step in achieving this goal. Public transportation provides important societal benefits. It provides access to work and education, reduces congestion, and meets the mobility needs of the public, including the elderly and disabled. It also has the potential to positively impact air quality. To do so, however, transit agencies must use the lowest-emission technology available to reduce ozone-forming emissions and reduce the public's exposure to cancer-causing pollutants, such as diesel particulate matter (PM). The ARB identified PM from diesel-fueled engines as a toxic air contaminant in August 1998. Current diesel urban buses usually emit more emissions of oxides of nitrogen (NOx) and PM than if all bus riders were driving separately. However, significant improvements in heavy-duty vehicle technology can result in clean public transportation and help reduce the public's exposure to harmful PM emissions. By taking advantage of engine improvements and new aftertreatment technologies, transit agencies and the ARB can be partners in achieving new air quality benefits from public transportation.

In September 1998, the ARB adopted Resolution 98-49 to encourage public agencies to purchase cleaner, alternative-fuel buses to reduce emissions and decrease the public's exposure to toxic air contaminants. Compared to conventional diesel technology, natural gas technology has already shown in-use emission reductions in the range of 50 percent for NOx and 90 percent for PM. Further advances in alternative-fuel technology, including hybrid-electric, battery-electric, and fuel cell technology, will provide even more opportunities for emission reductions from urban transit buses. Many transit agencies have been active in implementing the goals set forth in the resolution; others have not. As a result, additional strategies, in the form of this regulatory proposal, are necessary to achieve emission reductions from urban buses.

### Summary of Proposal

This regulatory proposal contains two elements to reduce emissions from urban buses: 1) a multi-component transit bus fleet rule applicable to transit agencies; and 2) more stringent emission standards for engines used in urban buses, applicable to engine manufacturers. The fleet rule is designed to achieve nearer-term emission benefits while the engine standards are designed to achieve long-term emission benefits resulting from new bus engines with ultra-low, near-zero, and zero-emissions.

The staff's proposal is structured to encourage transit agencies to voluntarily purchase cleaner alternative-fuel buses in order to reduce emissions of NOx and PM. To provide transit agencies with flexibility in determining their optimal fleet mix, the proposed rule allows transit agencies to choose between two compliance paths, either the diesel path or the alternative-fuel path.

The two-path system provides flexibility to transit agencies in making independent decisions for their region, while ensuring that maximum emission benefits are achieved. The alternative-fuel path provides immediate NOx and PM emissions benefits, although the two paths have been structured to provide approximately equivalent NOx emissions

over the lifetime of the requirements. The alternative-fuel path will provide greater PM emission benefits due to inherently low in-use PM emissions from alternative-fuel buses. Transit agencies on the diesel path would be responsible for being the first to implement low-emission and zero-emission buses.

Within the two paths, the staff is proposing a comprehensive transit bus program that encompasses a combination of different requirements. In total, these requirements will ensure low-emission public transportation within California. These requirements include: 1) an in-use NO<sub>x</sub> fleet average requirement that will encourage the retirement of the oldest, dirtiest diesel buses (1987 and earlier model year urban buses); 2) a PM retrofit requirement, with an emphasis on the dirtiest buses, to reduce public exposure to toxic diesel PM emissions; 3) a low-sulfur diesel fuel requirement; 4) low-emission bus purchase requirements, based on new urban bus emission standards; 5) a zero-emission bus demonstration project; and 6) zero-emission bus purchase requirements. A brief summary of each of these proposed requirements is presented below.

#### In-use NO<sub>x</sub> fleet average

In order to reduce NO<sub>x</sub> emissions from the in-use urban bus fleet, the ARB staff proposes that transit agencies on both the diesel and alternative-fuel paths must meet and maintain a minimum fleet average NO<sub>x</sub> standard of 4.8 grams per brake horsepower-hour (g/bhp-hr) by October 2002.

#### PM Retrofit Requirements

The PM retrofit requirements, applicable to transit agencies on both the diesel and alternative-fuel path, are intended to reduce PM emissions from existing diesel buses and those model year buses up to the year 2004. The ARB staff's proposal provides for a phase-in of the requirements from 2003 through 2009, with an emphasis on requiring retrofits for the oldest, dirtiest diesel buses first.

#### Low-sulfur Diesel Fuel Requirement

Low-sulfur diesel fuel is necessary for most aftertreatment technologies to function more efficiently and reliably. Therefore, the ARB staff's proposal includes requirements for transit agencies to purchase low-sulfur diesel fuel with a cap of 15 parts per million (ppm) sulfur beginning July 1, 2002. This requirement is timed to coincide with the PM retrofit requirements.

#### Low-emission Bus Purchase Requirements

The ARB staff's proposal includes new emission standards for NO<sub>x</sub>, PM, non-methane hydrocarbons, carbon monoxide, and formaldehyde for 2004 and subsequent model year diesel and dual-fuel urban bus engines, and for 2007 and subsequent model year urban bus engines, regardless of fuel type. Under the proposed transit fleet rule, the 2004 model year requirements for transit agencies purchasing diesel and dual-fuel engines include a 0.5 g/bhp-hr NO<sub>x</sub> standard and 0.01 g/bhp-hr PM standard. These levels represent approximately a 75 percent NO<sub>x</sub> reduction and an 80 percent PM

reduction from existing standards. The 2007 model year standards for all new bus purchases include a 0.2 g/bhp-hr NOx standard and a 0.01 g/bhp-hr PM standard, representing an additional 60 percent NOx reduction.

### Zero-emission Bus Demonstration Project

The ARB staff's proposal requires large transit agencies (an active fleet of more than 200 urban buses) on the diesel path to participate in zero-emission bus demonstration projects beginning in July 2003. At that time, each participating agency would be required to place at least three urban buses producing zero exhaust emissions in revenue service. Bus technologies qualifying as zero-emission include battery-electric buses, electric trolley buses, and fuel cell buses.

### Zero-emission Bus Purchase Requirements

The ARB staff's proposal also includes zero-emission bus purchase requirements for large transit agencies on both the diesel and alternative-fuel paths. For large transit agencies on the diesel path, a minimum 15 percent of all new urban bus purchases must be zero-emission buses beginning in 2008. For large transit agencies on the alternative-fuel path, the same purchase requirement applies beginning in 2010.

### **Environmental Impacts**

The ARB staff estimates that the proposed fleet average NOx requirement will reduce NOx emissions statewide by about 2 tons per day (tpd) in 2002. Although the staff's proposal ensures this reduction, it will mostly occur as a result of normal fleet turnover. Therefore, the staff does not assume any NOx benefit (or cost) due to the fleet average requirement. For the PM retrofit requirements, the ARB staff estimates that PM emissions will be reduced statewide by about 300 pounds per day (lbs/day) in 2005 and by about 100 lbs/day in 2010. The ARB staff estimates that the proposed low-emission bus purchase requirements, based on the new urban bus engine standards, together with the zero-emission bus purchase requirements, will reduce NOx emissions statewide in 2010 by about 5 tpd and PM emissions by about 50 lbs/day. In 2020, these emission reductions will increase to about 7 tpd of NOx and about 67 lbs/day of PM. All of these emission reduction estimates are based on the emission inventory model EMFAC 2000, which has not yet been adopted by the Board.

The estimated cost-effectiveness of the proposed low-emission bus purchase requirements, based on the new urban bus engine standards, together with the zero-emission bus purchase requirements, is \$1.80 per pound of NOx reduced in 2010. In 2020, the cost-effectiveness is \$1.50 per pound of NOx reduced. This cost-effectiveness compares favorably with that of other mobile source and motor vehicle fuel regulations adopted over the past decade.

The estimated cost-effectiveness of the proposed PM retrofit requirements is \$17.90 per pound of PM reduced annually from 2003 to 2009. This includes the costs associated with the requirement to purchase low-sulfur diesel fuel. The PM retrofit requirement

cost-effectiveness does not include the value of health benefits associated with a reduction in exposure to a toxic air contaminant.

### **Recommendations**

The ARB staff recommends that the Board adopt this regulatory proposal. It will provide for significant reductions of NO<sub>x</sub> and toxic PM emissions, especially in highly-populated urban environments. This proposal will ensure that the emissions of both new and in-use urban transit buses are significantly reduced while protecting the viability of transit operations.

## I. INTRODUCTION

Despite significant improvements in California's air quality over the last thirty years, there is still more work to do to achieve our air quality goals and provide healthful air for all Californians. California currently has eight major areas that are not in attainment with the one-hour federal ambient ozone standard. These areas are: the South Coast Air Basin, the Sacramento Metropolitan area, San Diego Air Basin, San Joaquin Valley Air Basin, Southeast Desert Air Basin, the San Francisco Bay Area, Santa Barbara County, and Ventura County. In addition, four of the six serious national nonattainment areas for particulate matter (PM) are located in California.

Mobile source controls are vital to the attainment of air quality standards. Mobile sources account for about 60 percent of ozone precursors and about 40 percent of combustion particulate emissions, statewide. Of the combustion particulate emissions, mobile source diesel engines account for about 30 percent. The Air Resources Board (ARB) identified particulate emissions from diesel exhaust as a toxic air contaminant in August 1998. Thus the control of particulate matter from diesel-fueled engines is critical.

The ARB's major goal is to provide clean, healthful air to all the citizens of California. The staff's proposal for clean public transportation is an important step in achieving this goal. Public transportation in California provides significant societal benefits. It provides mobility for those without cars, and reduces congestion when those with cars ride the bus. It also has the potential to positively impact air quality. Although current diesel urban buses usually emit more emissions of oxides of nitrogen (NOx) and PM than if all bus riders were driving separately, significant improvements in bus engine technology can result in clean public transportation and help reduce public exposure to harmful emissions. By taking advantage of these engine improvements, transit agencies and ARB can be partners in achieving new air quality benefits from congestion relief.

This proposal contains two components to reduce emissions from urban buses: 1) a fleet rule applicable to transit agencies; and 2) more stringent emission standards for engines used in urban buses, applicable to engine manufacturers. The fleet rule is designed to achieve nearer-term emission reductions, either through low-emission new bus purchases or through retrofitting or repowering older, higher-emitting urban bus engines to lower-emitting configurations. The engine standards are designed to achieve long-term emission benefits resulting from new bus engines with ultra-low, near-zero, and zero-emissions.

In September 1998, the ARB adopted Resolution 98-49 encouraging public agencies to purchase low-emission, alternative-fuel urban buses and school buses to achieve emission reductions and reduce the public's exposure risk to toxic air contaminants. While diesel engine technology may meet the staff's proposed engine standards in the future, this regulatory proposal is designed to increase low-emission, alternative-fuel engine use, including advanced battery and fuel cell technology use. Low-emission, alternative-fuel technology is already available today to achieve significant emission reductions. The ARB staff has identified at least 18 transit agencies throughout

California that are already using or have committed to purchasing significant numbers of low-emission, alternative-fuel urban buses. Other transit agencies are also purchasing smaller numbers of low-emission, alternative-fuel urban buses. Further improvements in low-emission, alternative-fuel technology, including advances in battery and fuel cell technology, will ensure its place as a key component in California's long-term clean air strategy.

## **II. BACKGROUND**

This chapter provides a brief overview of California's current air quality status; urban buses and applicable emission standards; and defines key terms used throughout the report. California is the only state that has the authority to establish motor vehicle emission standards different from federal standards. California's standards must be equivalent to or more stringent than the federal standards.

### **A. California's Air Quality Status**

Over the past three decades, there has been dramatic progress toward cleaner air in California, largely as a result of California's leadership in developing unique pollution control programs to reduce emissions from both vehicular and non-vehicular sources. For example, the peak one-hour ozone concentrations in southern California, the area in California with the most serious air quality problems, were as high as 0.65 parts per million during the 1960s. Peak ozone concentrations in southern California today are about one-third of the values in the 1960s, despite significant increases in population and the number of motor vehicles. In addition, the number of days exceeding both the federal and state one-hour ambient ozone standards has steadily declined. Since 1980, the number of days exceeding the federal and state standards has decreased by about 60 percent and 50 percent, respectively.

Despite this progress, including significant improvements resulting from the implementation of every feasible measure in the 1994 State Implementation Plan for Ozone, many areas of the state still fail to meet federal and state health-based air quality standards. This proposal is but one of several necessary measures to further California's progress in meeting its clean air challenges. Other measures to be considered in the near future include enhanced vapor recovery, more stringent emission standards for medium and heavy-duty gasoline vehicles, additional reductions from consumer products, and a suggested control measure for architectural coatings.

### **B. Urban Buses and Emission Standards**

In general, urban buses operate in heavily populated areas with a typical route consisting of stops and starts as passengers are routinely picked up and delivered to their destinations. Urban buses are typically 40 feet long, although they do vary in length; are normally powered by a heavy-duty diesel engine; and fall within the heavy-duty vehicle classification of greater than 33,000 pounds gross vehicle weight (GVW). These buses are owned (or leased) by public transit agencies that receive federal, state, and local funds to subsidize new bus purchases and to operate and maintain their bus fleets and facilities. The ARB staff estimates that there about 8,500

full-size transit buses operating in California. Of these, approximately 80 percent are operated by 16 large-sized transit fleets with more than 100 buses in their fleet. The remaining buses are spread among more than 60 other transit agencies operating throughout California.

Urban buses have relatively high emissions (on a per vehicle basis) of NOx and PM. Based on the emission inventory model EMFAC 2000, which has not yet been adopted by the Board, urban buses will emit approximately 24 tons per day of NOx, and 1,000 pounds per day of PM in the year 2000. NOx is critical because it is one of the two major components in ozone formation. Particulates are critical because of their adverse effect on respiratory health and because they are a significant toxic air contaminant. Diesel engines have relatively low emissions of carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), and hydrocarbons (HC). CO emissions create “hot spots” that affect public health, although nearly all areas of California are in attainment for CO. CO<sub>2</sub> is a greenhouse gas that contributes to global warming. Emissions of HC are important because in combination with NOx emissions, they create ozone.

In contrast, a natural gas bus engine will have significantly lower NOx and PM emissions than a comparable diesel bus engine, but it will likely have higher CO and CO<sub>2</sub> emissions and slightly higher HC emissions. However, the increase in these emissions is small compared to the decrease in NOx and PM emissions.

Tables 1 and 2 below present a recent history of both California and federal NOx and PM emission standards for urban bus engines. The heavy-duty emissions certification cycle is an engine-based test. This engine certification test determines emissions in units of grams per brake horsepower-hour (g/bhp-hr) or, in other words, emissions per unit of work performed.

**TABLE 1**

<b>California and Federal Urban Bus Engine NOx Emission Standards (g/bhp-hr)</b>		
	<b>California</b>	<b>Federal</b>
1988	6.0	10.7
1990	6.0	6.0
1991	5.0	5.0
1996	4.0	5.0
1998	4.0	4.0
October 2002	2.0 <sub>(1)(2)</sub>	2.0 <sub>(1)(2)</sub>

1. Nominal NOx level based on U.S. EPA and ARB emission standards of 2.4 g/bhp-hr NOx plus non-methane hydrocarbons (NMHC) or 2.5 g/bhp-hr NOx plus NMHC with 0.5 g/bhp-hr NMHC cap to take effect in October 2002.
2. For those engines subject to the Settlement Agreements between the heavy-duty engine manufacturers, the U.S. Environmental Protection Agency, and ARB. As part of the Settlement Agreements, the federal and state heavy-duty engine emission standards adopted for 2004 are to take effect in October 2002.

**TABLE 2**

<b>California and Federal Urban Bus Engine PM Emission Standards (g/bhp-hr)</b>		
	<b>California</b>	<b>Federal</b>
1988	0.6	0.6
1991	0.1	0.25
1993	0.1	0.1
1994	0.07	0.07
1996	0.05 <sup>(1)</sup>	0.05 <sup>(1)</sup>
October 2002	0.05	0.05

(1) In-use standard of 0.07 g/bhp-hr.

In addition to the mandatory emission standards shown above, the ARB also has optional, reduced-emission standards, which are integrated into the fleet rule component of the proposed regulation. A table presenting the optional, reduced-emission standards is presented in Chapter IV of this report.

**C. Federal Urban Bus Retrofit/Rebuild Program**

The United States Environmental Protection Agency (U.S. EPA) has adopted requirements for an urban bus retrofit/rebuild program as required by the Clean Air Act Amendments of 1990. The program applies to 1993 and earlier model year urban buses whose engines are rebuilt or replaced after January 1, 1995. The program is limited to urban buses operating in metropolitan areas with 1980 populations of 750,000 more.

The U.S. EPA's rule, which became effective on January 2, 1995, includes two options for reducing PM emissions from in-use urban buses, implicitly based on particulate trap or oxidation catalyst technology. It also includes cost ceilings that limit the cost a transit operator must pay in order to comply with the regulation.

Option 1 requires the transit operator to retrofit each applicable engine to achieve compliance with a PM emission standard of 0.1 g/bhp-hr or less, assuming it can be done for an incremental life-cycle cost maximum of \$7,490 per engine. If no equipment is available that meets these requirements, then each engine must be rebuilt to achieve a 25 percent reduction in PM emissions for an incremental life-cycle cost of \$2,000 or less. If there is no equipment available that meets either of these options, then each engine must be rebuilt to its original new engine configuration or, at the transit operator's choice, to a configuration with PM emissions lower than the original engine configuration. Formulae for calculating the life-cycle costs are included in the U.S. EPA's regulation. New facility costs and incremental fuel costs are included in the incremental cost calculations.

Option 2 is an averaging program set up to yield overall emission reductions equivalent to those expected under Option 1. This option provides a transit operator with enhanced flexibility to reduce PM emissions while minimizing costs. The averaging calculations included in the regulation provide guidance for determining the target level

for an applicable fleet (TLF, the average PM emission value the fleet is expected to meet) and the fleet level attained (FLA, the actual average PM emission value after retrofits have been conducted). The TLF calculation indirectly takes into account the cost limits developed for Option 1.

The ARB staff's proposed regulation also includes retrofit requirements for PM control from the older, in-use diesel urban bus fleet. However, because California required new urban bus engines to meet a 0.10 g/bhp-hr standard in 1991, two years prior to the federal 0.10 b/bhp-hr PM standard went into effect, the federal retrofit requirements only apply to 1990 and earlier urban bus engines in California. While the ARB staff's proposal does include a retrofit requirement for urban bus engines certified to 0.60 g/bhp-hr PM, which are 1990 and earlier model year engines in California, it is expected that the proposed requirement would be met by retiring most of the 0.60 g/bhp-hr PM engines, rather than retrofitting them.

#### **D. Regulatory Focus on Urban Buses**

Diesel urban buses are ideally suited for improved controls due to relatively high NOx and PM emissions (on a per bus basis) and other factors described below. The ARB and the local air pollution control districts and air quality management districts have already adopted control measures for nearly all sources----mobile, stationary, consumer products, and pesticides----to ensure California's continued progress in attaining federal and state air quality standards. However, more work needs to be done to achieve our air quality goals. Therefore, those sectors that still have opportunities for emission reductions, such as the heavy-duty vehicle sector, must be proactive in reducing emissions. This proposal focuses strictly on urban buses. The ARB will consider a separate proposal to reduce emissions from school buses at a later date. In addition, other heavy-duty vehicles will be required to comply with new emission standards in late 2002, and both the ARB and the U.S. EPA will be considering even more stringent emission standards for heavy-duty vehicles for beyond the 2004 time frame.

In September 1998, the ARB adopted Resolution 98-49 to encourage public agencies to purchase cleaner, alternative-fuel buses to reduce emissions and decrease the public's exposure to toxic air contaminants. While the staff recognizes that the primary responsibility of transit agencies is to provide efficient, convenient transportation, we also believe transit agencies, as publicly funded entities, should bear some of the responsibility for providing the people they serve with clean, less polluting transportation. Many transit agencies have been active in implementing the goals set forth in the resolution; others have not. As a result, additional strategies, in the form of this proposal, are necessary to achieve emission reductions from urban buses. In addition to requiring clean, low-emitting and zero-emitting new bus purchases, this proposal relies on retrofit strategies, a NOx fleet average system, and requirements to purchase low-sulfur diesel fuel to achieve emission reductions from the diesel urban bus fleet.

As stated above, diesel urban buses contribute relatively high NOx and PM emissions on a per bus basis. However, there are other contributing factors that make the diesel urban bus sector an ideal candidate for achieving emission reductions. First, many of

these buses operate in the most heavily congested urban areas where air quality is critical and direct exposure to toxic diesel particulates occurs for large numbers of people, thus making toxic particulate emissions an even greater public health concern. Second, they are centrally-fueled with known, fixed-routes, which allows for a cleaner, alternative fuel to be utilized more efficiently. Third, the entire cost of a new bus is not borne by the local transit agency. Transit agencies do not rely entirely on local funding for new bus purchases; the federal government subsidizes 83 percent of the purchase price of a new, low-emission alternative-fuel bus and 80 percent of the purchase price of a new diesel bus (funding issues are discussed in Chapter VI of this report). Finally, cost-effective emission reductions can be immediately achieved as cleaner, alternative-fuel engine technology is already available. Current natural gas bus engines emit about 50 percent less NOx and PM than comparable diesel bus engines based on engine certification levels. For PM, in-use test data also show that PM emissions from diesel buses are significantly higher than PM emissions from natural gas buses.

## **E. Definitions**

Urban Bus - Current California regulations, by reference to the Code of Federal Regulations (CFR), Section 86.091-2, define an urban bus as a heavy heavy-duty diesel-powered passenger-carrying vehicle (+33,000 pounds GVW) with a load capacity of fifteen or more passengers intended primarily for intra-city operation, i.e., within the confines of a city or greater metropolitan area. Urban bus operation is characterized by short rides and frequent stops. To facilitate this type of operation, more than one set of quick-operating entrance and exit doors are normally present. Since fares are usually paid in cash or tokens, rather than purchased in advance in the form of tickets, urban buses normally have equipment installed for collection of fares. Urban buses are also typically characterized by the absence of equipment and facilities for long distance travel, e.g., rest rooms, large luggage compartments, and facilities for stowing carry-on luggage.

(Note: A diesel-powered urban bus refers to a bus powered by a diesel-cycle engine, which includes alternative-fuel engines such as natural gas, propane, and methanol.)

Zero-emission Bus (ZEB) - "Zero-emission bus" means an urban bus, certified by the ARB Executive Officer, that produces zero exhaust emissions of any criteria pollutant (or ozone precursor pollutant) under any and all possible operational modes and conditions. The following provisions are applicable in defining a zero-emission bus:

- (a) A hydrogen fuel cell bus shall qualify as a zero-emission bus.
- (b) An electric trolley bus with overhead twin-wire power supply shall qualify as a zero-emission bus.
- (c) A battery-electric bus shall qualify as a zero-emission bus.
- (d) The incorporation of a fuel-fired heater shall not preclude an urban bus from being certified as a zero-emission bus provided that the fuel-fired heater cannot be operated at ambient temperatures above 40°F, and that

the heater has zero evaporative emissions under any and all possible operational modes and conditions.

Alternative-fuel - “Alternative-fuel “ means compressed and liquefied natural gas, propane, methanol, electricity, fuel cells, or other advanced technologies that do not rely on diesel fuel. For the purpose of this regulatory proposal, hybrid-electric and dual-fuel technologies that use diesel fuel are not considered alternative-fuel technologies.

Fleet Size - “Fleet size” means the total active fleet of urban buses, including spare buses, but not contingency vehicles (e.g., for emergencies) or non-revenue producing vehicles. This definition is consistent with that used by the Federal Transit Administration.

Transit Agency – “Transit agency” means a public entity responsible for administering and managing transit activities and services. Public transit agencies can directly operate transit service or contract out for all or part of the total transit service provided. This definition is consistent with that used by the Federal Transit Administration.

### **III. NEED FOR CONTROL**

The proposed emission standards for urban bus engines and the proposed fleet rule represent an important step in further reducing the human health and environmental impacts of ground-level ozone and the toxic impacts of PM emissions from diesel-fueled engines. This chapter summarizes the air quality rationale for the staff’s proposal.

#### **A. Ozone**

California has a serious, statewide ozone air pollution problem, which until very recently, included the worst air quality in the nation in the South Coast Air Basin (Houston, Texas recently acquired the distinction of having the worst air quality in the nation). Ozone, created by the photochemical reaction of NO<sub>x</sub> and HC, causes harmful health effects ranging from eye irritation, sore throats and coughing, to lung damage, cancer, and premature death. People with compromised respiratory systems and children are the most severely affected; however, even healthy children and adults who play or exercise outdoors are also at risk. Beyond their human health effects, other negative environmental effects are also associated with ozone and NO<sub>x</sub>. Ozone has been shown to injure plants and materials; NO<sub>x</sub> contributes to the secondary formation of PM (nitrates), and acid deposition.

California has made significant progress in controlling ozone. Statewide exposure to unhealthy ozone concentrations has been cut in half since 1980. The frequency and severity of pollution episodes is declining, and emissions are on a downward trend. However, as stated earlier, more needs to be done. California still has eight major areas that are designated as nonattainment with the one-hour federal ambient ozone standard. These are: the South Coast Air Basin (Los Angeles, San Bernardino, Riverside, and Orange counties), the Sacramento Metropolitan Area, San Diego Air Basin, San Joaquin Valley Air Basin, Southeast Desert Air Basin, the San Francisco

Bay Area, Santa Barbara County, and Ventura County. In addition, many more areas of the state violate our more stringent state ambient air quality standard for ozone.

The staff estimates that this proposal, once adopted, will reduce NOx emissions statewide by about seven tons per day (tpd) in 2020.

## **B. Particulate Matter**

In addition to California's serious ozone challenges, many areas of California violate the federal and state PM emission standards. This proposal, when adopted, will provide dual PM emission benefits: 1) it will help in the effort to attain the federal and state PM standards throughout California; and 2) it will reduce the public's direct exposure to toxic particulate emissions.

Particulate matter, like ozone, has been linked to a range of serious health problems. Particles are deposited deep in the lungs and can result in increased hospital admissions and emergency room visits; increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; alterations in lung tissue and respiratory tract defense mechanisms; and premature death.

In August 1998, the ARB identified particulate emissions from diesel-fueled engines as a toxic air contaminant, one that causes cancer. Preliminary estimates indicate that the particulate emissions from diesel-fueled engines are by far the most significant toxic risk faced by the citizens of California. Diesel buses operating in heavily congested urban areas cause direct exposure for the public to toxic diesel particulates. It is the ARB's goal to protect public health by reducing exposure to diesel particulate emissions.

This proposal, once adopted, will reduce PM emissions from urban buses by requiring new buses to meet more stringent PM standards and by requiring retrofits to reduce PM from certain portions of the older, diesel urban bus fleet. The staff estimates the PM reduction in 2005 as a result of the PM retrofit requirements is 300 pounds per day statewide. As a result of the proposed new emission standards, staff estimates the PM reduction will be 67 pounds per day in 2020 statewide.

## **IV. SUMMARY OF THE PROPOSED REGULATIONS**

The staff recommends that the Board adopt sections 1956.1, 1956.2, 1956.3 and 1956.4, and amend section 1956.8, Title 13, California Code of Regulations, and the incorporated "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Year Heavy-duty Engines and Vehicles," as set forth in Appendix A. All the provisions in the proposed regulation apply to engines and vehicles produced for sale in California. There are two components to this proposal: 1) a transit bus fleet rule applicable to transit agencies; and 2) more stringent emission standards for new urban bus engines applicable to urban bus engine manufacturers. The transit bus rule would require fleet operators to choose between operating a diesel bus fleet (the diesel path) or an alternative-fuel bus fleet (the alternative-fuel path). The fleet rule contains different requirements for each path. For both paths, there is a requirement to achieve reductions from the older in-use fleet through a minimum NOx fleet average system and

through requirements for retrofits for PM control. The alternative-fuel path achieves equivalent NOx reductions and greater PM reductions than the diesel path due to inherently low in-use PM emissions from alternative-fuel buses. PM emissions from alternative-fuel buses are on the order of 20 to 100 times lower than diesel buses. The fleet rule also contains requirements for larger fleets on the diesel path to undertake a zero-emission bus demonstration project, and for larger fleets on both paths to purchase a required percentage of zero-emission buses. The fleet rule would be in effect from the date of adoption of this regulation in 2000 through 2015. The proposed emission standards are applicable to urban bus engine manufacturers and begin in model year 2004 for diesel and dual-fuel urban bus engines and in the model year 2007 for all urban bus engines. The following sections discuss the major provisions of the proposed regulation in detail.

## **A. Applicability**

The current urban bus definition, as specified in Section 86.094-2 of Subpart N, Part 86, Title 40, CFR, is a passenger-carrying vehicle (+33,000 pound GVW) powered by a heavy heavy-duty diesel-powered engine with a load capacity of fifteen or more passengers and intended primarily for intra-city operation. Equipment on urban buses usually includes quick-opening exit and entrance doors and fare collection equipment. Urban buses are of various lengths, and include articulated buses, but are usually at least 25 feet long.

The proposed regulation does not apply to buses used in shuttle services, airport shuttle services, paratransit services, school transportation services and commuter services unless urban buses are used to provide those services. Buses used to provide long-distance service, that are generally equipped with luggage compartments, rest rooms, and overhead storage, are not included.

Smaller transit buses (14,001 to 33,000 pounds GVW) have historically been regulated as heavy-duty trucks. Both the U.S. EPA and the ARB will be evaluating the need for more stringent standards for heavy-duty trucks, including school buses and smaller transit buses.

The proposed fleet rule applies to those public transit fleets operated by government agencies or operated by private entities under contract to government agencies.

## **B. Emission Standards**

### **1. Advancement of the 2004 Heavy-duty Engine Standards to 2002**

The ARB and the U.S. EPA have already adopted heavy-duty engine emission standards to take effect in 2004. In addition, as a result of the Heavy-duty Diesel Settlement Agreements between the U.S. EPA, the ARB, and seven engine manufacturers, the engine manufacturers will introduce engines produced for sale in California meeting the 2004 heavy-duty engine emission standards beginning in October 2002. The Settlement Agreements are the result of engine manufacturers using alternative emission control strategies that increased emissions of NOx beyond

what would be expected on the Federal Test Procedure. Similar agreements, referred to collectively as the federal Consent Decree, are applicable to engines produced for sale outside of California. In October 2002, engine manufacturers subject to the Settlement Agreements must certify new urban bus and other heavy-duty engines to either a 2.4 g/bhp-hr NOx + NMHC standard, or a 2.5 g/bhp-hr NOx + NMHC standard with a cap of 0.5 g/bhp-hr of NMHC. The NOx emission level is assumed to be 2.0 g/bhp-hr in California's State Implementation Plan for Ozone and in calculating the ARB's emission inventory. Therefore, in discussing the standards to take effect in October 2002, the term "nominal 2.0 g/bhp-hr NOx" is sometimes used. The Settlement Agreements do not affect PM emission standards.

## 2. Proposed Emission Standards

Under this proposal, engine manufacturers can continue to certify urban bus engines to one of two sets of existing NOx emission standards until 2007: 1) the ARB's mandatory standards (either the current 4.0 g/bhp-hr NOx standard or the NOx + NMHC standard taking effect in October 2002); or 2) the ARB's optional, reduced-emission NOx standards. Currently, there are no heavy-duty diesel engines certified to the ARB's reduced-emission optional NOx standards. However, as discussed in Chapter V, some natural gas engines are certified to the optional standards. All new urban bus engines must currently certify to the 0.05 g/bhp-hr PM standard.

The staff is proposing that the Board adopt new mandatory emission standards for 2007 and subsequent model year urban bus engines for NOx, PM, NMHC, and formaldehyde. Urban bus engines would be required to certify to the standards for each pollutant as shown in Table 3 below. The staff is in the process of developing a certification procedure for zero-emission buses required under the fleet rule.

**TABLE 3**

<b>Proposed Emission Standards for 2007 and Subsequent Model Year Urban Bus Engines (g/bhp-hr)</b>				
<b>NOx</b>	<b>PM</b>	<b>NMHC</b>	<b>Formaldehyde</b>	<b>CO</b>
0.2	0.01	0.05	0.01	5.0

Prior to implementation of the mandatory emission standards proposed for 2007 and subsequent model year urban bus engines, the NOx and PM standards discussed below would apply, based on fleet rule requirements (specific fleet rule requirements are discussed later in this chapter).

### a. Urban Buses on the Diesel Path

For the 2000 to October 2002 model years, diesel engines must be certified to current emission standards. From October 2002 through 2003, diesel engines made by all but one manufacturer subject to the Settlement Agreement must be certified to the existing 2.4/2.5 g/bhp-hr NOx + NMHC standard and the existing PM standard of 0.05 g/bhp-hr.

For 2004 through 2006 model year diesel and dual-fuel engines, the staff proposes that the Board adopt the emission standards shown in Table 4 below.

**TABLE 4**

<b>Proposed Emission Standards for 2004 - 2006 Model Year Diesel or Dual-Fuel Urban Bus Engines (g/bhp-hr)</b>				
<b>NOx</b>	<b>PM</b>	<b>NMHC</b>	<b>Formaldehyde</b>	<b>CO</b>
0.5	0.01	0.05	0.01	5.0

Engine manufacturers can choose to meet these standards with an engine certified at the 2.5 g/bhp-hr standard and an applied aftertreatment system that together demonstrate NOx at 0.5 g/bhp-hr and PM at 0.01 g/bhp-hr. Manufacturers are responsible for full certification of the base engine; durability, testing, in-use compliance, and emissions warranty requirements. For the aftertreatment, the ARB is proposing that manufacturers have reduced certification requirements but full functional warranty requirements.

For 2007 and subsequent model year urban bus engines, the staff proposes that the Board adopt the emission standards shown in Table 6 below. The proposed standards for 2007 and subsequent model year urban bus engines are applicable to diesel and alternative-fuel engines.

b. Urban Buses on the Alternative-Fuel Path

From the adoption of the regulation through the 2015 model year, for transit agencies on the alternative fuel path, at least 85 percent of all new bus purchases must be alternative-fuel bus buses. Although transit agencies are not required to purchase alternative fuel buses that are certified to one of the ARB's existing reduced-emission optional NOx standards (at 2.5 g/bhp-hr NOx or lower), those are the only alternative fuel bus engines currently available. In addition, bus engines certified to an optional NOx standard could qualify for incentive funding. Existing California standards for NOx and NOx plus NMHC, (both required and optional standards) are shown in Table 5. The applicable PM standard from now until October 2002 would be the existing 0.05 g/bhp-hr standard.

**TABLE 5**

<b>Existing California Required and Optional, Reduced-Emission Standards for Urban Buses (g/bhp-hr)</b>			
<b>Model Year</b>	<b>Primary Standard</b>	<b>Optional Standards</b>	<b>Increment</b>
2000 to 10/2002	4.0 (NOx)	2.5 – 0.5	0.5
10/2002 through 2006	2.4 NOx+NMHC or 2.5 NOx+NMHC with 0.5 NMHC cap	1.8-0.3	0.3

For October 2002 through 2006 model years, urban bus engines, in buses purchased by transit agencies on the alternative fuel path, must be certified to either the 2.4/2.5 NOx + NMHC standard that takes effect in October 2002, or to one of the ARB's existing reduced-emission optional NOx + NMHC standards beginning at 1.8 g/bhp-hr. Only those engines certified to one of the ARB's optional, reduced NOx + NMHC standards would generally be eligible to receive incentive money to assist with the incremental purchase price. In either case, the engines must be certified to a new, proposed optional PM standard of 0.03 g/bhp-hr. This proposed new standard, plus the proposed 2004 NOx and PM standards for the diesel path, and the proposed new NOx and PM standards for 2007, applicable to both paths, are summarized in Table 6.

**TABLE 6**  
**Proposed Emission Standards for Urban Buses**  
**(g/bhp-hr)**

Model Year	"Diesel" Path		"Alternative Fuel" Path	
	NOx (g/bhp-hr)	PM (g/bhp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)
2004	0.5	0.01	(1)	0.03
2007	0.2	0.01	0.2	0.01

Dates shown indicate bus model years.

(1) No new standard is proposed for NOx on the alternative fuel path. The existing standard for 2004 is 2.4 g/bhp-hr NOx plus NMHC. Although transit agencies on the alternative-fuel path are not required to purchase engines certified to optional lower-NOx plus NMHC standard (1.8 g/bhp-hr NOx + NMHC or below), the staff expects that they will in order to qualify for incentive funding. At present, the only alternative-fuel engines available are certified to optional, lower-emission NOx standards.

Engines certified to the optional standards may not participate in any averaging, banking or trading program. However, the purchase of the buses with optional lower-NOx engines may be eligible for certain California mobile source emission reduction credit programs, or for low-emission vehicle incentive funding programs

### **C. Transit Bus Fleet Rule**

The ARB staff is proposing specific fleet requirements for transit agencies. First, transit agencies and other bus purchasers (e.g., bus leasing companies) would be required to buy buses that comply with the emission standards shown in Tables 3 and 4 above when making new bus purchases. Second, transit agencies would be required to choose between operating diesel bus fleets or low-emission, alternative-fuel bus fleets. Such a choice would put a transit agency on either the "diesel path" or the "alternative fuel path" of the proposed transit bus fleet rule. The proposed regulation contains different requirements for each path. The alternative fuel path achieves equivalent NOx and greater PM reductions than the diesel path. It would provide transit agencies incentives to continue implementing low-emission, alternative-fuel bus technology, or to start doing so immediately. Provisions of the fleet rule extend from the effective date of the proposed regulation in 2000 through 2015.

For the purpose of the fleet rule, low-emission, alternative-fuel buses are buses powered by natural gas, propane, ethanol, or a combination of those fuels and other

non-diesel fuels, and electricity and fuel cells. Buses powered by diesel fuel or a combination of fuels that includes diesel fuel (such as a diesel hybrid-electric) are not considered low-emission, alternative-fuel buses for the purpose of the proposed regulation.

The diesel and alternative-fuel paths differ primarily with respect to requirements for:

- New bus purchases and leases, emission standards, and fuel type.
- Zero-emission bus demonstration programs.
- Timing of zero-emission bus purchases.

## **1. Requirements for Transit Agencies on the Diesel Path**

### **a. New Bus Purchases and/or Leases**

New diesel urban buses would be required to use diesel engines certified to the applicable existing and proposed NO<sub>x</sub>, PM, NMHC, and formaldehyde emission standards or to the ARB's optional, reduced emission standards discussed in the previous section.

Some transit agencies on the diesel path may also want to purchase low-emission alternative-fuel buses, but not in quantities sufficient to qualify for the alternative-fuel path. Any model year 2004 through 2006 low-emission, alternative-fuel buses purchased by a diesel path transit agency must meet the 2004 proposed emission standards of 0.5 g/bhp-hr NO<sub>x</sub> and 0.01 g/bhp-hr PM. This is to prevent transit agencies on the diesel path from purchasing an alternative-fuel bus with higher NO<sub>x</sub> and PM emissions than a comparable diesel bus meeting the proposed emission standards of 0.5 g/bhp-hr NO<sub>x</sub> and a 0.01 g/bhp-hr PM. Fuel cell buses, electric trolley buses, and battery-electric buses would meet or exceed the proposed 2004 standards. Hybrid-electric buses may also meet these proposed emission standards. The proposed 2007 NO<sub>x</sub> and PM emission standards are applicable to all bus engines, whether diesel or low-emission, alternative-fuel.

### **b. Fleet Averaging for NO<sub>x</sub> Emissions**

The staff proposes that transit agencies meet a minimum active fleet average standard of 4.8 g/bhp-hr NO<sub>x</sub> by October 2002. The fleet average for each transit agency's fleet would be based on the NO<sub>x</sub> engine certification standard (new or repowered engine) for each urban bus, and all heavy-duty zero-emission buses, in the active fleet, whether owned or leased, of all fuel types. To achieve the proposed fleet average 4.8 g/bhp-hr NO<sub>x</sub> standard, transit agencies or their bus leasing companies may have to repower or retire older, high-emitting buses. It is possible to repower existing diesel urban buses with engines certified to 5.0 and 6.0 g/bhp-hr NO<sub>x</sub> standards with new 4.0 g/bhp-hr NO<sub>x</sub> engines. However, staff assumes that all but a few transit agencies on the diesel path would be able to meet and maintain the minimum required fleet average standard through normal bus retirement rates.

The staff also proposes that transit agencies have the option of retiring all 1987 and earlier model year diesel urban buses as a way to comply with the NOx fleet average requirement. This retirement option is intended to provide transit agencies flexibility in achieving fleet turnover, while maintaining the benefits of the NOx fleet average requirement.

### c. PM Retrofit Requirements

The ARB staff proposes that transit agencies could only operate buses in their active fleets that are in compliance with the PM retrofit requirements discussed here. The PM retrofit requirements would start in 2003 and extend to 2009. Diesel buses with the highest PM emissions would be given priority and would be the first buses to be retrofitted. A retrofit device that demonstrates 85 percent conversion efficiency would have to be installed. All low-sulfur fuel would have to be purchased beginning in July 1, 2002, to assure the durability of the retrofit devices. These requirements apply to transit agencies on both paths, but only diesel buses would have to be retrofitted. As discussed earlier, in-use emissions data show significant particulate benefits from CNG buses compared to diesel buses. Even with the bus retrofits, PM emissions would be lower for those agencies on the alternative-fuel path utilizing natural gas buses.

The staff has proposed that transit agencies with active fleets consisting of less than 20 buses operating in federal ozone attainment areas be allowed a delay in the Tier 1 and Tier 2 PM retrofit requirements, as described below, until 2007. This is primarily due to the projected cost and difficulty of securing delivery of low-sulfur diesel in outlying rural areas before 2007. By 2007, many of the buses subject to the Tier 1 and Tier 2 requirements would be retired and would not have to be retrofitted; this would be a cost savings for the smaller districts. These smaller transit agencies would be required to comply with the Tier 3 requirements as shown below.

Several types of buses would be exempt from the proposed PM retrofit requirements:

- Model year 2004 and newer buses certified at 0.01 g/bhp-hr PM.
- Buses scheduled for retirement within two years would be exempt from the 100 percent retrofit requirement, except as discussed below for 0.6 g/bhp-hr PM engines. Documentation of planned retirement schedules would be required.
- All alternative-fuel buses owned or leased by a transit agency.

The proposed PM retrofit requirements for fleets on the diesel path are shown below.

#### TIER 1

All 0.6 g/bhp-hr PM buses would require retrofits by January 1, 2003. The ARB staff assumes that most 1990 and older buses with 0.6 g/bhp-hr PM engines would be retired by 2003, so most transit agencies would be retiring, not retrofitting, their oldest buses. Only buses that have already been retrofitted to 0.10 g/bhp-hr PM with an ARB-certified retrofit device meeting the requirements of the U.S.EPA urban bus rebuild and retrofit program would be eligible for the two-year retirement exemption; buses retrofitted to 0.45 g/bhp-hr PM would not be eligible.

## TIER 2

- 1/1/03 -- 20 percent of 0.10 and 0.07 g/bhp-hr PM engines would have to be retrofitted
- 1/1/04 -- 75 percent of 0.10 and 0.07 g/bhp-hr PM engines would have to be retrofitted
- 1/1/05 -- 100 percent of 0.10 and 0.07 g/bhp-hr PM engines would have to be retrofitted

## TIER 3

- 1/1/07 -- 20 percent of 0.05 g/bhp-hr PM engines would have to be retrofitted
- 1/1/08 -- 75 percent of 0.05 g/bhp-hr PM engines would have to be retrofitted
- 1/1/09 -- 100 percent of 0.05 g/bhp-hr PM engines would have to be retrofitted

### d. Zero-emission Bus Demonstration Project

The ARB staff proposes that transit agencies with over 200 urban buses in their active fleets, either owned or leased, on January 31, 2001, would be required to buy or lease three zero-emission buses (ZEBs) and operate them in service for a minimum of a year, starting no later than July 1, 2003. The transit agencies would be required to secure refueling infrastructure and take any other actions necessary for implementation of the project. To qualify as a ZEB, a bus would have to be certified by the ARB Executive Officer. ZEB engines could be powered by fuel cells or electricity.

Transit agencies could petition the Executive Officer for approval to undertake a joint zero-emission bus demonstration project. At a minimum, transit agencies that want to participate in a joint project would have to designate the host agency and jointly fund the project. Electric trolley buses would not qualify as ZEBs for purposes of a joint demonstration project. To assure market penetration, staff proposes that no more than three transit agencies can participate in any one joint project.

### e. Zero-emission Bus Purchases and/or Leases

The ARB staff proposes that transit agencies with over 200 urban buses in their active fleets, either owned or leased on January 1, 2007, would be required to purchase and/or lease ZEBs in 2008. A minimum of 15 percent per year, from model year 2008 through model year 2015, of a transit agency's urban bus purchases and/or leases would have to be ZEBs. If flexibility is needed in scheduling bus purchases, a transit agency could apply to the Executive Officer for approval to deviate from the required purchase schedule. To qualify as a ZEB, an urban bus would have to be certified by the ARB Executive Officer. ZEB engines could be powered by fuel cells, electricity, or fuels that result in zero-emission exhaust levels.

This requirement does not apply if a transit agency's active urban bus fleet is composed of 15 percent or more zero-emission buses on January 1, 2008, or at any time thereafter.

## **2. Requirements for Transit Agencies on the Alternative-Fuel Path**

### **a. New Bus Purchases and/or Leases:**

In order for a transit agency to qualify for the alternative-fuel path, the ARB staff is proposing that at least 85 percent of all new urban bus purchases or leases must be low-emission, alternative-fuel buses, beginning with the adoption of the proposed regulation through model year 2015. If flexibility is needed in scheduling bus purchases, a transit agency could apply to the Executive Officer for approval to deviate from the proposed purchase schedule.

The staff is not proposing a 100 percent purchase or lease requirement as some types of urban buses used by transit agencies, such as articulated buses, may not be immediately available with low-emission, alternative-fuel engines. Additionally, there may not be an adequate number of alternative-fuel buses immediately available for lease.

One advantage to being on the alternative-fuel path is that transit agencies could buy or lease low-emission, alternative-fuel buses meeting the 2.5 g/bhp-hr NO<sub>x</sub> + NMHC standard through the model year 2006. However, in order for transit agencies to be eligible for state and local air quality incentive monies after October 2002, buses would have to be certified to one of the ARB's reduced-emission optional NO<sub>x</sub> + NMHC standards beginning at 1.8 g/bhp-hr NO<sub>x</sub> + NMHC.

### **b. Fleet Averaging for NO<sub>x</sub> Emissions**

The staff proposes that transit agencies meet a minimum fleet average emission standard of 4.8 g/bhp-hr NO<sub>x</sub> by October 2002. The fleet average for each transit agency's fleet would be based on the NO<sub>x</sub> engine certification standard (new or repowered engine) for each urban bus in the active fleet, whether owned or leased, of all fuel types. This is the same as the NO<sub>x</sub> fleet average requirement proposed for transit agencies on the diesel path. However, the ARB staff expects those transit agencies on the alternative-fuel path will be able to achieve and maintain the fleet average requirement fairly easily due to the low emissions of their alternative-fuel buses.

### **c. PM Retrofit Requirements**

The ARB staff is proposing identical PM retrofit requirements for transit agencies on the diesel and alternative-fuel paths as well as purchase of low sulfur diesel fuel, if any diesel fuel is required. However, since alternative-fuel buses already have significantly lower in-use PM emissions and are exempt from the PM bus retrofit requirements, transit districts on the alternative-fuel path would have a smaller percentage of their buses to retrofit. Transit agencies that have phased out their diesel buses, or do so by 2003, will not be required to do any PM retrofits.

d. Zero-emission Bus Demonstration Project

No demonstration program is required for transit agencies on the alternative-fuel path.

e. Zero-emission Bus Purchases and/or Leases

The ARB staff proposes that transit agencies with over 200 urban buses in their active fleets, either owned or leased on January 1, 2009, would be required to purchase or lease ZEBs beginning in 2010 (two years later than transit agencies on the diesel path). Transit agencies on the alternative-fuel path are allowed more time to comply with the ZEB purchase requirements because they have lower NOx fleet average emission levels and have already made investments in alternative-fuel infrastructure. From model year 2010 through model year 2015, a minimum of 15 percent per year of a transit agency's urban bus purchases and/or leases would have to be ZEBs. If flexibility is needed in scheduling bus purchases, a transit agency could apply to the Executive Officer for approval to deviate from the required purchase schedule. To qualify as a ZEB, an urban bus would have to be certified by the ARB Executive Officer. ZEB engines could be powered by fuel cells, electricity, or fuels that result in zero-emission exhaust levels.

This requirement does not apply if a transit agency's active urban bus fleet is composed of 15 percent or more zero-emission buses on January 1, 2010, or at any time thereafter.

**3. Comparison of Fleet Rule Requirements**

Table 7 below provides a comparison of the fleet rule components discussed above for transit agencies on the diesel path and on the alternative fuel path.

**TABLE 7**

<b>Comparison of Fleet Rule Requirements</b>		
<b>Year</b>	<b>Diesel Path</b>	<b>Alternative-Fuel Path</b>
10/2002	NOx fleet average requirement	NOx fleet average requirement
2003-09	PM retrofit requirement	PM retrofit requirement
7/2003	3 bus demo of ZEBs for large fleets (>200)	
1/2008	15% of new buses are ZEBs for large fleets (>200)	
1/2010		15% of new buses are ZEBs for large fleets (>200)

Although the NOx emission average and the diesel bus retrofit requirements are identical for the two paths, they are likely to have a significantly greater impact on those transit agencies on the diesel path. This is because the low NOx emissions of the alternative-fuel buses would allow for easier attainment of the fleet average standard. Also, natural gas buses, with their inherently low in-use PM emission are exempt from the retrofit requirements.

#### 4. Requirements for Low-sulfur Diesel Fuel

Low-sulfur diesel fuel is necessary for most aftertreatment technologies to function more efficiently and reliably. Low-sulfur fuel enables catalysts and particulate filters to operate more efficiently and with increased durability. With higher sulfur fuel, trap plugging and catalyst fouling can occur. Therefore, the proposed transit fleet rule requires most transit agencies (on both the diesel and alternative-fuel paths) using diesel fuel to purchase and use diesel fuel with a sulfur limit of 15 parts per million (ppm) or less. This requirement is effective beginning July 1, 2002, in order to be consistent with the proposed PM retrofit requirements. However, transit agencies with less than 20 buses in their active fleets that operate in federal ozone attainment areas would not be subject to this requirement until July 1, 2006, since the staff has proposed that these fleets be allowed a delay in the Tier 1 and Tier 2 PM retrofit requirements until January 1, 2007, due to the projected cost and difficulty of securing delivery of low-sulfur diesel fuel in outlying rural areas before 2007.

#### 5. Reporting Requirements

To assure compliance with the fleet rule, the ARB staff proposes that transit agencies submit reports shown below. Table 8 presents an overview of the proposed applicable reporting requirements and the dates on which they must be met.

- New bus purchases and/or leases by transit agencies on the alternative-fuel path.
- Fleet averaging for NOx emissions.
- Compliance with PM retrofit requirements for Tiers 1, 2, and 3.
- Zero-emission bus demonstrations.
- Zero-emission bus purchases and/or leases.

**TABLE 8**

<b>Proposed Fleet Rule Reporting Requirements</b>					
<b>Requirement</b>	<b>Applicable Dates</b>	<b>Path</b>	<b>Initial Reports</b>	<b>Date</b>	<b>Final Report</b>
Bus purchase	2000-15	AF	Intent; Records	1/2001	No
Fleet average	10/02	Both	Schedule	1/2001	1/2003
PM retrofits Tier 1	1/00-03	Both	Schedule; Records	1/2002	No
PM retrofits Tier 2	1/03-05	Both	Schedule; Records	1/2002	No
PM retrofits Tier 3	1/07-09	Both	Schedule; Records	1/2005	No
ZEB demo	7/03	D	Purchase/demo plan	1/2003	1/2005
ZEB purchase	2008-15	D	Plan; Records	1/2007	No
ZEB purchase	2010-15	AF	Plan; Records	1/2009	No

Notes: AF indicates alternative-fuel; D indicates diesel  
Some requirements and a delayed compliance date are based on fleet size.

a. New Bus Purchases and/or Leases by Transit Agencies on the Alternative Fuel Path

Transit agencies that intend to qualify for the alternative-fuel path would be required to report such intent by letter to the ARB by January 31, 2001. The responsible transit district would maintain and produce on request records of the number, model year, and fuel used for engines in transit buses they currently own or operate, bus purchases and/or leases beginning in January 1, 2000, fuel types, and annual average percentage of total bus purchases and/or leases that were alternative-fuel buses. Any requests for deviation from the requirement that 85 percent of buses purchased per year must be alternative-fuel buses would be submitted to the Executive Officer.

b. Fleet Averaging for NO<sub>x</sub> Emissions:

The ARB staff is proposing that all transit agencies calculate their current urban bus NO<sub>x</sub> fleet average and submit that information to the ARB by January 31, 2001. If the fleet average exceeds 4.8 g/bhp-hr NO<sub>x</sub>, a schedule adopted by their governing board for meeting the 4.8 g/bhp-hr NO<sub>x</sub> fleet average standard by October 1, 2002, would be included in the submittal. Agencies planning on complying with the requirement by retiring all model year 1987 and earlier buses would submit that information instead. By January 1, 2003, a final report demonstrating compliance with the NO<sub>x</sub> fleet average requirement would be submitted to the ARB.

c. PM Retrofit Requirements

The ARB staff is proposing that affected transit agencies submit to the ARB a report showing their schedule for Tier 1 and Tier 2 retrofits (or retirements, as applicable), and the number and type of exempt buses, by January 31, 2002. For Tier 3 retrofits, a similar report would be due January 31, 2005. The transit agencies would maintain and produce on request, records of the number and model year of buses retrofitted, types of retrofit devices used and number of buses exempt.

d. Zero-emission Bus Demonstration

The applicable transportation agency and/or the transit district governing board would submit by January 1, 2003 plans for the purchase and/or lease and demonstration of at least three ZEBs. The plan would indicate planned expenditures for buses, the projected bus order and delivery schedule, fuel type and facilities, plus information about how the buses will be demonstrated. A final report on the demonstration project would be due on January 31, 2005.

e. Zero-emission Bus Purchases

The responsible transportation agency and/or the transit district governing board would submit a report giving a description of the zero-emission technology to be utilized and overall plans for implementation of the purchase requirement, and any request for exemption from the purchase requirement based on existing zero-emission bus fleet

composition, by January 1, 2007, for transit agencies on the diesel path and by January 1, 2009, for transit agencies on the alternative-fuel path.

The responsible transit agency would maintain and produce on request, records on the the number, model year and fuel used for engines they currently own or operate, bus purchases and/or leases beginning in 2008 or 2010, fuel types, and annual average percentage of total bus purchases and/or leases that were ZEBs. Any requests for deviation from the requirement that 15 percent of buses purchased per year must be zero-emission buses would be submitted to the Executive Officer.

## **6. Future Feasibility Review**

The ARB staff proposes that the Board provide for review of zero-emission bus technology, and the feasibility of implementing the proposed requirements. The ARB would conduct its review no later than January 2006. This review would reassess the need for the requirements and their technical and economical feasibility, based on information available in 2005 from the ZEB demonstration projects. If the technical feasibility of the zero-emission bus requirements are confirmed, the staff would recommend to the Board the implementation of the 2008 and 2010 zero-emission bus purchase requirements.

## **V. TECHNOLOGICAL FEASIBILITY**

Diesel engines have long been the engines of choice for use in urban buses. This is due to the efficiency and durability of diesel engines, as well as the operators' familiarity with diesel engine technology. Historically, this preference is also due to the lack of viable alternative-fuel engine technology for use in heavy-duty vehicle applications. This is no longer the case. Recent advances have enabled alternative-fuel engines to close the performance and reliability gaps with diesel engines and, at the same time, clearly outperform diesel engines in terms of emissions. This chapter focuses on the technologies that make the proposed standards technologically feasible. Included here are discussions of currently-available technologies, retrofit technologies for reducing NO<sub>x</sub> and toxic PM emissions from the older diesel urban bus fleet, and emerging diesel and advanced, alternative-fuel technologies.

### **A. Currently-Available Technology**

#### **1. Diesel Technology**

Diesel engines operate by compression ignition that causes the fuel to ignite upon injection into highly compressed air at elevated temperatures. NO<sub>x</sub> formation is directly dependent on the flame temperature. As combustion temperatures increase, NO<sub>x</sub> emissions also increase. Therefore, NO<sub>x</sub> control technologies generally focus on reducing the combustion temperatures and the duration of these high temperatures within the cylinder. In general, however, emission control strategies that reduce NO<sub>x</sub> tend to increase PM. Current emission control technologies such as combustion chamber modifications, advanced induction systems, and fuel injection strategies have

resulted in diesel engines that emit about 30 percent less NOx than diesel engines manufactured a decade earlier, while still allowing for decreases in PM emissions.

#### a. Combustion Chamber Modifications

Manufacturers have made significant progress in the area of combustion chamber modifications. If the fuel/air mixing rates and the shape of the flame in the combustion chamber are sufficiently controlled, they can be optimized over the range of engine operating conditions to control and minimize the formation of pollutants. This involves careful attention to combustion chamber geometry to optimize air flow parameters.

Proper air flow in the combustion chamber is also important to allow proper fuel injection penetration. If injected too far, the fuel spray will wet the cylinder wall leading to increased unburned HC emissions and increased wear. If the fuel spray is not injected far enough, inadequate mixing will lead to increased HC and PM emissions.

#### b. Advanced Induction Systems

Manufacturers have incorporated advanced turbochargers/aftercoolers in current diesel engines to provide better air/fuel management and lower intake air temperatures to meet lower emission standards. Turbocharging has a positive influence on the pumping losses of an engine and on the combustion efficiency through control of the air/fuel ratio. Aftercoolers cool the intake charge to reduce peak combustion temperatures, thus reducing NOx emissions.

#### c. Injection Timing/High Pressure Fuel Injection

Retarding injection timing (starting combustion later) reduces NOx through a reduction in the peak combustion temperature. However, this tends to increase PM emissions and fuel consumption. Manufacturers have developed higher pressure injection systems as one approach to reduce fuel economy impacts and PM emission increases. Higher injection pressures result in better atomization, better air utilization, more complete combustion, and consequently reduce PM emission, while improving fuel efficiency.

### **2. Alternative-Fuel Technology**

#### a. CNG and LNG

Alternative fuels such as methanol, ethanol, propane, compressed natural gas (CNG), and liquefied natural gas (LNG) have provided manufacturers with new options in meeting increasingly stringent emission standards. Currently, only natural gas technology has developed sufficiently for commercial heavy-duty vehicle applications. Compared to conventional diesel technology, natural gas technology has already shown emission reductions in the range of 50 percent for NOx and PM. As discussed earlier, PM in-use emissions are inherently lower, from 20 to 100 times lower.

Unlike diesel engines, which ignite by compression, natural gas engines are spark-ignited. In this respect, they are similar to gasoline engines, which also use the electrical energy provided by spark plugs to initiate the combustion process. Spark-ignition engines are slightly less efficient than compression-ignition engines (i.e., diesel engines). However, current heavy-duty natural gas engine technology, such as lean-burn, closed-loop, electronic fuel management, has enabled natural gas engines to approach diesel-like fuel economy and performance, while emitting 50 percent less NOx and PM than comparable diesel engines.

Both CNG and LNG engines are currently available for heavy-duty vehicle applications. CNG engines have traditionally been used in urban buses, although LNG engines have also been ordered. Some transit agencies, in fact, prefer LNG since its higher energy density provides for longer vehicle range, reduced weight and lower capital costs than CNG. However, LNG is not readily available in California today, therefore the incremental fuel cost is higher. Ongoing demonstration programs could allow for LNG availability in the future at significantly lower costs.

Most heavy-duty engine manufacturers sell both natural gas and diesel fuel engines. Some engine manufacturers have certified their natural gas engines to the ARB's optional, reduced-emission NOx standards, which start at approximately 40 percent less than the current 4.0 g/bhp-hr NOx standard. Table 9 below shows the 1999 model year urban bus engines certified to the ARB's optional, reduced-emission NOx standards.

**TABLE 9**

<b>1999 Model Year Urban Bus Engines Certified to ARB's Optional, Reduced-Emission NOx Standards (Emission Levels for NOx, PM, and NMHC are in g/bhp-hr)</b>									
<b>MY</b>	<b>Manuf.<sup>a</sup></b>	<b>Service Type</b>	<b>Fuel Type</b>	<b>Displ. (ltr)</b>	<b>NOx</b>	<b>PM</b>	<b>NMHC</b>	<b>Cert. Std. NOx/PM</b>	<b>HP</b>
1999	DDC	UB/HHD	CNG	12.7	2.0	0.02	0.8	2.5/0.05	330
1999	DDC	UB/HHD	CNG	8.5	2.2	0.01	0.6	2.5/0.05	275
1999	Cummins	UB/HHD	L/CNG	10.0	1.4	0.02	0.03	2.0/0.05	280/ 300
1999	Cummins	UB/HHD	L/CNG	8.3	1.7	0.01	0.2	2.5/0.05	250/ 275

<sup>a</sup>Service Type: UB(Urban Bus); HHD(Heavy Heavy-Duty)

**b. Electric Trolley Buses**

Trackless electric trolley systems have been operated in North America and Europe for decades. Electric trolley buses are commercially available and in regular use in several transit districts nationwide. In California, the San Francisco Municipal Railway's transit fleet includes over 340 electric trolley buses.<sup>1</sup> Electric trolley buses are rubber-tired urban buses with electric motors powered by electricity distributed through an overhead twin-wire power supply. The electric power from the utility is converted to 750 volts DC at substations located at approximately one mile intervals and is fed from the substation

through underground cable to the overhead twin-wire. Onboard batteries provide electric trolley buses with limited emergency propulsion capabilities.

While electric trolley buses do not produce exhaust emissions, there are emissions associated with the generation of electricity used to power the buses. These emissions depend on the mix of power plants supplying the electricity. While this technology provides opportunities for significant emission reductions from conventional urban buses, it provides transit agencies with less flexibility due to the extensive and expensive public infrastructure and fixed routes.

## **B. Retrofit Technology**

Retrofit technologies are available to reduce emissions from the older urban bus fleet. A retrofit involves a hardware modification to an existing engine to reduce its emissions from the standards to which it was originally certified. This section discusses only NO<sub>x</sub> and PM retrofit technologies, although other pollutants may also be reduced through retrofits.

### **1. PM Retrofit Technology**

#### **a. Diesel Particulate Trap Oxidizer**

A trap oxidizer system consists of a filter positioned in the exhaust stream designed to collect a significant fraction of the particulate emissions while allowing the exhaust gases to pass through the system. Since the volume of particulate matter generated by a diesel engine is sufficient to fill up and plug a reasonably sized filter over time, a means of disposing of the trapped particulate must be provided. The most promising means of disposal is to oxidize the particulate in the trap, thus regenerating the filter. Different techniques are available to facilitate trap regeneration since the exhaust temperature of diesels is not always sufficient to initiate regeneration. Trap systems do not appear to cause any additional engine wear or affect vehicle maintenance.<sup>2</sup>

Several promising particulate trap technologies are Johnson Matthey's Continuously Regenerating Technology (CRT<sup>TM</sup>) diesel particulate filter and Engelhard's DPX<sup>TM</sup> catalytic soot filter. The CRT<sup>TM</sup> combines a platinum-based catalyst with a filter element. The catalyst oxidizes NO to NO<sub>2</sub> and uses the produced NO<sub>2</sub> as an oxidant to remove the PM trapped in the filter material following the catalyst. The CRT<sup>TM</sup> does require the use of low-sulfur diesel fuel (< 50 parts per million sulfur). Engelhard manufacturers different DPX<sup>TM</sup> PM systems that can work at different fuel sulfur levels, including current California fuel. Programs are underway to evaluate appropriate levels of sulfur for future diesel fuel. In one such program in southern California, Detroit Diesel Corporation, Johnson Matthey, and Engelhard will demonstrate ARCO's new diesel fuel containing virtually no sulfur, thus enabling catalysts and particulate filters to operate more efficiently and with increased durability.<sup>3</sup> The CRT<sup>TM</sup> has demonstrated reductions in PM emissions by greater than 90 percent.

## b. Diesel Oxidation Catalyst

An oxidation catalyst transforms pollutants into harmless gases by means of oxidation. The catalyst oxidizes CO, gaseous HC, and the liquid HCs adsorbed on the carbon particles present in diesel exhaust gases. The liquid HCs are referred to as the soluble organic fraction (SOF) and make up part of the total PM. Oxidation catalysts can reduce the SOF of particulate by 90 percent under certain operating conditions<sup>4</sup>, and according to staff estimates, could reduce total particulate emissions by greater than 30 percent.

Oxidation catalysts have proven effective in achieving modest PM emission reductions on older buses. Under the U.S. EPA's urban bus rebuild/retrofit program, five manufacturers have certified diesel oxidation catalysts as providing at least a 25 percent reduction in PM emissions.

## **2. NOx Retrofit Technology**

### a. Selective Catalytic Reduction

Selective catalytic reduction (SCR) systems use a reductant, usually ammonia or urea, to convert NOx to nitrogen and oxygen. These systems are common in stationary sources and are also used on some mobile sources in Europe. In this system, the reductant is injected into the exhaust upstream of the catalyst. As the exhaust gases, along with the reductant, pass over a catalyst applied to either a ceramic or metallic substrate, NOx emissions can be reduced by more than 70 percent<sup>5</sup>. The staff estimates PM emissions could be reduced by 25 percent and HC emissions by 50 to 90 percent. SCR retrofit systems are expected to be available for urban bus applications within two to three years.

## **C. New Technology**

To comply with future, more stringent NOx emission standards, diesel engine manufacturers are researching several promising technologies for diesel engines, such as cooled exhaust gas recirculation (EGR) and aftertreatment technologies. Incorporation of these technologies into natural gas engines will also lower their emissions significantly from current levels, continuing to make them lower-emitting than even the best available diesel technology.

Other technologies capable of reducing emissions to near-zero or zero levels, such as hybrid-electric, battery-electric, and fuel cell technologies, are rapidly emerging. However, few of these technologies are at a commercial stage for urban buses today. The proposed regulation's aggressive time frame for longer-term engine standards is necessary to move near-zero and zero-emission urban buses from the developmental stage to commercial production. The proposed regulation requires the ARB staff to perform a technology assessment of zero-emission technology for urban transit buses no later than January 2006.

## **1. Future Diesel Technology**

### **a. Exhaust Gas Recirculation**

Exhaust gas recirculation is one of the most effective engine control methods for reducing NOx emissions. Spent combustion gases recirculated back into the intake system serve as a diluent to lower the oxygen concentration and to also increase the heat capacity of the air/fuel charge. Cooled EGR (cooled through the aftercooler) is used to minimize combustion temperatures. This reduces peak combustion temperature and the rate of combustion, thus reducing NOx emissions. However, PM emissions may increase and fuel economy may decrease. The proper balance of EGR and temperature may provide the proper characteristics necessary for decreasing NOx emissions without increasing PM emissions. It is anticipated cooled EGR would be an integral part of the engine manufacturers' effort to meet the lower NOx emission requirements in October 2002.

### **b. Aftertreatment Technologies**

Heavy-duty engine exhaust aftertreatment for NOx is currently limited by the lean environment (excess oxygen) of diesel engines. Automotive catalysts rely on a nearly perfect balance of oxygen in the exhaust stream to maximize catalytic converter efficiency. One solution for heavy-duty vehicles, including urban buses, is the use of SCR systems described above in the Retrofit Technology section. The estimated cost of an SCR system appears reasonable and NOx emissions are reduced by more than 70 percent. Most of the challenges to SCR use appear to be pragmatic (e.g., packaging, communication of the SCR system with the engine's computer controls, etc.). SCR systems are expected to be commercially available on new buses within two to three years.

For the 2004 time frame, NOx adsorbers are expected to be available. NOx adsorbers do not require an additional reductant to be added. Again, the cost is expected to be reasonable and NOx emissions are expected to be reduced by more than 70 percent. However, a critical element of this technology and other aftertreatment technologies is the necessity to have low-sulfur fuels. Although an SCR system may not need low-sulfur fuel, most other heavy-duty aftertreatment technologies will not function efficiently and reliably in an exhaust environment with a significant quantity of sulfates present, which cause trap plugging and catalyst fouling. As mentioned previously, programs are underway to evaluate appropriate levels of sulfur for future diesel fuel.

As discussed in the retrofit section, several particulate trap systems are available to reduce PM emission levels by more than 90 percent. It is expected that to meet the proposed 2004 requirements particulate trap systems will be used in conjunction with a NOx aftertreatment (SCR or adsorbers). Low-sulfur fuel (less than 30 ppm sulfur) will be necessary with this technology.

### c. Diesel Hybrid-Electric

Bus manufacturers and transit agencies have expressed interest in diesel hybrid-electric technology because of their familiarity with diesel technology and its compatibility with current fueling infrastructure. Diesel hybrid-electric technology utilizes electric traction drive motors, batteries, and a diesel engine/generator set combination, rather than the conventional engine/transmission combination. The batteries can be charged by the engine/generator set and through regenerative braking. On site "plug-in" charging may also be used to recharge batteries

Several demonstration projects with diesel hybrid-electric buses are underway with promising results. Preliminary reports indicate that the higher efficiencies associated with diesel hybrid-electric technology, compared to conventional diesel technology, can reduce fuel consumption by 25 percent, and reduce emissions of NOx and PM by 30 percent and 80 percent, respectively. In addition, an engine operating in a hybrid vehicle generally operates in a limited operating range. Therefore, without the severe transient parameters that typically accompany urban bus operation, exhaust aftertreatment can be designed far more efficiently. Significant emphasis is being placed on cost reductions for future hybrid-electric buses.

### d. Additional Controls

In order to reach the 0.2 g/bhp-hr NOx levels in 2007, additional engine controls and refined aftertreatment are expected to be necessary. It is anticipated that significantly lower NOx levels can be achieved through increased and optimized exhaust gas recirculation rates under all operating conditions. Relatively high PM emissions resulting from increased exhaust gas recirculation usage can be significantly reduced with a particulate filter, as discussed earlier. The ARB staff has attempted to harmonize the proposed 2007 model year urban bus engine standards (0.2g/bhp-hr NOx and 0.01 g/bhp-hr PM) with the heavy-duty engine standards under consideration by the U.S. EPA for the 2007 time frame.

## **2. Alternative-Fuel Technology**

### a. Natural Gas

The engine and aftertreatment technologies discussed above in the Diesel Technology section are generally applicable to lean-burn natural gas engines. Because natural gas engines operate at higher temperatures, which can improve the efficiency of aftertreatment technologies, higher aftertreatment efficiencies could be achieved than from comparable diesel engines. In addition, natural gas contains little or no sulfur so aftertreatment systems would not have the efficiency and durability issues associated with sulfur poisoning from diesel fuel.

### b. Hybrid-electric (non diesel)

In the developmental and early demonstration stage, hybrid-electric buses have been designed with power systems integrating battery-electric motors with internal

combustion engines (or fuel cells). Hybrid-electric bus designs can incorporate internal combustion engines fueled by alternative-fuels, such as LPG and CNG, in addition to diesel fuel, as discussed above in the Diesel Technology section. These buses can operate in pure electric mode or in hybrid mode. A bus operating in pure electric mode does not have emissions. A bus operating in hybrid mode will have emissions, which will vary depending on fuel type, but will have the potential for significantly lower emissions than a conventional diesel urban bus.

#### c. Battery-electric

Battery electric motor propulsion systems offer quiet, exhaust free, and odorless bus operation without the fixed route constraints of electric trolley buses. Batteries are devices that store electrochemical energy, without the polluting byproducts of combustion. When the stored energy is depleted, the batteries must be recharged (refueled) by the process of passing electricity into the battery. The current practice is to connect the buses to an electricity generation grid overnight. As noted in the previous discussion on electric trolley buses, emissions from power plants supplying electricity are a consideration.

An electric powertrain can process stored energy more than five times as efficiently as a diesel engine and can be further enhanced with the presence of regenerative braking. However, compared to diesel buses, the range of battery-electric buses is severely limited by the energy storage capacity of the various chemical battery technologies. For example, diesel #2 fuel has nearly 300 times by weight and 90 times by volume the stored energy of a lead-acid battery. Utilization of advanced lead-acid or nickel cadmium batteries will provide buses with more range -- up to 120 miles. While the passenger capacity of battery-electric buses is also reduced by the weight and volume of current batteries, these buses are suitable for the many short-range duty cycles typical of urban bus operations. Furthermore, range can be extended with opportunity charging (with fast or rapid charging), battery-exchange, or on-board auxiliary power units.

Commercial battery-electric bus technology is currently limited to smaller buses, known as electric shuttles, that do not meet the gross vehicle weight rating classification for conventional urban buses (>33,000 pounds). These electric shuttles are in regular service in many transit districts nationwide. In California, about 30 percent of the Santa Barbara Municipal Transit District fleet is battery-electric shuttles, which are used primarily on waterfront and downtown routes. Electric shuttle utilization is constrained by range requirements, terrain, and climate. Current development efforts are focusing on battery and recharging technology. Larger electric buses that would meet the definition of an urban bus are still in the developmental stage.

#### d. Fuel Cells

Fuel cell vehicles operate quietly, efficiently, and have the potential for zero or near-zero exhaust emissions. Fuel cells generate electric power through an electrochemical reaction in the same manner as batteries. While batteries must be recharged when the

stored reactants (fuels) are depleted, fuel cells can produce power as long as hydrogen and oxygen fuels are continuously supplied.

Each cell of a fuel cell stack contains two electrodes (usually containing platinum to catalyze the anodic and cathodic reactions) separated by an electrolyte (either aqueous or nonaqueous). Hydrogen (H<sub>2</sub>) is supplied to the anode, and oxygen (O<sub>2</sub>) to the cathode. The anodic oxidation of hydrogen results in protons (H<sup>+</sup>) and electrons (e<sup>-</sup>). Protons migrate through the electrolyte membrane to the cathode. The electrons flow through an external circuit to the cathode. The external circuit can power a load while the protons, electrons, and oxygen recombine at the cathode to produce water.

The choice of fuel will impact emissions, overall fuel efficiency, and cost of the fuel cell bus. The type of fuel supplied to a fuel cell bus will determine the exhaust emissions. If onboard hydrogen (either delivered or produced at a transit agency's central fueling station) is the fuel source, the exhaust emissions will be zero. On-site production of hydrogen would be primarily by electrolysis of water or reforming of hydrogen-containing fuels. If fuels such as natural gas, methanol, diesel, or gasoline are reformed onboard the bus (to produce hydrogen for the fuel cell), then some level of controlled emissions will occur, although at lower amounts than those emitted by internal combustion engines. Onboard fuel reforming reduces fuel efficiency because a percentage of the energy content of the original fuel is lost in the conversion. Onboard reforming also increases the purchase cost of the bus.

Proton exchange membrane (PEM) fuel cell and phosphoric acid fuel cell (PAFC) technologies have proven to be reliable. PAFCs are currently used worldwide to produce heat and electricity. They are particularly suited for hospitals and high technology facilities where a highly reliable source of energy is needed. The two most prominent types of fuel cells currently under development for transit applications are PEM fuel cells and PAFCs. In particular, the PEM fuel cell technology has emerged as the prime candidate in the transportation market. Ballard Power Systems has employed the PEM technology in demonstration fuel cell bus programs in Chicago, Illinois, and Vancouver, Canada. Additionally, dbb fuel cell engines, inc. expects to commercially produce fuel cell bus engines by 2002.<sup>6</sup> Fuel cell buses using the PAFC technology with onboard methanol reforming have been built under a Department of Energy/Federal Transit Administration contract and demonstrated by Georgetown University.

## **VI. ISSUES**

The following sections discuss issues and topics pertaining to the proposed regulation.

### **A. Compressed Natural Gas Urban Bus Fleets**

Several transit agencies have indicated that CNG bus operating costs are higher than diesel bus operating costs. However, some transit agencies have reported lower operating costs for CNG buses than for diesel buses. As natural gas fleets are relatively new, a comprehensive long-term comparison of operating costs of CNG buses to diesel buses is difficult to do at this time. Operating costs include both maintenance and fuel costs. While maintaining diesel fleets can currently cost less than for CNG

fleets, the requirements for diesel engines to meet more stringent emission standards, along with the availability of more reliable natural gas engines, should close that gap and equalize the costs. Fuel costs per mile for natural gas buses, including natural gas compression or liquefaction, is less than for diesel buses. The increased price of low-sulfur diesel fuel needed in the future should increase this difference. Future operating costs for natural gas fleets and diesel fleets are expected to be comparable. Transit agencies can project local costs for operating different types of fleets and consider that information when choosing the diesel path or the alternative-fuel path.

## **B. Funding Sources**

Funding constraints have been raised by many transit agencies as a concern associated with this proposal, and the ARB staff has looked into the urban bus funding process. The Federal Transit Administration (FTA) pays 80-83 percent of the purchase cost of a new urban bus. The remaining cost is made up from local and state transportation funds. Local and regional transportation planning agencies control the allocation of federal, state and local transportation funding in urban areas; the State Department of Transportation allocates some funds in rural areas.

The transportation planning agencies prioritize project categories and assign funding to each category. Transportation projects can include planning projects, streets and highways, bridges, public transit, rail projects, ferry operation, pedestrian and bicycle facilities, and other services and projects. Without additional transit funding in some regions, any additional cost of buying and operating transit buses meeting lower emission standards could result in service cut-backs or fare increases. In order to adequately fund transit operations, some transportation planning agencies would have to re-prioritize their project categories. The ARB staff and some local air districts are encouraging transportation planning agencies to provide more funding for transit agencies.

Various incentive programs to assist with new bus purchases are also available in most areas of the state. These incentive programs include the federal TEA-21 Congestion Mitigation and Air Quality Improvement Program (CMAQ), the state Carl Moyer Memorial Program, grants from the California Energy Commission (CEC), and air districts' motor vehicle registration fee (MV) programs. Additional funding should become available from other TEA-21 programs, as well as from state transportation accounts.

Projected statewide funding for new alternative-fuel buses is shown below in Table 10. In addition to new alternative-fuel bus purchases, some programs can also fund infrastructure costs.

**TABLE 10**

<b>Funding Scenario for Alternative-Fuel Buses and Infrastructure</b>		
<b>Funding Program</b>	<b>\$M for New Bus Purchases</b>	<b>Infrastructure Costs Covered</b>
FHWA CMAQ <sub>2</sub>	60	Yes
FTA Formula 5307 <sub>1</sub>	102	Yes
FTA Clean Fuels Formula Grants <sub>2</sub>	10	Yes
FTA Transit Capital 5309 <sub>2</sub>	11	Yes
Moyer Incentive <sub>3</sub>	4.0	No
State, local <sub>1</sub>	34	Yes
MV Projects <sub>1</sub>	12	Yes
CEC grants	0	Yes (\$2M)

1. Based on historical funding.
2. Best case scenario in California
3. Estimated amount as statewide data not yet available

The incentive programs generally co-fund the cost of an alternative-fuel bus and, in some cases, the cost of the infrastructure. In general, the staff found that adequate funding -- from transportation, air quality and energy-related sources -- is available to subsidize the incremental cost of alternative-fuel buses in urban areas, assuming a normal bus turnover rate. However, enough transportation or incentive funding has not been identified to cover the entire cost of the required infrastructure. The ARB staff is working with other agencies to assist in securing additional funding from federal, state, and local sources.

Only the purchase of buses with engines meeting the ARB's optional, reduced-emission standards or other low-emission standards (as defined by the air districts) meet the eligibility criteria for air quality incentive funds. Only the incremental cost of buses meeting the lower standards is generally funded. The ARB expects alternative-fuel buses that certify to the ARB's optional 2.5 g/bhp-hr NOx standard from 2000 to October 2002 to be eligible for grant funding. After October 2002 when a more stringent NOx + NMHC engine standard is in effect, only buses with engines meeting the 1.8 g/bhp-hr optional NOx + NMHC standard (or a lower reduced-emission optional standard) are expected to be eligible for incentive funding. Air quality incentive funds may also be used for technology advancement. Therefore, emerging zero-emitting technologies, such as fuel cell buses, would be eligible for co-funding with air quality incentive funds.

### **C. School Buses**

The ARB staff has received numerous comments that school buses should be included in this proposal, and, in fact, ARB sets a high priority on reducing student exposure to toxic particulate emissions from diesel-powered school buses. Originally, a school bus fleet rule was included in this proposal. However, the ARB staff has found barriers to including school districts in the fleet rule. The most significant barrier is the lack of available funding for new bus purchases and infrastructure for the approximately 900

school districts in the state that provide school bus service. The ARB will consider a separate proposal to reduce emissions from school buses at a later date. In the interim, the ARB staff will assist and encourage transportation agencies, air districts, state agencies, environmental groups, school districts and others to identify funding opportunities and regulatory methods that would reduce student exposure to toxic PM emissions from diesel-fueled engines.

#### **D. Long-term Viability of Natural Gas Fleets**

One of the concerns expressed to the ARB staff during the development of this proposal was the possibility of stranding transit agencies' investments in natural gas infrastructure as fleet operators acquire zero-emission buses. The ARB encourages and supports the purchase of clean natural gas buses and believes this technology has long-term viability. The staff proposal for transit agencies on the alternative fuel path requires that 85 percent of new bus purchases be alternative-fuel through model year 2015. Therefore, 85 percent of new bus purchases for transit agencies on the alternative-fuel path would likely be natural gas or, eventually, for large fleets, zero-emission buses. An option for producing hydrogen is to reform CNG on site. In this case, the existing natural gas infrastructure will be transferable to the operation of fuel cell buses and could substantially reduce the infrastructure cost for fuel cell bus fleets.

#### **E. Natural Gas Availability**

Pipeline natural gas is not available in some areas, including the Lake Tahoe area and some rural counties. In those areas, transit districts have little opportunity to operate natural gas buses. The ARB staff expects that in areas of the state where natural gas is unavailable, transit fleets will continue to purchase and/or lease diesel buses, thus participating in the diesel path of the transit bus fleet rule. Diesel bus purchases or leases will be required to meet the emission standards for the years 2002, 2004, and 2007, as proposed in this regulation.

#### **F. Safety Issues**

The safety of all motor vehicle technologies is a concern. Compressed natural gas tanks, which are under high pressure, have the potential to rupture. A rupture of a CNG tank can cause severe damage. One such rupture occurred several years ago at the Los Angeles County Metropolitan Transit Authority. To help ensure safety, operators with natural gas buses have instituted rigorous inspection procedures and provided safety training, in addition to other safeguards. Since CNG is more volatile than diesel fuel, modifications to existing maintenance facilities are generally necessary. The modifications usually consist of a methane detection system, an improved ventilation system, new lighting, employee training, and containment procedures.

Safety issues for battery-electric buses (and passenger vehicles) have been addressed by codes, standards or recommended guidelines for battery recharging stations, by onboard systems, and by training programs for emergency response personnel. One California transit district reports no battery-related incidents after 25,000 duty cycles.

The ARB staff is aware of only two emergency incidents, both of which occurred on the East Coast.

For fuel cell buses, safety concerns vary according to the fuel feedstock, but frequently focus on hydrogen handling and use. Hydrogen and natural gas, as flammable substances, have similar safety issues. Gaseous fuels have been used in transit applications for several years. This existing base of information can be fairly easily extrapolated to hydrogen. Some work has gone into the preparation and publication of guidelines for hydrogen systems and equipment.

## **G. Ridership Issues**

Transit agencies that operate low-emission, alternative-fuel buses advertise the clean air benefits of their buses. Some studies show a definite increase in ridership attributable to reduced air pollution and smoke-free exhaust. However, a lack of transportation funding due to increased capital and operating costs of alternative-fuel buses could cause delays in replacing older, less reliable diesel buses or increases in fares, thus decreasing ridership. This could adversely impact emission reduction opportunities and those who depend on public transit. Adequate availability of incentive funding can help avoid such impacts.

## **H. Statement of Principles**

The Statement of Principles (SOP), an agreement signed by the ARB, U.S. EPA, and heavy-duty engine manufacturers in 1995, provides a fixed schedule for the introduction of new heavy-duty engine standards. It is intended to result in consistency nationwide, where possible, in heavy-duty engine standards, including urban bus engine standards. The adoption of a transit bus fleet rule is not in conflict with the SOP agreement. In lieu of adopting new mandatory urban bus engine standards effective in the short term, the ARB staff is proposing a transit bus fleet rule to achieve near term emission reductions. For the long term, the ARB staff has attempted to harmonize the new urban bus engine standards in this proposal (0.2g/bhp-hr NO<sub>x</sub> and 0.01 g/bhp-hr PM) with the heavy-duty engine standards under consideration by the U.S. EPA for the 2007 time frame. If the proposed levels are not the emission levels ultimately adopted by the U.S. EPA, staff would consider modifications to the proposed long-term emission standards.

## **I. Settlement Agreements**

The ARB and the U.S. EPA have already adopted heavy-duty engine emission standards to take effect in 2004. As a result of the Heavy-duty Diesel Settlement Agreements between the U.S. EPA, the ARB, and seven engine manufacturers, signed in 1998, the engine manufacturers will "pull-ahead" the introduction of new engines, i.e., they will introduce engines meeting the 2004 heavy-duty engine emission standards into California buses beginning in October 2002. However, there is an issue related to one engine manufacturer not subject to the pull-ahead requirement that is producing urban bus engines being marketed and sold by a second engine manufacturer that is subject to this requirement. The ARB staff believes that if these engines were indeed marketed by the second manufacturer beginning in October 2002, this would jeopardize the

emission benefits of this proposal and would be a circumvention of the Settlement Agreements and a violation of its applicable requirements.

#### **J. Buses Designated as Alternative-fuel Buses**

For the purposes of the fleet rule, ARB staff proposes that buses designated as alternative-fuel buses are: natural gas, propane, ethanol buses, battery-powered buses, electric trolley buses, hybrid-electric CNG buses, fuel cell buses and other advanced technologies that do not rely on diesel fuel. Diesel, diesel hybrid-electric, dual-fuel buses, and other buses that use diesel fuel would not be considered alternative-fuel buses.

The purchase of diesel hybrid-electric buses is allowed on the alternative-fuel path, as 15 percent of new purchases can be something other than alternative-fuel buses. However, engine manufacturers have expressed concern that purchase of diesel-hybrid-electric buses would not count towards the 85 percent alternative-fuel purchase requirement. Engine manufacturers maintain that emissions from diesel hybrid-electric buses, and from newer technology diesel buses from 2004 to 2007, could be lower than those of natural gas buses.

The ARB staff agrees that, at a particular point in time, NO<sub>x</sub> emissions from a new diesel hybrid-electric or newer technology diesel bus could be lower than NO<sub>x</sub> emissions from a new CNG bus (though not as low as emissions from electric-powered buses, hybrid-electric CNG buses, or hydrogen fuel cell buses). However, ARB staff does not believe lower NO<sub>x</sub> emissions for some model years is sufficient justification to allow diesel buses or diesel hybrid-electric buses to qualify toward the 85 percent alternative-fuel purchase requirement.

One of the main purposes of the alternative-fuel path is to encourage transit agencies to make a firm commitment to operating an alternative-fuel fleet. In the long-term, this helps engine manufacturers justify continued reliability and emission reduction improvements to their alternative-fuel engines. Second, staff estimates, based on existing in-use test data, that PM in-use emissions would be 30 to 50 percent lower for a natural gas bus engine certified to the proposed 0.03 g/bhp-hr PM standard than for a diesel bus engine certified to the proposed 0.01 g/bhp-hr PM standard.

#### **K. Zero-emission Bus Demonstration Projects**

The ARB staff is proposing that transit agencies that are required to undertake a zero-emission bus demonstration project could conduct a joint project with a limit of no more than three agencies per project. A joint demonstration project would mean significant cost-savings for those transit agencies involved because the cost of management, training, infrastructure, any new facilities or modifications, and other costs would be shared. In the proposal, a demonstration project would include three zero-emission buses. A request has been made to allow fewer than the required three buses per agency in a joint project. In light of the cost-savings already achieved, and the need to provide a broad-based demonstration that includes mechanic and driver training, public visibility, revenue service over a large area, passenger reaction, and overall experience

with this new technology, the staff believes its proposal requiring three buses per agency is also appropriate for joint zero-emission bus demonstration projects.

## **L. Composite Buses**

The possible exemption of lightweight composite buses from urban bus standards is an issue. Urban buses are defined by several characteristics including a gross vehicle weight of more than 33,000 pounds. Innovative bus manufacturers are proposing development of diesel, hybrid-electric and alternative-fuel buses made of lightweight composite materials with a nominal curb weight as low as 22,000 pounds. Even when fully loaded, such buses may weigh less than 33,000 pounds GVW. Staff proposes that lightweight buses that are powered with heavy-duty diesel engines, diesel-derived engines, or zero-emission engines, carry comparable passenger loads in urban bus service, and meet other definitions of urban buses, would be considered urban buses for the purposes of this proposal.

## **VII. REGULATORY ALTERNATIVES**

### **A. Do Not Adopt Transit Agency Fleet Rule and Amend California Urban Bus Standards**

One alternative to this proposal would be to continue using the current heavy-duty diesel engine standards. In addition to being less stringent than the proposed emission standards for urban bus engines, the current standards do not include a transit bus fleet rule component to increase low-emission, alternative-fuel use in the new fleet and to reduce NOx and PM emissions from the in-use fleet. Low-emission, alternative-fuel technology can provide significant emission reductions over conventional diesel technology, and can reduce the public's exposure to toxic PM emissions. Retrofit technologies can provide additional emission reductions and also reduce the public's exposure to toxic PM emissions. While some transit agencies have voluntarily taken steps to reduce emissions immediately, others have not. Many areas of California are still in violation of health-based state and federal air quality standards and therefore emission reductions are necessary from those sources with the ability to provide them. The staff recommends the Board adopt the regulation, as proposed, presented in this report.

### **B. Adopt Low-Emission Standards Requiring Alternative-Fuel Use**

Another alternative to the current proposal would be to adopt emission standards that would immediately require all new bus purchases to be low-emission, alternative-fuel buses. Alternative-fuel technology has the ability to meet low-emission NOx and PM levels now. Furthermore, this technology is well established and many transit agencies already have practical experience with converting their fleets to low-emission, alternative-fuels.

However, during the development of this regulatory proposal, many transit districts and transportation agencies expressed the need for greater flexibility. As such, the staff's proposal incorporates provisions to allow diesel technology as an alternative for

reducing emissions, yet includes mechanisms to remove the most polluting diesel engines from service and to introduce advanced, alternative-fuel technologies (e.g., battery-electric buses and fuel cell buses). The staff believes the current proposal will provide more flexibility to transit districts than emission standards requiring the use of low-emission, alternative fuel only.

### **C. Adopt A Fleet Average Rule**

An additional alternative to the current proposal would be to adopt a fleet average rule, in lieu of new emission standards, that takes into account new bus purchases and buses already in-use. However, in analyzing the fleet average concept, the staff discovered that fleet characteristics differed so significantly between transit agencies that an effective fleet average system could not be established unless the baseline emission rate started so low as to challenge even the most proactive transit agencies. Alternatively, the baseline emission rate could be set higher to accommodate the transit fleets with large numbers of older buses, but this would drastically reduce achievable emission benefits.

Instead, the ARB staff is proposing a modified fleet average rule that is just one component of the overall transit bus fleet rule. The modified fleet average component reduces the challenges associated with the “fleet average rule only” alternative.

### **D. Adopt Public Workshop Proposal Dated September 23, 1999**

On October 18 and 20, 1999, the staff held two public workshops to discuss a publicly released proposal dated September 23, 1999. Like the current proposal, the September 23, 1999, proposal contained two paths for transit agencies to choose from in reducing emissions from their urban bus fleets. It was clear from the workshops, however, that the proposed paths, both of which allowed the use of diesel technology, did not adequately induce an increased penetration in low-emission, alternative-fuel technology, or an investment in advanced, alternative-fuel technologies that are zero-emitting. Additionally, the September 23, 1999, proposal did not contain any retrofit or repower provisions to reduce NO<sub>x</sub> and toxic PM emissions from the in-use urban bus fleet.

In the current proposal, one of the two paths that transit agencies must choose requires the use of low-emission, alternative-fuel technology, while the other path allows the use of diesel technology. Structured this way, the staff’s current proposal provides for increased penetration of low-emission, alternative-fuel technology, including investment in advanced, alternative-fuel technologies, yet it still provides flexibility to transit agencies. It is intended that the emission standards in the proposal harmonize with the standards that U.S. EPA is expected to adopt in 2000. Furthermore, the current proposal contains a modified fleet average component for NO<sub>x</sub> control, as well as retrofit requirements to achieve both NO<sub>x</sub> and PM emission reductions.

## **VIII. ECONOMIC IMPACTS**

### **A. Legal Requirement**

Sections 11346.3 and 11346.54 of the Government Code require state agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include consideration of the impact of the proposed regulation on California jobs, business, expansion, elimination, or creation, and the ability of California businesses to compete.

State agencies are also required to estimate the cost or savings to any state or local agency and school districts in accordance with instruction adopted by the Department of Finance. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the state.

### **B. Affected Businesses**

Businesses that may be affected as a result of the proposed regulation include heavy heavy-duty diesel or alternative-fuel urban bus engine manufacturers, urban bus manufacturers, engine retrofit kit manufacturers, exhaust aftertreatment emission control manufacturers, and manufacturers of advanced, alternative-fuel technologies, such as batteries and fuel cells. Since there are no urban bus engine manufacturers located in California and only one urban bus manufacturer in California, most impacts to business, both positive and negative, will occur in other states.

### **C. Potential Impacts on Business**

The proposed regulation is projected to have some cost impact on companies involved in the manufacture and production of engines and transit buses by creating the need for new engines and buses. Currently, there are no urban bus engine manufacturers located in California and only one urban bus manufacturer. The staff estimates that the cost of the proposed regulation to engine and bus manufacturers would be less than \$10,000 per bus. The total impact on businesses in California will be determined by the extent to which these companies choose to expand production in California, as well as the extent to which any increases in costs could be passed on to the final purchasers of engines and buses. As an example, ddb fuel cell engines, inc. has recently opened a research and development site near San Diego, California, to promote the use of fuel cell technology in passenger cars and urban transit buses. Specific to the retrofit requirements, California businesses capable of performing engine retrofits will be positively affected with increased workload.

The proposed regulation will also have a financial impact on transportation agencies and commissions statewide by requiring these entities to fund retrofits of existing engines to low-emission configurations and purchase new clean buses. For new bus purchases, federal funds are available to cover 80 percent of the total cost of a diesel urban bus, and 83 percent of a low-emission alternative-fuel bus. The remaining percent of new bus purchase costs not covered by federal funds, as well as costs for

retrofits, will have to be covered by other funding sources, which include transportation, air quality, and energy funds.

#### **D. Potential Impact on Business Competitiveness**

The proposed regulation is not expected to impact the ability of California businesses to compete with businesses in other states. As indicated above, most businesses that produce the products needed to meet the proposal are located in other states. By requiring new, clean technology, this proposal may actually provide new opportunities for California businesses engaged in advanced technology.

#### **E. Potential Impact on Employment**

The proposed regulation will likely create a market for manufacturers of heavy-duty diesel or natural gas urban bus engines, urban buses, and exhaust aftertreatment devices. For those businesses located in California, the creation of new jobs is expected to meet this demand. Services to retrofit existing buses are expected to take place in California creating new opportunities for existing businesses.

#### **F. Potential Impact on Business Creation, Elimination, or Expansion**

The proposed regulation could impact any California companies involved in the manufacture and production of engines and transit buses. Currently, there are no engine manufacturers and only one bus manufacturer located in California. Requiring new, cleaner engines and buses, could create new business opportunities for manufacturers of heavy-duty diesel or natural gas bus engines, urban buses, and exhaust aftertreatment control devices. While most businesses that could benefit from the increased business are located outside of California, the total impact on California business will be determined by the extent to which these companies choose to expand in California. As an example, ddb fuel cell engines, inc. has recently opened a research and development site near San Diego, California, to promote the use of fuel cell technology in passenger cars and transit buses. This expansion is a result of the expected new business opportunities created by the need for cleaner transportation technologies.

#### **G. Potential Costs to Local and State Agencies**

The proposed regulation is expected to have an impact on transportation planning agencies and commissions (the entities that fund transit agencies), and transit agencies statewide. This is due to the proposed requirements for a NOx fleet average standard, low-sulfur diesel fuel, new bus purchases, and PM retrofits. The following provides a summary of the costs to agencies for complying with the proposed regulation.

## 1. Fleet NOx Average Emission Requirements

The ARB staff projects that most transit agencies will comply with the fleet average NOx emission standard by retiring 1987 and earlier buses and then replacing them with new buses meeting more stringent emission standards. The ARB staff anticipates that in most cases, transit agencies will be able to obtain sufficient funding from available state and federal sources to purchase the new buses. As a result, no significant additional costs to transit agencies are expected for compliance with the fleet average NOx emission standard in 2002. There may be, however, instances where a transit agency is not able to obtain sufficient funds to purchase the new buses necessary for compliance with the fleet average NOx emission standard. Reasons for insufficient funding could include gaps in a particular funding cycle or the requirement for an inordinately large number of pre-1988 buses that need to be replaced. In these cases, there will be some cost to the transit agency to comply with the fleet average NOx emission standard.

This cost cannot be determined accurately since it would be based on specific fleet composition and internal bus replacement policy of each transit agency and their local transportation commission. An alternative available to transit agencies is to repower or retrofit a certain number of existing buses to lower emission configurations. The cost of an engine repower or retrofit kit is several times less expensive than the cost of a new bus, although the remaining useful life of a repowered or retrofitted bus will likely be less than that of a new bus. The ARB staff estimates that an engine repower or a retrofit kit will have an incremental cost of less than \$10,000, including installation. This may be done instead of, or in addition to, buying new buses. A transit agency will need to evaluate the most cost-effective method for its specific fleet to comply with this requirement.

## 2. PM Retrofit Requirements

Under the proposed PM retrofit requirements, transit agencies are responsible for installing PM retrofit devices that are certified with a conversion efficiency of at least 85 percent. To provide the time necessary to accomplish this program and to focus on the most serious problems first, the PM retrofit requirements are divided in three Tiers. Table 11 provides estimated costs for a "typical" 200-bus fleet, as well as statewide costs.

**Tier 1:** Tier 1 requires that buses certified to a PM standard of 0.6 g/bhp-hr be retrofitted by January 1, 2003. These are 1990 and earlier model-year buses and have extremely high emission levels of toxic particulates. On-road emissions of these buses are estimated as greater than 1.7 g/mile, compared to 0.02 g/mile for a natural gas bus. The ARB estimated that there are currently over 4,300 of these buses statewide. Many of these older buses are expected to be retired by 2003 a part of normal fleet turnover and because of the proposed NOx fleet average requirement. A conservative estimate would be that 12 and 13 year old buses are still within the fleet, but that all buses 14 year old and older have been retired. Therefore, given the current in-use fleet distribution, staff estimates that approximately 800 buses would be affected by this requirement. For a "typical" evenly distributed 200-bus fleet, this would represent

approximately 16 buses. At a cost of \$3,000 per bus, the total cost for a typical 200-bus fleet would be \$50,000. Larger fleets would obviously have greater costs and smaller fleets would have lower costs. Total statewide costs are estimated at \$2,400,000.

**Tier 2:** Tier 2 requires that buses certified to 0.10 g/bhp-hr PM and 0.07 g/bhp-hr PM be retrofitted in the 2003 to 2005 time frame. These are 1991 to 1995 model-year buses. On-road emissions of these buses are estimated as greater than 1.0 g/mile of PM. The ARB staff currently estimates that there are about 2,000 of these buses. The staff estimates that most of the 1991 model year buses are likely to be normally retired prior to requiring retrofits. Therefore, based on the current in-use fleet, the Tier 2 requirements are likely to affect approximately 1,500 buses total. For a typical 200-bus fleet, approximately 70 buses would require retrofits, for a cost of \$200,000. Total costs statewide are estimated at \$4,500,000.

**Tier 3:** Tier 3 requires that buses certified to 0.05 g/bhp-hr PM be retrofitted in the 2007 to 2009 time frame. These are 1996-2003 model-year buses, although it is likely that new buses delivered to transit districts in 2002 and 2003 could already be equipped with the "retrofit" installed. If the particulate aftertreatment were marketed by the engine or bus manufacturer as part of a new bus, it is likely that the cost could be reduced substantially. In addition, staff is assuming that by the time Tier 3 requirements are needed, at least modest cost reductions of 25 percent would have occurred. Therefore, staff is assuming a retrofit cost of \$2,250. ARB staff estimates that there are a total of about 3,800 of these 1996-2003 model year buses, but only about 2,200 of these buses will be required to retrofit. This is because the retrofit requirements do not apply to alternative-fuel buses. For a "typical" 200-bus fleet on the diesel path, 130 vehicles would require retrofit systems at a total cost of \$300,000. A transit agency on the alternative-fuel path would have retired most of their diesel buses and is expected to have a cost of no more than \$70,000. Total statewide costs, assuming half of the transit districts are on the alternative-fuel path, are \$5,000,000.

**TABLE 11**

<b>Average Annual Cost of PM Retrofit Requirements (2003-2009)</b>		
	<b>"Typical" 200-bus fleet</b>	<b>Statewide Transit Costs</b>
Tier 1 (by 1/1/03)	\$50,000	\$2,400,000
Tier 2 (by 1/1/05)	\$200,000	\$4,500,000
Tier 3 (by 1/1/09)	\$300,000	\$5,000,000
Total (average annual cost 2002-2008)	\$80,000	\$1,700,000

### **3. Low-Sulfur Diesel Fuel**

ARB staff is proposing that by July 1, 2002, all diesel fuel used by transit districts must have a sulfur content no greater than 15 parts per million (ppm). The incremental cost of the lower sulfur diesel fuel is estimated to be five cents per gallon. However, some fuel providers have quoted lower incremental costs for lower sulfur diesel fuel, while other fuel providers have quoted incremental costs as high as 15 cents per gallon. For a 200-bus diesel fleet, the estimated cost would be \$120,000 per year. Transit districts

are assumed to have modest savings with the fuel due to increased engine durability. This should be especially significant with engines produced after October 1, 2002, which are likely to incorporate EGR in order to meet lower emission standards. The savings, however, are not quantifiable at this time. For transit districts on the alternative-fuel path, the incremental fuel cost will be directly proportional to the percentage of diesel buses remaining. Total statewide annual costs are expected to be approximately \$3,000,000 in 2003, dropping to \$2,000,000 by 2010.

#### 4. New Bus Purchase Requirements

The ARB staff projects that a total of about 420 diesel buses will be purchased annually that would meet the proposed 2004 emission standards of 0.5 g/bhp-hr NOx and 0.01 g/bhp-hr PM. In 2007, staff projects that about 440 diesel buses will be purchased annually that would meet the proposed emission standards of 0.2 g/bhp-hr NOx and 0.01 g/bhp-hr PM. For large transit fleets, the ARB staff estimates that 18 demonstration ZEBs will be purchased in 2003, 30 commercial ZEBs will be purchased in 2008, and 80 ZEBs in 2010.

The incremental costs for the low-emission buses required are estimated at \$8,000 to meet the proposed 2004 standards, and an additional \$1,000 to meet the lower standards in 2007. For ZEB technology, staff estimates incremental costs at \$275,000 in 2002, \$50,000 in 2007, and nominal incremental cost in 2010.

Combining the total number of buses needed with the incremental cost allows the ARB staff to calculate the total annual cost of the requirement. In 2004-2006, the total cost of the program is \$5,900,000 per year, including the cost of zero-emission bus demonstration program. In 2007-2009, this total becomes \$5,300,000 per year. This total is reduced by 80 percent due to Federal Transit Administration (FTA) grants and results in a cost to transit agencies of \$1,200,000 per year in years 2004-2006 and \$1,300,000 per year in 2007-2009. The estimated statewide incremental cost to transit agencies in 2010 of \$800,000 is attributable to the expected reductions in costs of zero-emission buses in that time frame. Table 12 provides a summary of the costs associated with the new bus purchase requirements.

**TABLE 12**

<b>Estimated Incremental Costs To Transit Agencies of New Buses</b>			
<b>Year</b>	<b>"Typical" 200-bus fleet</b>		<b>Statewide<sup>2</sup></b>
	<b>Conventional</b>	<b>ZEB purchase<sup>1</sup></b>	
2004	\$27,000	\$35,000	\$1,200,000
2005	\$27,000	\$35,000	\$1,200,000
2006	\$27,000	\$35,000	\$1,200,000
2007	\$30,000	\$35,000	\$1,300,000
2008	\$30,000	\$25,000	\$1,300,000
2009	\$30,000	\$25,000	\$1,300,000
2010	\$30,000	\$25,000	\$800,000

<sup>1</sup> State and local incentives for advanced technologies may be available to offset a significant portion of the remaining incremental costs after FTA funding

<sup>2</sup> Federal funding covers 80 percent of new bus purchases and is not included in the costs shown in this table.

## **5. Alternative-Fuel Buses**

Under the proposed regulation, no transit agencies are required to buy natural gas buses if they want to continue buying conventional diesel buses. This section provides estimates of the costs that could be incurred if a transit agency elects to go on the alternative-fuel path as a means of compliance with the proposed regulation. Based on current fleet composition of transit agencies that have a significant presence of alternative-fuel buses, ARB staff estimates that about 300 alternative-fuel buses would be purchased annually, which could increase to 320 buses in 2007. Thus, the total incremental bus purchase cost to transit agencies, based on an incremental cost of \$40,000 per bus and an 83 percent fund match from FTA grants, is about \$2,200,000 per year. This cost is based on current purchasing trends from transit agencies that already have a significant number of alternative-fuel buses in their fleets. These transit agencies would be expected to continue to purchase alternative-fuel buses in the absence of this proposed regulation. Incentive funding by state and local air quality agencies has been available in the past to offset the incremental bus purchase cost not covered by FTA grants. It is not clear whether sufficient funding will continue to be available to offset the entire incremental purchase and infrastructure costs. Based on information obtained from transit agencies that already have significant numbers of alternative-fuel buses, operating costs vary significantly from one transit agency to another. Some transit agencies have shown cost savings.

## **IX. ENVIRONMENTAL IMPACTS**

This chapter presents the air quality benefits resulting from the implementation of the proposed public transit bus fleet rule and new urban bus engine emission standards. Adoption of the proposed regulation would benefit California's environment and would reduce the public's exposure to toxic diesel particulate emissions. The air quality benefits presented here are based on the mobile source inventory, EMFAC 2000, which has not yet been adopted by the Board.

In developing this regulation, the ARB staff has attempted to strike a balance between the need to reduce emissions as much as technologically feasible, and the desire to minimize the economic impact on affected businesses and transit organizations. A cost-effective approach is to reduce the emissions from the oldest buses in operation in fleets throughout the state. Under the proposed regulation, this could be accomplished by retrofitting an existing engine in a bus to a lower-emitting configuration, replacing an existing engine with a new lower-emitting engine, or retiring an old bus and replacing it with a new bus.

The useful life of an urban bus is twelve years. This is the minimum life required for buses purchased with FTA funds. However, many transit agencies are typically keeping at least a portion of their buses several years beyond the twelve-year useful life. These older buses are sometimes kept as reserve buses, but in actual practice, many of them are being placed in revenue service on a regular basis. Currently, a number of transit agencies in California have a significant number of pre-1988 buses in their fleets. Some agencies are operating 1984 and older buses. Based on information obtained by the ARB staff, pre-1988 buses comprise about 25 percent of the total number of buses in

California. These older buses emit more than one-and a half times the NO<sub>x</sub> emissions and twelve times the PM emissions of diesel buses meeting current emission standards. Significant emission benefits would be achieved if these older buses are retired and new buses are purchased to replace them. However, some transit agencies may be unable to obtain sufficient funding to replace all those older buses in their fleets in the time frame specified by the proposed fleet average NO<sub>x</sub> emission requirement. Significant emission benefits could also be achieved, particularly for PM emissions, by retrofitting these older engines to lower- emission configurations.

The proposed fleet average NO<sub>x</sub> emission level of 4.8 g/bhp-hr in 2002 could be easily achieved by most transit agencies simply by retiring their pre-1988 buses and replacing them with new buses. Depending on the actual fleet composition for each transit agency, staff believes that this is the most cost-effective way for many transit agencies to achieve the proposed fleet average emission level. In addition to retiring older buses, transit agencies could also repower or retrofit their existing buses to lower NO<sub>x</sub> emission levels. Engine repowering options are now available that can reduce emissions of engines from 6.0 g/bhp-hr to 4.0 g/bhp-hr and from 5.0 g/bhp-hr to 4.0 g/bhp-hr. In addition, engine manufacturers may make available a retrofit kit for urban bus engines that would reduce NO<sub>x</sub> emissions from 4.0 g/bhp-hr to 2.5 g/bhp-hr in the time frame of this regulation. Based on the fleet average emission level of existing buses, staff estimates that NO<sub>x</sub> emissions from urban buses would be reduced by about two tpd statewide in 2002. Although the staff's proposal ensures these two tpd are reduced, most of the reductions will be occurring through normal fleet turnover. Therefore, staff will not be assuming any NO<sub>x</sub> benefit (or cost) due to the fleet average requirement.

The proposed PM retrofit requirements are intended to reduce toxic diesel particulate emissions from existing diesel buses and those model year buses up to the year 2004. As discussed above, the PM emission standard for pre-1988 buses is about twelve times higher than the PM emission standard for current buses. The PM emission standards for pre-1996 buses are up to two times higher than the PM emission standard for current buses and model year buses up to the year 2004. As significant as these numbers are, in-use emissions data from chassis dynamometer tests show greater differences of PM emissions from diesel buses and CNG buses than would be predicted from the engine emission certification standards. Available chassis dynamometer data for urban buses operated on a Central Business District (CBD) test cycle show that for 1988 to 1990 buses, the average in-use PM emission level is about 1.7 grams per mile (g/mi). For 1991 to 1997 model year buses, the CBD data show the average in-use PM emission level to be about 1.0 g/mi. Even the current diesel buses have in-use particulate emissions of about 0.23 g/mi. By comparison, CNG bus emissions average 0.02 g/mi, regardless of their age. For these reasons, the ARB staff is proposing PM retrofit requirements for diesel buses. The ARB staff estimates that the retrofit requirements will reduce toxic PM emissions by about 300 pounds per day (lbs/day) statewide in 2005, and by about 100 lbs/day in statewide 2010, based on in-use CBD data.

While retrofit technology can yield immediate emission reductions from the existing bus fleet, future emission reductions from the urban bus sector can only be sustained

through more stringent emission requirements for new urban buses. Therefore, the proposed regulation contains new emission standards for buses, as well as requirements for larger transit agencies (fleets >200) to purchase zero-emission buses. As discussed previously, the ARB staff is proposing a 0.5 g/bhp-hr NOx standard and a 0.01 g/bhp-hr PM standard for diesel and dual-fuel urban bus engines effective in 2004. In 2007, all heavy-duty urban bus engines, diesel and alternative-fuel, will have to meet NOx and PM emission standards of 0.02 g/bhp-hr and 0.01 g/bhp-hr, respectively. To encourage the early introduction of zero-emission technologies for urban bus applications, the ARB staff is proposing a zero-emission bus purchase requirement for larger transit fleets. Transit fleets with more than 200 buses in their active fleets that are on the diesel path of the fleet rule will be subject to a zero-emission purchase requirement applicable to 15 percent of their new bus purchases starting in 2008. This same zero-emission purchase requirement will apply in 2010 for transit fleets with more than 200 buses in their active fleets that are on the alternative-fuel path of the fleet rule.

The ARB staff estimates the proposed new engine emission standards and the zero-emission bus purchase requirements will cumulatively reduce emissions statewide in 2010 by about 5.4 tpd of NOx and about 0.04 tpd (50 lbs/day) of PM. The emission benefits for the proposed regulation are summarized in Table 13 below.

**TABLE 13**

<b>Emission Benefits of Proposed Regulation</b>						
	<b>2005</b>	<b>2007</b>	<b>2010</b>		<b>2020</b>	
<b>Proposed Regulation Component</b>	PM (lbs/day)	PM (lbs/day)	NOx (tpd)	PM (lbs/day)	NOx (tpd)	PM (lbs/day)
PM Retrofit	300 <sup>1</sup>	100 <sup>1</sup>				
New Low-Emission and Zero-Emission Requirements			5.4 <sub>2</sub>	50 <sub>2</sub>	7.2 <sub>2</sub>	67 <sub>2</sub>

(1) Based on in-use CBD emission data from chassis tests.

(2) Based on combined benefits of 2004 and 2007 emission standards.

## **X. COST-EFFECTIVENESS**

The estimated cost-effectiveness of the proposed regulation is given in Table 14. The cost-effectiveness of engine emission standards and zero-emission bus purchase requirements is estimated to be about \$1.80/lb of NOx in 2010. The cost-effectiveness for these requirements is estimated to be reduced to \$1.50/lb by 2020. The cost-effectiveness of the proposed requirements compares favorably with the cost-effectiveness of mobile source and motor vehicle fuels regulations adopted over the past decade. Those adopted measures had cost-effectiveness values from \$0.17 to \$2.55 per pound of ozone precursors reduced.

As shown in Table 14, the cost-effectiveness for the PM retrofit requirements averages about \$17.90 per pound (\$/lb) annually from 2003 to 2009. This cost-effectiveness includes the cost associated with the requirement to purchase low-sulfur diesel fuel. In comparison, the cost-effectiveness of previously adopted PM control measures ranges from \$1.44/lb to \$3.20/lb. The cost-effectiveness of the PM retrofit requirement under this proposal does not include the value of health benefits associated with a reduction in exposure to a toxic air contaminant. The risk management process for the control of toxic PM emissions from diesel-fueled engines is ongoing. Any PM control measures resulting from the risk management process will produce additional PM reductions and health benefits that are not included in this regulatory proposal and that are not part of this cost-effectiveness determination.

**TABLE 14**

<b>Estimated Cost-Effectiveness of Proposed Regulation</b>			
<b>Proposed Requirement</b>	<b>Cost-Effectiveness</b>		
	<b>2003-2009 (\$/lb PM)</b>	<b>2010 (\$/lb NOx)</b>	<b>2020 (\$/lb NOx)</b>
PM Retrofit	17.90		
Engine Standards		1.80 <sub>1</sub>	1.50 <sub>1</sub>

(1) Estimated cost-effectiveness of engine standards includes federal contribution to bus purchase costs.

## **XI. SUMMARY AND STAFF RECOMMENDATION**

### **A. Summary of Staff's Proposal**

As presented in the previous chapters, the ARB staff's proposal is designed to reduce ozone precursor emissions, particularly NOx, and toxic air contaminants (diesel PM) by encouraging transit agencies to purchase or lease low-emission, alternative-fuel urban buses. The staff's proposal includes the following:

- A public transit fleet rule with two paths for compliance – a diesel path and an alternative-fuel path.
- A 4.8 g/bhp-hr NOx fleet average requirement for transit agencies.
- PM retrofit requirements for 2003 and earlier model year diesel urban buses.
- Zero-emission bus demonstration project requirements in 2003 for large transit agencies on the diesel path.
- Zero-emission bus purchase requirements beginning in 2008 for large transit agencies on the diesel path and in 2010 for large transit agencies on the alternative-fuel path.
- Requirements for transit agencies using diesel fuel to use low-sulfur fuel (15 ppm or less) beginning July 1, 2002.

- Reporting requirements as a means to determine a transit agency's compliance with the public transit fleet rule.
- More stringent emission standards, including a 0.5 g/bhp-hr NO<sub>x</sub> standard and 0.01 PM g/bhp-hr PM standard, for 2004 and subsequent model year diesel and dual-fuel urban bus engines.
- More stringent emission standards, including a 0.2 g/bhp-hr NO<sub>x</sub> standards and a 0.01 g/bhp-hr PM standard, for all 2007 and subsequent model year engines.

#### **B. Staff Recommendation**

The ARB staff recommends that the Board adopt new sections 1956.1, 1956.2, 1956.3, and 1956.4, Title 13, California Code of Regulations, and amend section 1956.8, Title 13, California Code of Regulations, and the incorporated "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Year Heavy-duty Engines and Vehicles." The regulation is set forth in the proposed Regulation Order in Appendix A.

## **XII. References**

1. Magary, Kerstin Fraser, San Francisco Municipal Railway, Information Provided on November 15, 1999.
2. Manufacturers of Emissions Controls Association (MECA), Emission Control Retrofit of Diesel-Fueled Vehicles, March 1998.
3. Detroit Diesel Corporation, Press Release, October 7, 1999.
4. MECA, Emission Control Retrofit of Diesel-Fueled Vehicles, March 1998.
5. MECA, Emission Control Retrofit of Diesel-Fueled Vehicles, March 1998.
6. Rothwell, Bruce, Marketing Manager, dbb fuel cell engines, inc., Information Provided on December 2, 1999

## Proposal for Cleaner Transit Buses

The ARB is developing a proposal for low-emission transit buses that would have a long-term requirement for zero or near-zero bus emissions in California. In the short-term, this proposal would provide incentives for transit agencies that implement low-emission technology immediately.

ARB has taken action statewide to assure that all mobile sources of air pollution bear some responsibility for improving air quality. The staff recognizes that the transit operators' primary responsibility is to efficiently provide convenient transportation. Meeting the transportation needs of commuters, students, transit-dependent riders and reducing traffic congestion are high priorities in our society. However, current diesel buses usually emit more pollutants than if the bus riders drove alone in their cars.

Cleaner, alternative-fuel technology is currently an available method of achieving significant emissions benefits for both transit and school buses. Staff originally considered a straightforward proposal that would immediately require all new bus purchases to be low-emission based on the ability of cleaner alternative-fuel technology to meet the lower emissions standards. ARB staff's current proposal is designed to provide the same emissions benefit, give the transit districts greater flexibility in making their operations part of the clean air solution, and still encourage cleaner buses immediately.

### **What are some impacts of air pollution?**

California has a serious, statewide ozone air pollution problem, including the worst air quality in the United States in the South Coast Air Basin (Los Angeles, San Bernardino, Riverside, and Orange Counties). Air pollution directly impacts public health, ranging from eye irritation, sore throats and coughing to lung damage, cancer and premature death. Healthy children and adults who play or exercise vigorously are also at risk. Federal requirements dictate that the South Coast Air Basin meet national ambient air quality standards for ozone by 2010. Other regions within California have even earlier attainment requirements.

The particulate emissions from diesel-fueled engines have been identified as a toxic air contaminant, one that causes cancer. In fact, preliminary estimates indicate that the particulate emissions from diesel-fueled engines are by far the most significant mobile source toxic risk faced by citizens of California. The ARB has adopted the goal of reducing exposure to diesel particulate emissions in order to protect the public health. Additional information on the specific toxic risk from particulate emissions at such locations as bus depots and bus stops is currently being determined.

### **What bus pollutants are we most concerned with?**

Current diesel buses have relatively high emissions of oxides of nitrogen (NOx) and particulates. NOx is critical because it is one of the two major components

that create ozone (or smog). Particulates, as discussed above, are a significant toxic air contaminant. Diesel engines have relatively low emissions of carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), and non-methane hydrocarbons (NMHC). CO emissions create hot spots that affect public health, although nearly all areas of California are in attainment for CO. CO<sub>2</sub> is a greenhouse gas that contributes to global warming. Emissions of NMHC are critical because in combination with NOx emissions they create ozone.

A natural gas bus will have significantly lower NOx and particulate matter (PM) emissions than a comparable diesel engine. A natural gas bus is also likely to have higher CO and CO<sub>2</sub> emissions and slightly higher NMHC emissions. However, the increase in these emissions is small compared to the decrease in NOx emissions.

### **Who would be affected by this proposal?**

This proposal is composed of two parts: a fleet rule applicable to transit districts and a regulation setting lower emission standards for urban buses. As proposed, the fleet rule would affect new purchases and leases of full-size buses. It would consider fleet size and normal fleet turnover rates. The proposed new urban bus standards would be implemented in phases and applicable to engine manufacturers.

Ideally, ARB staff would like all 8400 full-size transit buses, and all 23,000 school buses in California to be lower-emission immediately. However, that isn't practical. Long-term, it is generally more effective for requirements to apply to new purchases and not require retrofitting or repowering of existing buses. Also, most of the efforts by manufacturers has gone into demonstrating low-emission technology on "traditional" buses, e.g., 30 to 40 foot transit and school buses. Technology for specialized buses such as articulated buses may require additional time. These buses are currently low in sales and are not likely to be included in this proposal as long as their sales remain low.

### **Aren't buses just a small portion of the total air pollution problem?**

Yes and no. Urban buses do not make up a significant percentage of pollutant emissions; however, all emission sources are important. The ARB and local air districts have reduced emissions from nearly all sources, including very small ones, in order to make air quality progress over the last 20 years.

Several factors make bus fleets ideally suited for improved controls. Many of these buses operate in the most heavily congested urban areas where air quality is often critical and direct exposure to toxic diesel particulates occurs. This makes the toxic particulate emissions an even greater public health concern. Diesel buses operating on city streets cause direct exposure to this toxic air contaminant to children, passengers, and others in close proximity to the buses. They are centrally fueled, allowing for a cleaner alternative fuel to be utilized efficiently. As well, transit bus fleets do not have to rely entirely on local funding. The federal government heavily subsidizes the purchase of transit buses. Also, there are often

air quality funds available to offset most of the differential bus costs and some infrastructure costs.

**Are lower emission benefits feasible?**

Definitely. In fact, about 30 percent of California transit operators have some low-emission alternative-fuel buses, in use or on order. In most cases, their engines emit one-half the NOx and PM of comparable diesel engines. So immediate air quality benefits are possible. All diesel engines are currently certified to the dirtiest emission levels allowable; none are certified to ARB's low optional NOx standards. Therefore, there is no such thing as a "clean diesel" bus engine today.

**What about future emission standards – won't diesel engines be getting cleaner?**

Yes. New emission standards will require lower-emission engines. In late 2002, NOx emission requirements for most heavy-duty engines will be reduced by approximately 50 percent (2.5 g/bhp-hr NOx + NMHC), to the current NOx emission levels of natural gas engines. PM emission standards, however, will stay the same, and we expect PM emissions from natural gas buses to continue to be less than that from diesel buses. As diesel engines get cleaner, so can natural gas engines. To meet future standards, it is expected manufacturers will utilize more sophisticated fuel management and increased exhaust gas recirculation. Incorporation of these technologies into natural gas engines will also lower their emissions significantly from the current levels, continuing to make them lower emitting than the best available diesel technology.

**What do we mean when we talk about alternative fuels?**

Alternative fuels include compressed and liquefied natural gas, propane, methanol, electricity, and fuel cells. The most common type of low-emission alternative-fuel engine available uses natural gas. Natural gas is usually stored on-board the bus as compressed natural gas (CNG) or liquefied natural gas (LNG). Currently California transit operators have many CNG buses, a few electric buses, and LNG buses are on order by several operators. As well, CNG/electric hybrid buses are becoming available. A more detailed discussion of current and future transit bus technology (both diesel and cleaner alternative fuels) is contained in Appendix I.

**What are the costs associated with low-emission natural gas buses?**

Cost is a multi-faceted issue, and includes both capital and operating costs. Capital costs to the transit operator vary depending on the level of subsidized funding that is available to cover the higher costs of the low-emission buses and new or modified refueling and maintenance facilities. In general, air quality funds have been able to pay most or all of the differential cost of the buses. However, operators have generally borne a larger responsibility for the cost of the refueling and maintenance facilities.

Operating costs (including fuel, compression or liquefaction, bus and facility maintenance, and other costs) are generally not subsidized by non-transportation

agencies. Differential fuel costs per mile of natural gas fleets vary depending on the current diesel fuel prices, which tend to fluctuate more than natural gas prices. (Current diesel fuel retail price averages about \$1.40 per gallon and CNG about \$1.20 per diesel gallon equivalent, including compression costs.) Natural gas technology is relatively new; therefore, insufficient historical data is available on maintenance costs. Different transit agencies report significantly different operating costs. In general, however, it can be expected that overall future operating costs for natural gas and diesel will be approximately equivalent. A more detailed description of the costs associated with cleaner alternative fuels is contained in Appendix II.

### **What other concerns are associated with low-emission alternative-fuel buses?**

Additional issues discussed often include reliability, driving range, and safety. Much of the reliability issue reflects the learning curve that engine manufacturers and bus operators have experienced as they implement the relatively new natural gas bus technology. The reliability and the learning curve are tightly tied to the costs of the technology and are also discussed more extensively in Appendix II. Relatively new technologies, such as natural gas bus engines, take time to become efficient and reliable; new programs take special efforts to implement. Some transit operators and school districts report few reliability issues; others report numerous problems. ARB staff knows of no reason to conclude that natural gas engines will be any less reliable than diesel engines in the long term. However, we have noticed common factors among those successfully incorporating these engines today. Management support and involvement, training for mechanics and drivers, and qualified and experienced engineering support seem to be crucial in achieving successful operations.

The driving range of CNG buses is typically less than comparable diesel buses. This is more of an issue for transit bus operators with long runs than for school bus operators. First, operators can take steps to insure that the CNG tanks are completely full after refueling. If that doesn't give adequate range, several options are available. Some operators can schedule mid-day fueling or bus substitutions en-route, although they must consider the impact on lost revenue time and scheduling difficulties. LNG buses are also available which have greater ranges, although they may have higher fuel costs.

Safety of any new technology is always a serious issue. CNG tanks are under high pressure. A rupture of such a tank can cause severe damage. One such rupture occurred several years ago at the Los Angeles County Metropolitan Transit Authority (LACMTA). However, operators with natural gas buses have instituted rigorous inspection procedures and other safeguards. Since CNG is more volatile than diesel, modifications to existing maintenance facilities are generally necessary. These usually consist of a methane detection system, an improved ventilation system, new lighting, employee training, and containment procedures.

**What has the ARB done to investigate all of these issues?**

The ARB staff has visited transit operations at LACMTA, Sacramento Regional Transit District, Cleveland Regional Transit Authority, New York City Transit, Pierce Transit in Tacoma, Washington, and Dallas Area Rapid Transit and Houston Metropolitan Transit Authority in Texas. Staff has had discussions with many more transit agencies and additional site visits are planned. Staff has also questioned engine and bus manufacturers, natural gas providers, and many others.

**Why wouldn't all operators move to cleaner, alternative fuels?**

Just like private businesses, some transit operators welcome new technology, while others prefer a traditional approach. Governing boards of some transit agencies adopt air quality improvement as one of their goals; others do not. In some cases, operators relying solely on diesel are biased based on outdated information or misconceptions. Often, a bad experience many years ago with a new technology can remain with a transit agency and make them apprehensive about trying new technologies. Some do not know about the significant funding that could be available to offset increased costs.

A few transit agencies are well informed on the issues and are making deliberate decisions to stay with higher-polluting diesel engines for now. These transit agencies have argued that future technology is very promising, will provide even greater emission benefits, and the investment in natural gas infrastructure is not warranted. ARB is also excited about the future technologies. However, seldom have air quality benefits been achieved with a "wait and see" approach. In addition, many of the future technologies will work as well or better with natural gas than they will with diesel. So ARB believes an investment in natural gas infrastructure will continue to pay dividends. Nonetheless, the ARB staff has structured its current proposal in such a way that will allow significant flexibility for these transit agencies while maintaining the emissions benefits of the program.

**What are the longer-term technical possibilities?**

Longer-term possibilities include low-sulfur diesel fuel, NOx exhaust aftertreatment, hybrid electric vehicles, and fuel cell vehicles. In general, each of these technologies shows great promise for reliable, cost-effective emission reductions. A system that uses low-sulfur fuel and an advanced NOx exhaust aftertreatment, in conjunction with an optimized hybrid electric system, has the potential to achieve near-zero emissions. Fuel cell propulsion systems, although slightly longer term, show incredible promise for public transit with zero or near-zero emissions.

**What type of proposal is the ARB considering?**

The staff's proposal combines two main components: a fleet rule and more stringent urban bus engine standards. The fleet rule is designed to achieve early emission reductions. The engine standards are designed for long-term ultra-low and near-zero emission benefits.

### **Why is ARB considering a fleet rule?**

A fleet rule is a departure from typical ARB rulemaking. ARB staff is proposing this type of rule to provide flexibility and incentives to transit bus operators. In determining what fleets are subject to the rule, ARB staff can consider air quality attainment status, fleet size, cost-effectiveness, and available funding. By providing incentives related to phasing-in of requirements, the proposal can reward operators already committed to low-emission fleets and encourage other operators to make that commitment. Small fleets, where it may not be cost-effective to make a substantial investment in new natural gas refueling capabilities and facility modifications, can be exempted from buying low-emission buses for a longer period of time.

### **What are the specifics of the fleet rule?**

To provide flexibility to transit operators, ARB staff is developing a proposal with two different options for compliance with the fleet rule. The options are a “conventional/advanced technology” option and an “incentive” option.

The “conventional/advanced technology” option is for those operators that in the near-term continue to purchase or lease buses that only meet the current standards. Some transit agencies have stated that they would forego investment in cleaner alternative-fuel engines now, and instead invest in advanced technologies such as hybrid and fuel cell buses. Those agencies that follow the “conventional/advanced technology” path would bear the responsibility and potentially greater expense of introducing that zero or near-zero technology into fleets first. For these operators, new buses delivered after January 1, 2005 must meet NO<sub>x</sub> and PM standards of 0.5 g/bhp-hr and 0.01 g/bhp-hr, respectively. This represents a 75% NO<sub>x</sub> reduction and an 80% PM reduction from the 2002 requirements. See Table 1 below and Figures 1 and 2 attached to the end of this document.

The “incentive” path is for transit agencies that have already committed to cleaner alternative-fuel engines, or transit agencies that move to cleaner-than-required engines very soon after approval of a fleet rule by our Board. This option would create immediate emission reductions. Operators that have purchased buses that meet the lower emission levels (2.5 g/bhp-hr NO<sub>x</sub> and 0.03 g/bhp-hr PM) would then be eligible to delay buying buses with engines meeting the 0.5 g/bhp-hr NO<sub>x</sub> and 0.01 g/bhp-hr PM standards until 2007. To qualify for the “incentive” path, staff is considering a requirement, based on a 12-year bus life, that at least one-fourth of an operator’s fleet (including ordered buses) meets the NO<sub>x</sub> and PM lower emission levels as of January 1, 2003. The ARB is also considering an additional requirement that at least 75 percent of the buses ordered between the adoption of the fleet rule and January 1, 2003 meet the lower emission levels. See Table 1 below and Figures 1 and 2 attached to the end of this document.

**TABLE 1 -- PROPOSED EMISSION LEVELS FOR TRANSIT BUSES**

Year	"Conventional" Path		"Incentive" Path	
	NOx (g/bhp-hr)	PM (g/bhp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)
2000	4.0	0.05	2.0	0.03
2003	2.0	0.05		
2005	0.5	0.01	2.0	0.01
2007			0.5	0.01
2008	0.1	0.0	0.5	0.0
2012			0.1	0.0

Whether a transit operator follows the "conventional/advanced technology" or the "incentive" path is voluntary. However, those that follow the "conventional/advanced technology" path are locked onto that path after January 1, 2003 and cannot switch to the "incentive" path after that time. It is expected many fleet operators would have to choose in the first year which path to take in order to accrue a sufficient percentage of buses meeting the lower emission levels.

Overall, the average NOx emissions through 2012 from the "conventional/advanced technology" and "incentive" compliance paths would be virtually equal. For PM there would still be a significant benefit with the "incentive" path.

**What about "small" fleets?**

The ARB staff believes most transit agencies will comply with the "incentive" path through the use of natural gas buses (although other options are available as long as the engines meet the proposed standards). Therefore, after analyzing natural gas fleets, staff plans to propose that "small" fleets be defined as those that could not support a natural gas refueling station. In general, the ARB believes this level is somewhere between 20- and 40-bus fleets. Staff is proposing that all small fleets would automatically qualify for the "incentive" path.

**Describe the near-zero bus standard proposal.**

To meet air quality goals, the ARB needs to pursue zero or near-zero technologies where it is feasible and cost-effective. Urban buses are such a category. As discussed earlier, several promising technologies are possible, independently or in tandem. Staff is proposing standards of 0.1 g/bhp-hr NOx and 0.00 g/bhp-hr PM. Those operators on the "conventional/advanced technology" path would be required to buy or lease buses with engines meeting these standards in the 2008 model-year. Those on the "incentive" path would be required to meet these standards in the 2012 model-year.

### **What is the ARB considering for school buses?**

It is important to reduce emissions from school buses. A school bus travels far fewer miles than a transit bus – generally 15,000 miles annually, compared to over 40,000 miles; however, there are almost three times as many school buses, and many are very old, high-polluting diesel buses. Their emissions' impact on ozone formation may be small as fleets operate primarily outside the ozone season. However, reducing the direct exposure of students to toxic diesel particulates is a high priority for ARB.

Those school transportation operators with CNG buses are generally very enthusiastic about their new buses. Some have their own refueling stations; some share refueling stations with other local fleets. However, staff has found there are barriers to including school districts in the fleet rule. First, there are many small fleets; a joint-use refueling station will not always be available; and it would not be cost-effective to require small fleets to install this infrastructure. Second, there is a shortage of grant funds to subsidize the low-emission alternative-fuel buses and infrastructure. As few school districts charge students any fees to ride buses, transportation services must compete with all other school district operations for funding.

Therefore, the ARB is not including school districts in this fleet rule. Staff will evaluate a proposal in 2000 addressing school buses. In the interim, ARB staff will encourage transportation agencies to spend some of their air quality funds on school bus projects and air districts to subsidize school buses and infrastructure. Staff is also working with the California Energy Commission to secure additional school bus and infrastructure funding and investigating possible new sources of funds. As well, staff plans to work with local air districts and school districts to identify other voluntary and regulatory methods to reduce student exposure to toxic diesel particulates emitted by school buses.

Although the ARB is not proposing to include school buses in this proposal, some emission reductions are expected. First, the late-2002 heavy-duty engine requirements (2.4-2.5 g/bhp-hr NO<sub>x</sub>+NMHC) will apply to most school bus engines. Also, truck engines used to power full-size school buses would have to comply with new heavy-duty truck engine standards expected in the future. Finally, as discussed previously, the ARB is in the risk management phase for control of particulates from diesel-fueled engines. This work will be completed in early 2000. At that time, the ARB will evaluate whether any toxic-specific control measures are appropriate for school buses.

### **Are any alternatives being considered for the transit rule?**

The staff has considered several different alternatives in the development of the current proposal. The original proposal was a straightforward requirement that would have required all transit operators to purchase only buses that meet lower-emission standards immediately. A second alternative that was analyzed was one in which a declining fleet average standard would be required. A fleet rule

provision that would update older technology is being evaluated. Finally, the staff is still considering including an alternative that would provide regulatory incentives for transit operators that move to near-zero technology quickly. Each of these options is presented below along with a discussion, and staff welcomes comments on each of these possibilities.

Low-Emission Standard: As discussed earlier, the staff originally considered a proposal that would set engine standards that would likely have required all new bus purchases to be cleaner alternative-fuel buses; they meet low emission NOx and PM levels now. In addition, the technology to achieve these benefits is already well established and many transit operators are converting their fleets to alternative fuels. Such a proposal would have provided significant emissions benefits.

As well, in September 1998, the ARB Board adopted Resolution 98-49, that urged State, local and federal agencies to join together with ARB in actions to “clean the fleet”.

ARB is on record as encouraging the replacement of diesel-fueled school and transit buses with cleaner alternative-fuel buses, including provision of necessary infrastructure and technical training. Subsequent to the adoption of this Resolution, ARB staff has contacted funding agencies in attempts to secure funding for cleaner alternative-fuel buses and infrastructure, and conducted other outreach efforts.

However, in the many meetings that staff had with transit districts and transportation agencies, several of them were strongly in favor of additional flexibility. The greatest challenge was developing a proposal with more flexibility that isn't a “give-away”, i.e., a proposal that maintains the same emissions benefits as one that sets low emission standards. One proposal seriously considered was a fleet average rule.

Fleet Average Rule: A fleet average rule would be one that would not just consider new bus purchases but would also consider those buses already in the fleet. Diesel buses have become modestly cleaner over the past several years. For example, whereas the current NOx standard has been 4.0 g/bhp-hr since 1996, the standard was 6.0 g/bhp-hr from 1988 through 1990 and 5.0 g/bhp-hr from 1991 through 1995. The useful life of an urban bus is considered to be 12 years (although many operators operate older buses). If a transit operator has an evenly distributed fleet it would have three years of buses (1988-1990) at the 6.0 g/bhp-hr level, five years of buses (1991-1995) at the 5.0 g/bhp-hr level, and four years of buses (1996-1999) at the 4.0 g/bhp-hr level. Their current fleet average emission level would be approximately 4.9 g/bhp-hr NOx.

Although an evenly distributed fleet no older than 12 years would have a fleet average of 4.9 g/bhp-hr NOx, many operators have older buses and their actual in-use fleet average would be higher. However, staff would not propose a starting

fleet average higher than 4.9 g/bhp-hr NO<sub>x</sub> since that, in effect, would provide a reward for those transit operators that have not yet replaced their old, very high-emitting diesel buses. In fact, a lower starting fleet average would seem to be appropriate. Several proactive transit districts such as LACMTA, Sacramento Regional Transit, and Sunline Transit have been purchasing low-emission buses for many years and their fleet average would be considerably less, in the range of 4.0 g/bhp-hr NO<sub>x</sub>. Thus, a fleet average standard that began around 4.9 g/bhp-hr would be extremely lax and provide no benefit with these fleets.

The gaps between the different operators is so large that a practical fleet average system could not be established unless it started out low enough to challenge even the proactive transit operators. Staff has had difficulty determining how such a proposal could work, and finds that only if credits could be bought and sold, could such a system provide emission benefits. The price of those credits would be established by supply and demand. However, a starting point for those credits would be in the range of \$12,000/ton that is often the limit for cost-effective mobile source projects.

Therefore, if a fleet average rule were pursued, it would be one that requires an operator to determine its fleet average emissions every year, or every other year, and compare that with a declining ARB fleet average standard. The starting point could be a current level of approximately 4.0 g/bhp-hr NO<sub>x</sub>, with the next specified fleet average standard in the range of 3 g/bhp-hr NO<sub>x</sub> in 2003 and declining in subsequent years. Operators that did not meet these standards would have to purchase credits each year until they had met the declining fleet average standard. Operators that did not purchase any buses meeting the low-emission "incentive" levels would likely need to buy credits from those that did so. Price of the credits could be substantial depending on how much the transit operator would be willing to do in terms of fleet turnover, retrofits and repowers.

Several issues were raised in the analysis of this concept. First, as discussed, establishing the appropriate fleet average standards is difficult given the large gap that currently exists between different fleets. A second issue is that local air quality districts may be relying on low-emission transit buses in their clean air plans. Having the ability to purchase credits from another transit agency (possibly outside their air district) may provide flexibility but does not provide needed air quality benefits. A final issue is that the system is quite complex. Transit operators would have to track emission levels or standards of all their buses; annual fleet average determinations would need to be computed and submitted to ARB; and an entire credit system would need to be developed.

Update Older Technology: ARB is considering including an engine repower, certified retrofit, or bus replacement provision in its fleet rule. It would be based on the normal bus life of 12 years. For instance, it could require that all engines certified to over the 6.0 g/bhp-hr NO<sub>x</sub> standard be retrofitted or repowered, or the buses replaced, by the end of 2000. Bus engines certified to the 6.0 g/bhp-hr

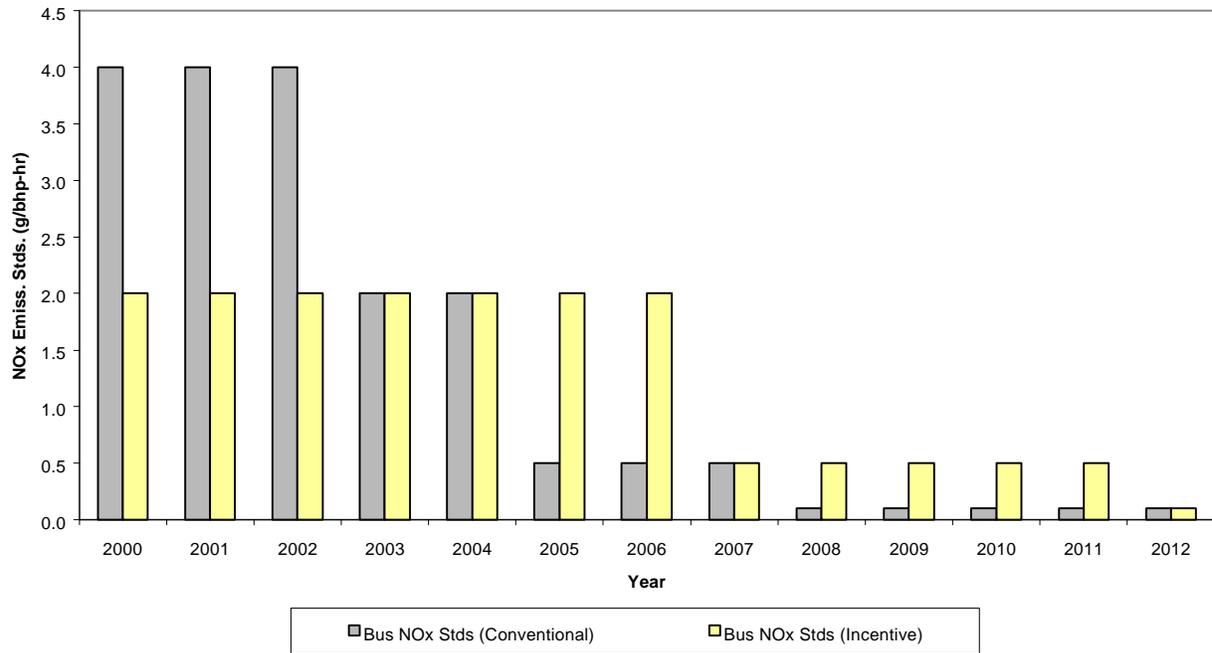
standard would have to be retrofitted or repowered, or the buses replaced, by the end of 2002, and 5.0 g/bhp-hr engines by the end of 2008. This would be in addition to any retrofits required under the U.S. Environmental Protection Agency urban bus retrofit program for particulate matter.

Near-Zero Option: A final option that the ARB is considering is one that would provide flexibility to those operators that want to move directly to the zero/near-zero technologies. Some operators have expressed a strong interest in fuel cell technology and an option may be developed which encourages operators to expeditiously implement such technologies.

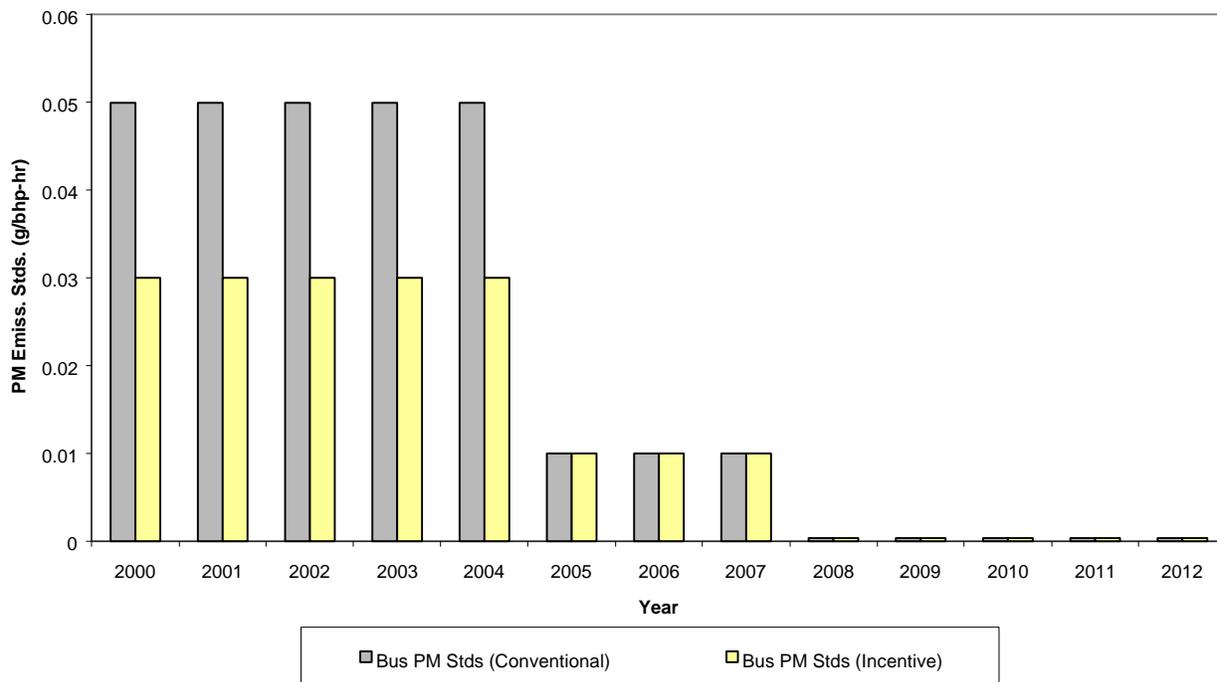
**What are the next steps?**

Staff will make a more detailed proposal available on our web site ([www.arb.ca.gov](http://www.arb.ca.gov)) shortly. We will also include draft regulatory language. The proposal outlined here is a staff proposal. It will be refined through the workshop process and will be presented to the ARB governing board at a regulatory hearing currently scheduled for January 2000. Public participation throughout the process is encouraged.

**FIGURE 1  
NOx STANDARDS COMPARISON**



**FIGURE 2  
PM STANDARDS COMPARISON**



## Appendix I

### Emission Control Technologies

#### **Introduction**

This section briefly discusses both commercially-available technology and emerging technology, that could be used in urban transit buses and school buses. Diesel engines have long been the engines of choice for use in urban transit buses. This is due to the efficiency and durability of diesel engines, as well as the operators' familiarity with diesel engine technology. Historically, this preference is also due to the lack of viable alternative engine technology for use in heavy-duty vehicle applications. This is no longer the case. Recent advances have enabled alternative engine technologies to close the performance and reliability gaps with diesel engines and, at the same time, clearly outperform diesel engines in terms of emissions. Some of these technologies are commercially available today, such as natural gas engines. Other technologies are being demonstrated that are expected to be available soon and have great potential to reduce emissions to near-zero or zero levels, such as hybrid-electric and fuel-cell technologies.

#### **Diesel Technology**

Diesel engines dominate the heavy-duty transportation sector due to their efficiency, long life, and fuel economy. Current emission control technologies such as combustion chamber modifications, advanced induction systems, and fuel injection strategies, such as retarded timing and high injection pressure, have resulted in diesel engines emitting about 30 percent less oxides of nitrogen (NO<sub>x</sub>) emissions than diesel engines manufactured a decade earlier. This achievement from diesel engines is significant but the level of NO<sub>x</sub> emissions from diesel engines is still about twice that of currently available alternative fuel engines. Regulatory pressure to produce even lower-emission diesel engines has increased efforts by engine manufacturers and aftermarket companies to develop advanced emission control technologies. To comply with future lower NO<sub>x</sub> emission standards, engine manufactures are researching several promising technologies such as cooled exhaust gas recirculation (EGR) and aftertreatment technology.

EGR is one of the most effective engine control methods for reducing NO<sub>x</sub> emissions. Spent combustion gases recirculated back into the intake system serve as a diluent to lower the oxygen concentration and to also increase the heat capacity of the air/fuel charge. Cooled EGR (cooled through the aftercooler) is used to minimize combustion temperatures. This reduces peak combustion temperature and the rate of combustion, thus reducing NO<sub>x</sub> emissions. However, particulate matter (PM) emissions may increase and fuel economy may decrease. The proper balance of EGR and temperature may provide the proper characteristics for decreasing NO<sub>x</sub> emissions while not increasing PM.

Currently, heavy-duty engine exhaust aftertreatment for NO<sub>x</sub> is limited by the lean environment, i.e., excess oxygen, of the diesel engines. Automotive catalysts rely on a nearly perfect balance of oxygen in the exhaust stream to maximize catalytic converter efficiency. One solution for heavy-duty vehicles is a selective catalytic reduction (SCR) system. These systems are common in stationary sources and are also used on some mobile sources in Europe. In this system, a reductant, commonly ammonia or urea, is injected into the exhaust upstream of the catalyst. In an SCR system with a reducing agent, the reductant decomposes and reacts across a catalyst to reduce NO<sub>x</sub> emissions. Cost is reasonable and NO<sub>x</sub> emission reductions are greater than 70 percent. Most of the issues appear to be pragmatic ones (packaging, communication of the SCR system with the engine's computer controls, etc.) These systems could be commercially available on new buses or even as retrofits within one to two years. For the longer term, NO<sub>x</sub> adsorbers could be available which would not require an additional reductant to be added. Again, cost would be reasonable. Efficiency could be greater than 70 percent and this technology could be available in the 2004 time frame. A critical element of many aftertreatment technologies is the necessity to have low-sulfur fuels. Although an SCR system may not necessarily need low-sulfur fuel, most other heavy-duty aftertreatment technologies could not function efficiently and reliably in an exhaust environment with significant quantity of sulfates present, due to trap plugging and catalyst fouling. Numerous programs are underway to evaluate appropriate levels of sulfur for future diesel fuel.

### **Current Natural Gas Technology**

A number of alternative fuels are available for use in vehicular applications, such as methanol, ethanol, natural gas, propane, and others. Currently, however, only natural gas engine technologies have developed sufficiently for heavy-duty vehicle applications. This discussion, hence, only focuses on natural gas engine technology, for both compressed natural gas (CNG) and liquefied natural gas (LNG) engines.

Unlike diesel engines, which ignite by compression, natural gas engines are spark-ignited. In this respect, they are similar to gasoline engines, which also use the electrical energy provided by spark plugs to initiate the combustion process. Spark-ignition engines (SI engines) have slightly less efficiencies than compression-ignition (i.e., diesel, or CI, engines). Current technology for heavy-duty natural gas engines, such as lean-burn, closed-loop, and electronic fuel management system, has enabled natural gas engines to approach diesel-like fuel economy and performance, while emitting only one-half of the NO<sub>x</sub> and PM emissions compared to diesel engines. There is a slight increase in emissions of carbon monoxide, carbon dioxide and non-methane hydrocarbons from natural gas engines.

Both CNG and LNG heavy-duty engines operate in the same way; the difference in the two being the fuel storage and delivery methods, for both onboard the

vehicle and at the fueling facility. CNG is natural gas under high pressure. To increase the energy content per unit of fuel storage volume, natural gas from pipeline is compressed to high pressure, usually around 3,600 to 4,000 pounds per square inch. The high pressure of CNG requires special tanks constructed from either steel or carbon composite. The weight and costs of CNG tanks are important factors to consider when specifying the number and types of tanks to be put on a bus. LNG is natural gas chilled to cryogenic temperature. At minus 260 degrees Fahrenheit (-260°F) natural gas is condensed into a liquid. The advantage of LNG as a fuel is its greater energy density, compared to CNG, and its purity. Liquefaction removes most of the non-methane constituents present in natural gas, such as water, hydrogen sulfide, carbon dioxide, particulate and foreign matter, and the heavier hydrocarbons. The result is very pure natural gas that is 95 to 99 percent methane. Since LNG has higher energy density for a given storage volume than CNG, it could provide sufficient fuel for longer vehicle range and with less weight penalty than CNG. LNG is stored in double-walled vacuum-insulated tanks designed to minimize heat gain. The composition of LNG could be altered significantly, however, if LNG is left in storage for a long time and is exposed to high ambient temperatures, a process sometimes referred to as “LNG weathering”. Out of specification LNG could negatively affect engine performance.

Both CNG and LNG engines are currently available for heavy-duty vehicle applications. Urban transit buses have traditionally used CNG engines, although LNG transit buses have also been ordered. Some transit agencies, in fact, prefer LNG engines due to the increased range, along with reduced weight and costs, associated with LNG buses. Considerable emphasis is being placed on demonstrating efficient small-scale liquefaction units in California that could provide LNG fuel at a significantly reduced price. However, LNG is not readily available in California today, whereas the state’s utility companies could easily supply natural gas for compression for use in CNG buses. Most heavy-duty engine manufacturers have natural gas engines for sale. Some engine manufacturers have certified their natural gas engines to the ARB’s optional NO<sub>x</sub> standards that is approximately one-half of the existing NO<sub>x</sub> emission standard for heavy-duty engines.

The engine and aftertreatment technologies discussed in the Diesel Technology section are generally applicable to lean-burn natural gas engines as well. In some cases, higher aftertreatment efficiencies could be achieved. This is because the natural gas engine operates at a higher temperature and the higher temperatures can improve the efficiency of aftertreatment technologies. In addition, the natural gas does not contain sulfur so these systems would not have the efficiency and durability issues associated with sulfur poisoning from diesel fuel.

## **Emerging Engine Technology**

Rapid advances in emission control technology are expected to substantially reduce both NO<sub>x</sub> and PM emissions from diesel and natural gas heavy-duty engines. In addition to diesel and natural gas engines, hybrid-electric and fuel-cell technology for transit bus application are developing rapidly and are expected to be commercially available in the next few years. These technologies have the potential to lower emissions from buses to zero or near-zero level.

Hybrid-electric bus technology combines an internal combustion engine (diesel or a cleaner alternative fuel) and an electric motor to optimize the function of each to achieve very low emission levels and improved range. Hybrid-electric buses are currently under demonstration at several transit agencies. Fuel cell technology uses electrochemical reactions to provide power to operate the bus. The most promising fuel cell technology currently under demonstration is proton exchange membrane. In a fuel cell, hydrogen fuel dissociates in the presence of catalyst into free electrons and protons. The free electrons are conducted through an external circuit creating an electric current to power the fuel-cell engine. The protons migrate across the membrane, combine with oxygen in the air and electrons from the external circuit to form water and heat; no pollutants are created. The hydrogen use in fuel cells can come from any number of sources, including gasoline, methanol, and natural gas. Fuel-cell buses are also currently being demonstrated and tested at several transit agencies.

## Appendix II

### Costs Associated with Cleaner Alternative-Fuel Buses

#### **How much do natural gas buses cost?**

Natural gas buses are more expensive than diesel buses for two basic reasons. The most significant reason is that they are produced in smaller volume (and small volume almost always translates into higher cost). In addition, natural gas engines include a few additional components that the diesel engine does not have (e.g., spark plugs and coils). Although the incremental cost varies from one purchase to another, partly based on differences in specifications, it is generally in the range of \$35,000 to \$50,000 more for a full-size transit bus and \$25,000 for a school bus. This is 12 to 16 percent more than the cost of a typical transit bus and approximately 25 percent more than the cost of a typical school bus.

How much of this cost a transit operator would have to secure from local transportation agencies and other local funding sources is not a straightforward issue. The Federal Transit Administration subsidizes up to 83 percent of the cost of a new alternative-fuel transit bus. In addition, local air district funding is available to many transit agencies that buy clean-fuel buses. In many cases, transit agencies have purchased low-emission natural gas buses at no additional cost to them because of the grant funds available.

School districts, however, are required to bear much of the additional costs. There are few dedicated State or local funds set aside to meet school transportation needs. Air quality funds are not so easily accessed, as school buses may not accumulate enough miles each year to meet the cost-effectiveness criterion of the air districts or the State. As well, school districts often need more than the incremental purchase cost to be able to buy any new buses at all.

#### **Are there other capital costs associated with natural gas buses?**

Yes. Refueling and facility costs are significant. For compressed natural gas (CNG), new pumps are needed and compressors are required. Compressing the gas allows more fuel to be stored on the bus as well as allowing faster filling of the on-board tanks. Fuel for LNG buses can be trucked to the site, or liquefied on site, come from a joint-use facility, or other otherwise provided.

Facility costs will vary based on the pressure of the available natural gas, space available for expansion, type of liquefaction and compression equipment, and the condition of the current facility. In the maintenance facility, methane monitoring devices, ventilation equipment, and non-explosive lighting fixtures are usually needed. Some small operators start their fleet conversions using less expensive slow-fill equipment and plan to install permanent fast-fill refueling capability when required. School buses may be fueled off-site at public or private fueling stations.

Total costs for a complete 200-bus facility changeover to CNG are in the range of three to four million dollars in California. Usually, there are not enough local air district or State incentive funds available to cover a significant portion of these costs. Federal funds could be available, or diverted from other sources, by the local transportation agencies that distribute federal funds by region.

Some transit agencies and school districts have begun contracting for on-site fueling services with natural gas facility providers. The companies build facilities and maintain them for a monthly fee that is added to the delivered cost of the fuel. In some cases, at the end of a contract with the provider, the bus operator owns the fueling station. Some transit operators prefer not to share management of their operations with others, but such arrangements have the potential to allow the operator to move to natural gas-fueled fleets with much lower up-front costs. As well, some operators sell CNG to other users to help pay for their refueling facilities.

The joint use of a refueling facility by several public and private fleets -- transit and school bus operators, post office fleets, paratransit and shuttle operators, and trucking fleets and so forth -- can reduce costs.

#### **What about operating costs associated with natural gas buses?**

Fuel price, fuel compression or liquefaction, facility maintenance, bus maintenance and other costs are defined as operating costs by major operators, though accounting procedures vary. ARB staff has found that different transit agencies report significantly different operating costs, based partly on size and location of their operations. Of major importance seems to be the training of the technical staff and mechanics to maintain more sophisticated computer-controlled engines. This is an issue not only with natural gas engines, but also with all future diesel engines. The majority of natural gas and diesel bus equipment is the same (frame, doors, seats, wheels, brakes, transmission, equipment for the disabled, etc.) so those maintenance costs should be relatively similar.

However, natural gas engines have some parts that are not on diesel engines and these parts can be relatively expensive due to their low sales volume. CNG buses are heavy due to the extra weight of the CNG tanks; LNG buses are not as heavy. One would expect to have incrementally greater brake wear on CNG buses than diesel buses. However, not all natural gas bus operators have observed this and it may only be an issue where buses are overloaded. Some maintenance costs can be lower. Natural gas engines also burn cleaner and therefore should have longer intervals between rebuilds.

New high-maintenance components may be needed in all diesel engines designed to comply with the 2002 oxides of nitrogen (NOx) requirements and the proposed 2005 NOx and particulate matter (PM) standards. Probably new fuel

management systems, and aftertreatment devices such as particulate traps and catalysts, will be required that will increase the maintenance costs of diesel engines. These increases may tend to close any gap between the maintenance costs of diesel engines and alternative-fuel engines. Natural gas engines already meet the 2002 NOx requirement so will not have to undergo extensive redesign and improvements by manufacturers.

Some natural gas bus operators have converted their fleets to natural gas to save fuel costs. Natural gas prices are usually more stable than diesel fuel prices. In determining fuel costs per mile for CNG, both delivered price of the fuel and compression costs have to be considered. For LNG, fuel and liquefaction costs have to be considered. Until recently, diesel fuel prices have been very low so costs per mile have been very similar for CNG and diesel buses. Currently there is a saving in fuel costs per mile for CNG buses as diesel fuel is priced at about \$1.40 per gallon and CNG at about \$1.20 per diesel gallon equivalent. ARB staff estimates the low-sulfur diesel fuel that lower-emission diesel engines will require in the future will have an increased wholesale price of as much as 10 percent.

Several transit operators have tried to do an “apples-to-apples” comparison of CNG and diesel engine maintenance and repair costs. Invariably, these comparisons suffer from the same issue: CNG buses have not been on the road long enough to provide a true comparison. As expected, when CNG buses were first introduced in substantial quantities four years ago, there were problems. Since then, operators have been subjected to a fairly steep learning curve. Significant improvements have occurred, and many early problems have been solved. On the other hand, these early buses were under warranty, and although operators had to deal with increased down time, they were not responsible for many of the high repair costs. Transit operators are only now operating a significant number of CNG buses that are out of warranty. School bus operators report that maintenance requirements are less than diesel buses. Finally, CNG buses are only now reaching the point where normal engine overhauls are needed. It is not clear how far CNG buses can go before an overhaul – therefore the size of this benefit is not known. Generally, incentive funding is not available to subsidize any increased operating costs.

Although no comprehensive comparison of natural gas to diesel buses is possible at this time, ARB has analyzed operating costs reported by numerous transit agencies. We have reached these conclusions:

- Initially, there are higher maintenance costs for natural gas fleets. Availability of more reliable natural gas engines, and operation of diesel engines meeting future lower emission standards will tend to decrease this difference. Together, these changes should almost close the gap, and result in only slightly higher maintenance costs for natural gas engines.

- Fuel costs per mile, including natural gas compression or liquefaction, is less for natural gas fleets. The increased price of low-sulfur fuel needed for diesel engines in the future should make this difference in cost even greater.
- As a result, operating costs of new natural gas fleets in the future are estimated to be only slightly higher than that for new diesel fleets.
- The capital costs for natural gas fleets -- initial bus purchase price and the refueling and facility modification costs -- will continue to be higher than that for diesel fleets.

ARB staff has been charged with analyzing the funding available for increased capital costs. In general, funding -- from transportation, air quality, and energy sources -- is available to subsidize the incremental purchase price of natural gas buses, based on a normal turnover rate. However, so far the staff has not identified enough transportation or incentive funding to cover the entire cost of the infrastructure required to operate natural gas buses.

## ATTACHMENT C

<b>Proposed Urban Transit Bus Fleet Rule Requirements and Emission Standards</b>				
<b>Model Year</b>	<b>“Diesel” Path</b>		<b>“Alternative-Fuel” Path</b>	
	<b>NOx (g/bhp-hr)</b>	<b>PM (g/bhp-hr)</b>	<b>NOx (g/bhp-hr)</b>	<b>PM (g/bhp-hr)</b>
2000	4.0	0.05	2.5 optional <sub>(1)</sub>	0.05
10/2002	2.5 NOx+NMHC	0.05	1.8 NOx+NMHC optional <sub>(1)</sub>	0.03
10/2002	4.8 NOx fleet average		4.8 NOx fleet average	
2003-09	PM Retrofit requirements		PM Retrofit Requirements	
7/2003	3 bus demo of ZEBs for large fleets (>200)			
2004	0.5	0.01		
2007	0.2	0.01	0.2	0.01
2008	15% of new purchases are ZEBs for large fleets (>200)			
2010			15% of new purchases are ZEBs for large fleets (>200)	

Notes: Shaded area shows existing requirements and existing optional emission standards  
 (1) Although transit agencies on the alternative-fuel path are not required to purchase engines certified to these optional standards, the staff expects that they will do so in order to qualify for incentive funding. At present, the only alternative-fuel engines available are certified to optional, lower-emission NOx standards.

# **SACRAMENTO REGIONAL TRANSIT DISTRICT**

## **Bus Maintenance Department**



### **Monthly Status Report**

**December 1999**

## Table of Contents

<u>Topic</u>	<u>Page</u>
Road Call Summary/Current Operating Fleet.....	1 - 4
Fleet Consumption.....	5
Fleet Cost Data.....	6
CNG Cost Chart.....	7
Diesel Cost Chart.....	8

Report Prepared By:

Michael Cooke, Maintenance Manager  
Judy Engleman, Administrative Assistant

## ROAD CALL SUMMARY

December 1999 miles between chargeable road calls came in at 7,979. This represents less than a 1% decrease over November 1999, and a 3% increase over the same period in 1998. December's 7,979 figure is 979 miles over our monthly goal of 7,000 miles.

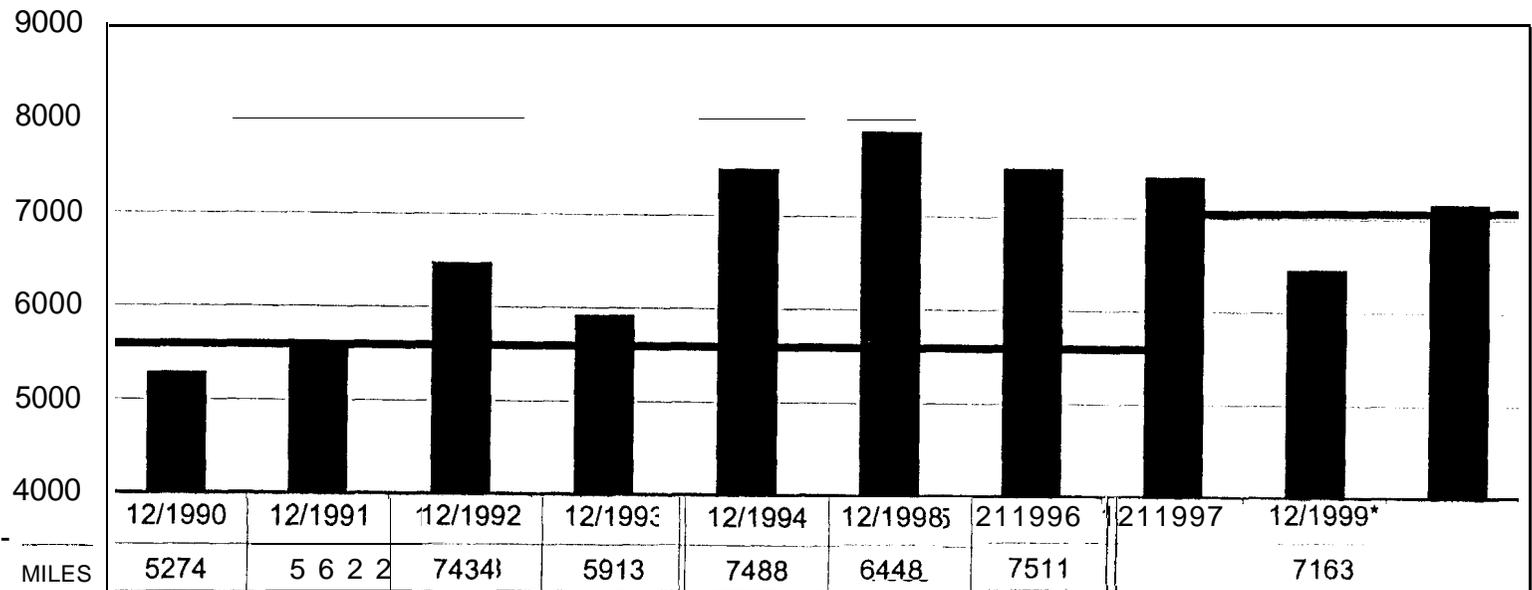
Our 73-bus diesel fleet averaged 8,779 miles between chargeable road calls and our 136-bus CNG fleet averaged 7,697 miles.

Listed below are the six (chargeable) systems that caused most of our road calls.

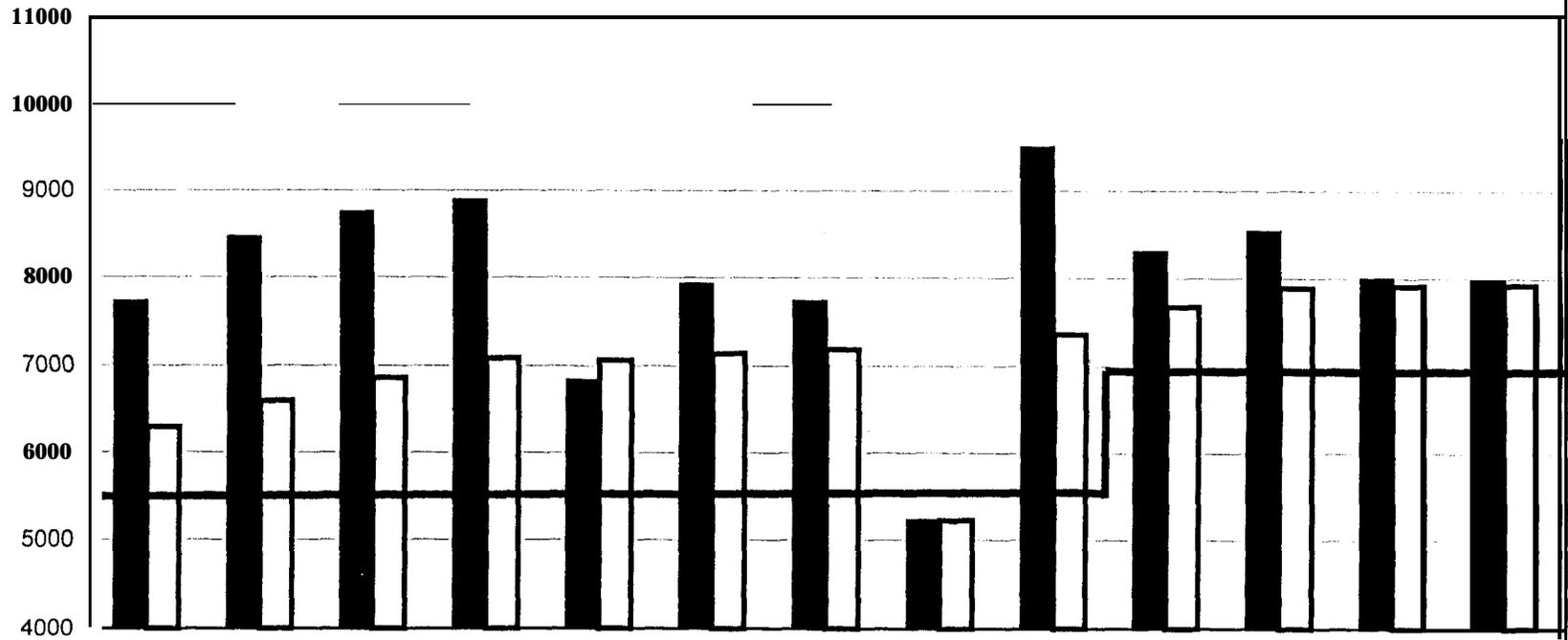
	<u>1998</u>		<u>1999</u>
Engine	25	Engine	17
Lift	13	Cooling	17
Doors	11	Doors	9
Cooling	11	Lift	8
Brakes	8	CNG Fuel	7
Steering	6	Air	7
	<hr/>		<hr/>
	74		65

# AVERAGE MILES BETWEEN CHARGEABLE ROAD CALLS 1990/1 999

\*CUMULATIVE YEAR TO DATE AVERAGE



# MILES BETWEEN CHARGEABLE ROAD CALLS



	12/1998	1/1999	2/1999	3/1999	4/1999	5/1999	6/1999	7/1999	8/1999	9/1999	10/1999	11/1999	12/1999
■ CHARGEABLE R/C'S	7726	8459	8743	8891	6836	7929	7738	5231	9501	8308	8536	8002	7979
□ AVERAGE FY TO DATE	6284	6595	6863	7089	7063	7142	7192	5231	7366	7680	7894	7916	7926

## FLEET CONSUMPTION

During December 1999, our 73-bus diesel fleet traveled 219,489 miles and consumed the following amounts:

	<u>Total</u>	<u>Average</u>
Diesel fuel	62,560 gallons	3.51 MPG
Engine oil*	993 qts.	221.04 MPQ
Transmission fluid	20 qts.	10,974.45 MPQ

Our 136-bus CNG fleet traveled 546,457 miles and consumed the following:

	<u>Total</u>	<u>Average</u>
Natural gas	229,725 therms	2.38 MPT
	163,628 gallons	3.34 MPG
Engine oil*	1,288 qts.	424.27 MPQ
Transmission fluid	6 qts.	91,076.17 MPQ

\*Does not include oil changes

## REPEAT ROAD CALLS

There were two buses in December 1999 that had a repeat road call in the same system code. A repeat road call is any reported road call recorded in the same system code within a fifteen-day period.

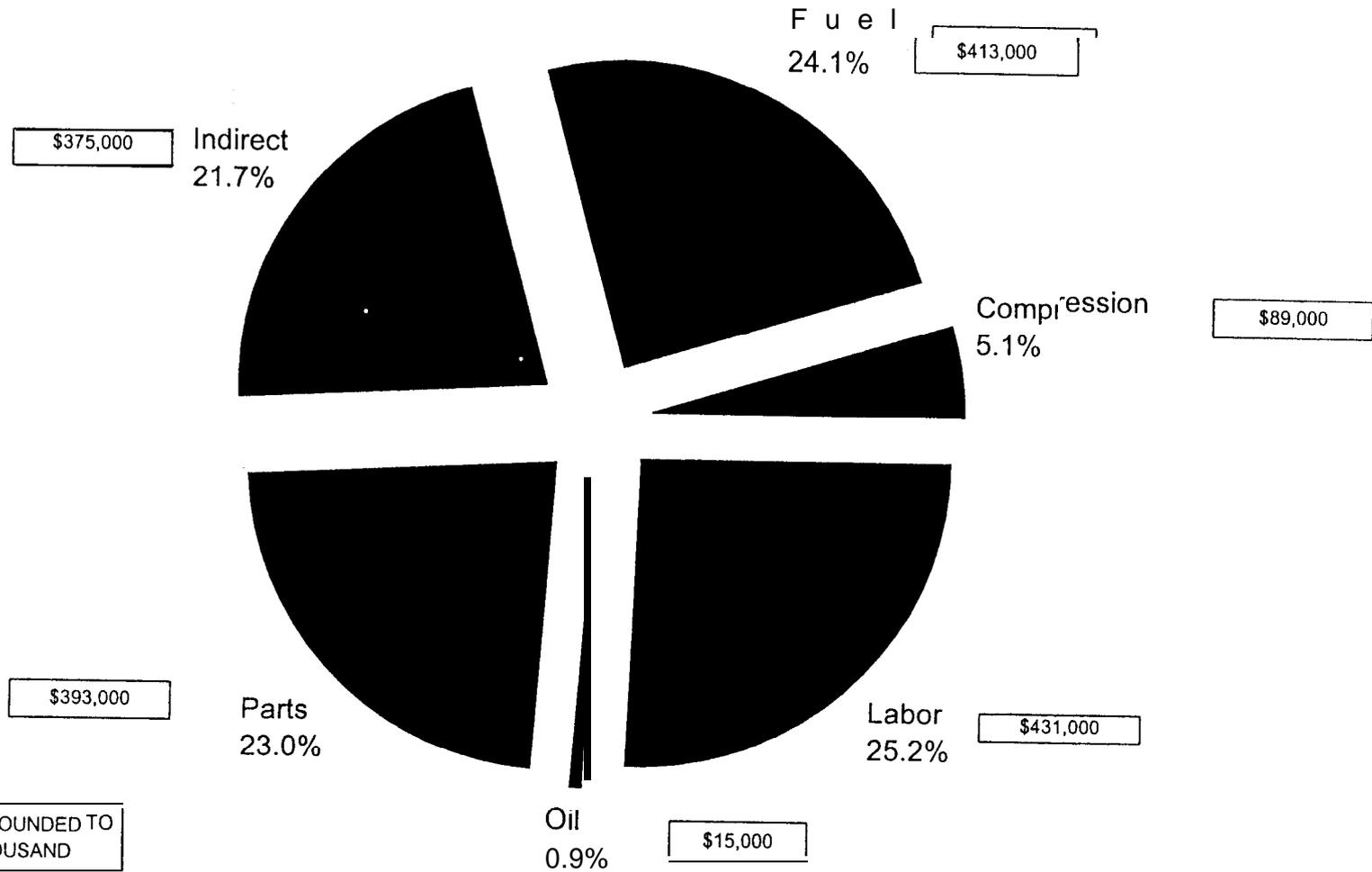
<u>Bus #</u>	<u>Repeat Problem</u>
9016	Heating
9315	Engine

## CURRENT OPERATING FLEET

<u>Quantitv</u>	<u>Manufacturer</u>	<u>Year</u>	<u>Engine Type</u>	<u>Fuel Type</u>
41	Orion	1996	Cummins L10G/280	CNG
20	Orion	1994	Cummins L10G/240	CNG
75	Orion	1993	Cummins L10G/240	CNG
50	Gillig	1990	Detroit 6V92TA	Diesel
23	Gillig	1985	Detroit 6V92TB	Diesel

# CNG FLEET COST PER MILE \$0.548

7/1/1999 THROUGH 12/31/1999 TOTAL CNG MILES 3,126,267



DOLLAR FIGURE ROUNDED TO NEAREST THOUSAND

## FLEET COST DATA

Our fiscal year to-date (7/1/1 999 through 12/31/1 999) fleet cost is as follows:

### 73-Bus Diesel Fleet – 1,281,939 Miles

Labor	0.184
Parts	0.118
Fuel	0.225
Oil*	0.004
indirect	0.119

---

Cost Per Mile	\$0.650
---------------	---------

### 136-Bus CNG Fleet – 3,126,267 Miles

Labor	0.138
Parts	0.126
Fuel	0.132
Oil*	0.005
Compression Cost	0.028
Indirect	0.119

---

Cost Per Mile	\$0.548
---------------	---------

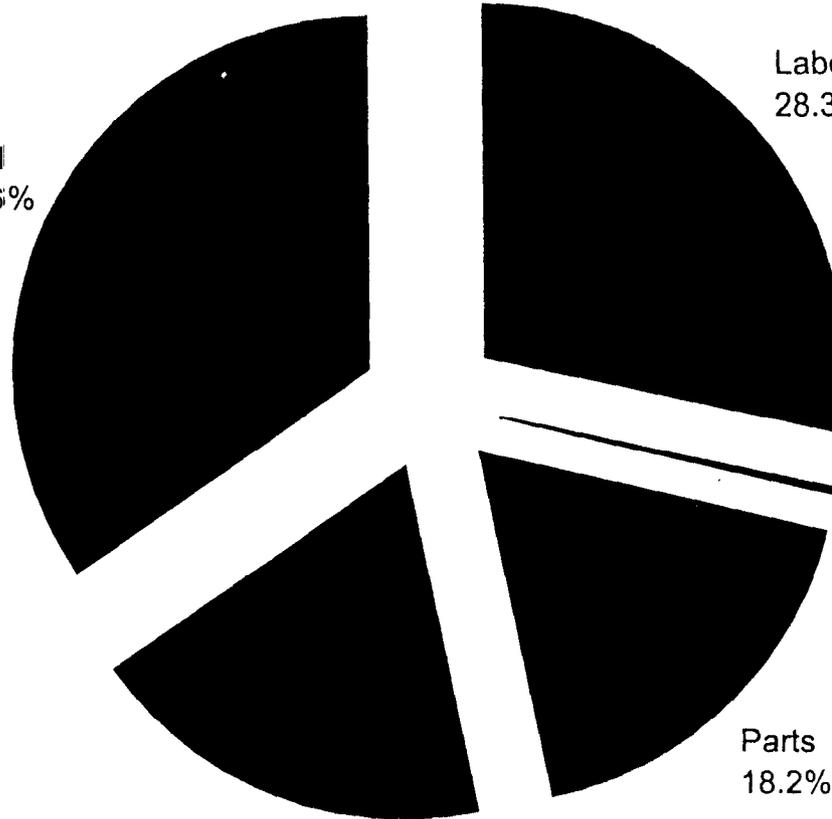
\*This figure includes oil changes

# DIESEL FLEET COST PER MILE \$0.65

7/1/1999 THROUGH 12/31/1999 TOTAL DIESEL MILES 1,281,939

\$288,000

Fuel  
34.6%



Labor  
28.3%

\$236,000

Oil  
0.6%

\$6,000

Parts  
18.2%

\$151,000

Indirect  
18.3%

\$201,000

DOLLAR FIGURE ROUNDED TO  
NEAREST THOUSAND

# CNG means Cleaner Air For Everyone

RT made the transition to Clean Natural Gas buses from diesel buses because CNG was determined to be the most favorable clean air alternative for Sacramento. At RT, Clean Natural Gas buses are replacing diesel buses built between 1968 and 1975. RT has operated these older buses as cleanly as possible by using low-sulphur diesel and by maintaining an aggressive bus tune-up program but that alone is not enough to meet today's tougher federal and state emission standards. RT's new CNG buses substantially exceed the new standards, which will help that much more in improving Sacramento's air quality.

## CNG Standards set by the California Air Resources Board (CARB)

Particulates	CNG 0.02	CARB* 0.10
Carbon Monoxide [CO]	CNG 0.4	CARB* 15.5
Nitrogen Oxides [NOx]	CNG 2.0	CARB* 5.0
Non-Methane Hydrocarbons [NMHC]	CNG 0.6	CARB* 1.2

### CNG Bus Specifications

Number in Service	95
Lifespan	12 years
Seating Capacity	40 + 2 Wheelchairs + Standees
cost	\$260,000 each
<b>Manufacturer</b>	Bus Industries of America
Length	40'
Width	102"
Height	134"
Lift-Equipped	
Step Height	14"
Turning Radius	40'6"
Range	400 miles

### Engine

Cummins L-10 in-line 6 cylinder, rated up to 240hp at 2,100 rpm, controlled by a Woodward Electronic Control Unit (ECU), 850 foot-pounds of torque.

### Fuel Cylinder

Manufactured by Structural Composites Industries. Twelve 15" x 76.5" aerodynamic fiberglass cylinders mounted on the roof with a total capacity of 16,000 S.C.F. at 3,000 psi at 70 degrees Fahrenheit.

### Transmission

ZF 590hp, 5-speed, with built-in retarder

• standard

# RT would like to thank

the following for their contribution to the

**successful** design, construction and

completion of **RT's** new CNG fueling **facility:**

RT Engineering & Construction and Operations Divisions

Pacific Gas & Electric

Boor • Allen & Hamilton

The Industrial Company

Adair Engineering

Gage-Babcock & Associates, Inc.

Bus Industries of America, Inc.

Cummins Engine Company, Inc.

## Special clean air support

Sacramento Metropolitan Air Quality Management District

Toronto Transit Commission

The Hamilton Street Railway Co.

If you would like further information

about Sacramento Regional Transit's

CNG fueling facility, contact:

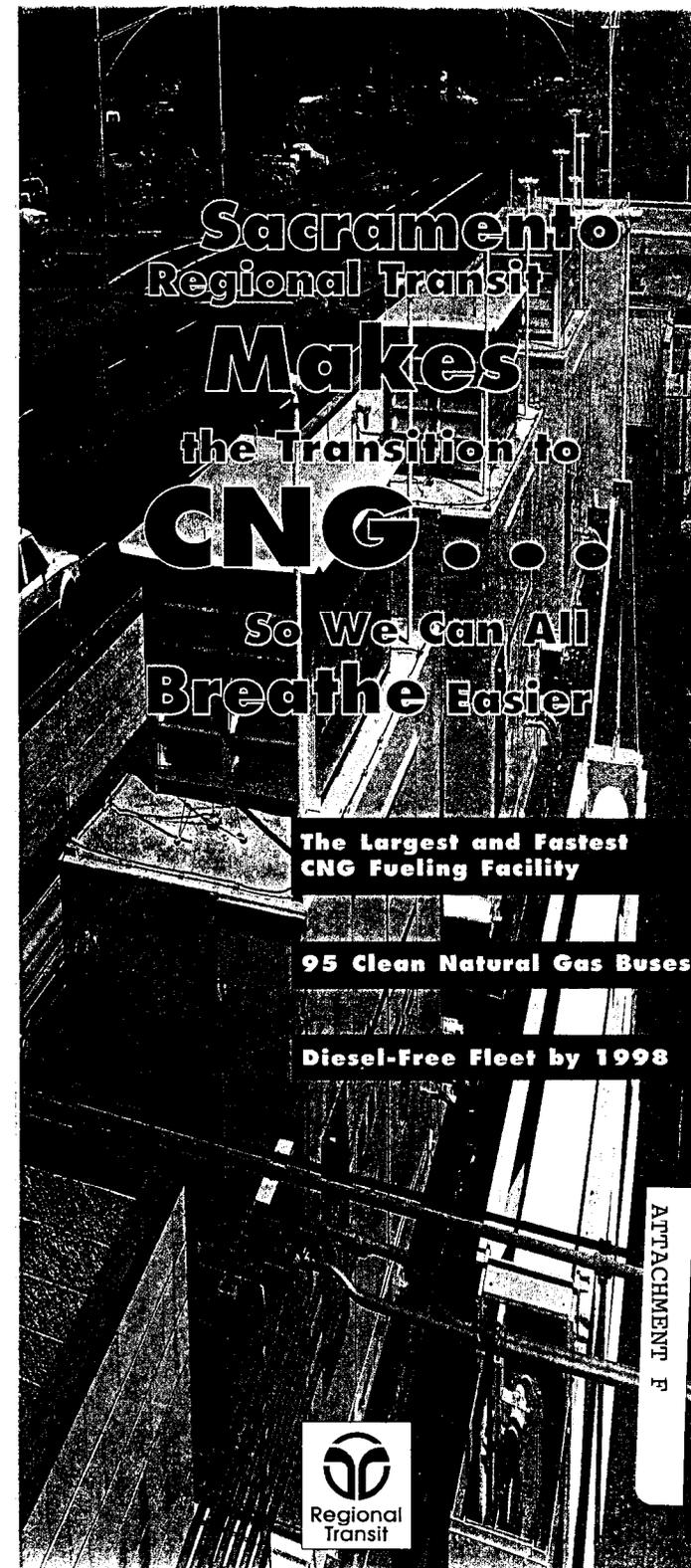
RT Engineering and Construction

Division, [916] 321-3842

RT's new CNG facility is located at:

29th Street & Capitol Avenue,

Sacramento, CA 958 16

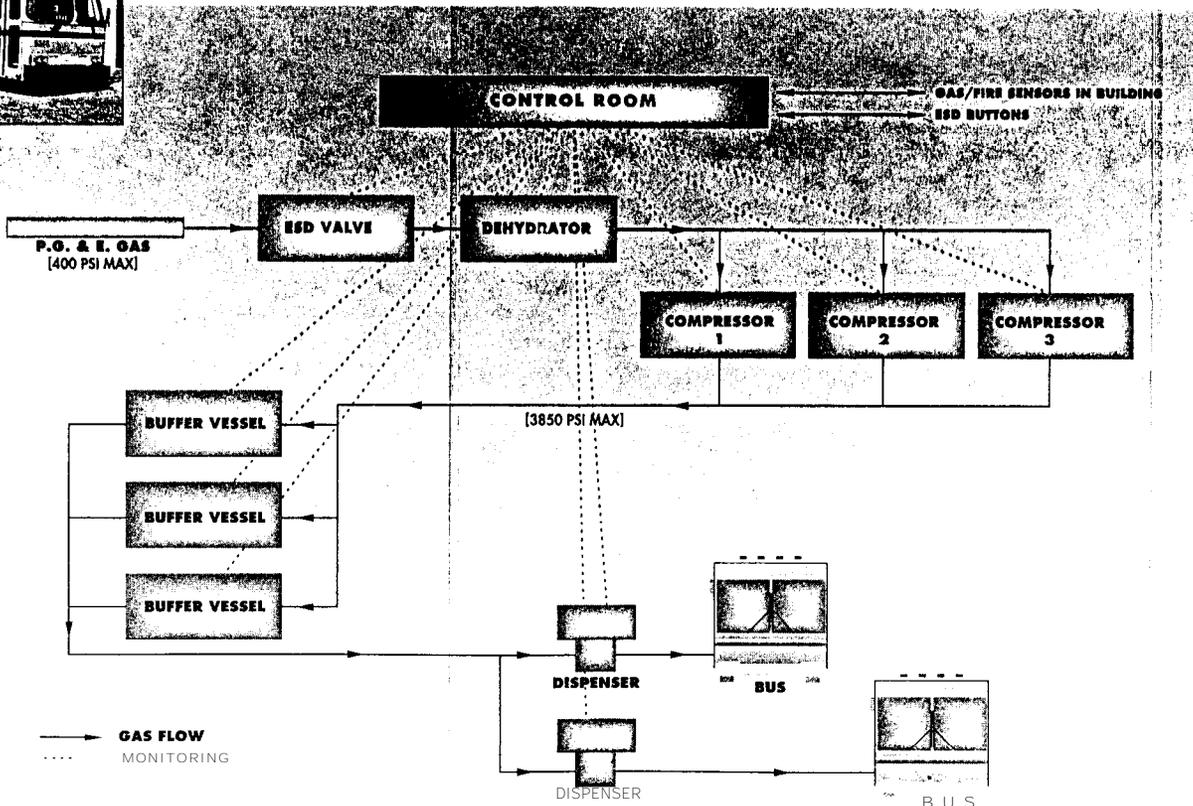


ATTACHMENT E

# RT's CNG Fueling Facility Leads the Way in Technology

Sacramento Regional Transit [RT] is making the transition to a fleet of free fleet with safe, clean CNG buses. In order to fuel the CNG buses, the construction of the largest and fastest fueling facility was recently completed within RT's existing bus maintenance complex. The project includes state-of-the-art safety features and the latest technology—making it the most efficient CNG facility in the nation.

Measure A Financing of the CNG Fueling Facility and Buses Conversion to CNG was made possible by using local Measure A sales tax monies matched by Federal monies. While the majority of funding was provided for with Federal money, RT would not have been able to secure such funding without the local match of Measure A.



## CNG Fueling Facility

- \$3.5 million to design and construct
- Can fuel 125 buses in 8 hours at 2.5 minutes per bus

## PG&E Natural Gas Supply

- Dedicated supply line of natural gas
- Gas supply at 400 pounds per square inch (psi)

## Emergency Shut Down (ESD)

- Stops operation of facility in case of emergency
- Provides fail safe operation

# CNG Fueling Facility Specifications

## Dehydrators

- Drier to remove moisture from incoming natural gas
- Twin towers -one operating, one on standby

## Compressors

- Compresses natural gas from 400 psi to 3,850 psi
- Discharges CNG at rate of 852 cubic feet per minute

## Buffer Vessels

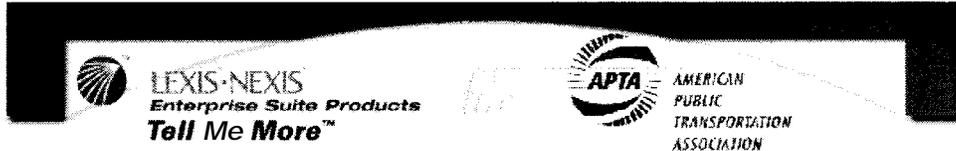
- Stores CNG at high pressure to assist fueling
- Vessels refill before or between fuelings

## Dispensers and Key Pad Unit

- Authorizes and dispenses CNG fuel into buses
- Automatically calculates fill for each bus

## Control Room

- Main computer controls for all CNG systems and operations
- Seven computers monitor and record all CNG activities



[\[Topic Index\]](#) [\[Document List\]](#) [\[Terms and Conditions\]](#)

◀ Document 14 of 34 ▶

Copyright 2000 PR Newswire Association, Inc.

PR Newswire

January 26, 2000, Wednesday

**SECTION:** STATE AND REGIONAL NEWS

**DISTRIBUTION:** TO STATE AND ENVIRONMENTAL EDITORS

**LENGTH:** 827 words

**HEADLINE:** California Fuel Cell Partnership Adds New Partners

**DATELINE:** SACRAMENTO, Calif., Jan. 26

**BODY:**

The California Fuel Cell Partnership today announced the addition of new partners to its team who will add value and expertise to the push to commercialize fuel cell electric vehicles.

The Partnership -- which formally began in April 1999 -- includes auto manufacturers (DaimlerChrysler, Ford, Honda and Volkswagen); energy providers (ARCO, Shell, and Texaco); a fuel cell company (Ballard Power Systems); and the State of California (Air Resources Board and the California Energy Commission).

Joining those partners is the U.S. Department of Energy ([www.ott.doe.gov](http://www.ott.doe.gov)) who will work with the state government partners to provide insight into identifying and resolving potential technical and infrastructure barriers for fuel cell-powered cars and buses. DOE will also help secure needed resources. DOE's office of Energy Efficiency and Renewable Energy will be involved in the Partnership.

The Partnership has also added new associate partners -- entities who bring specific expertise to aid in fuel, vehicle, and bus demonstration activities. Air Products and Chemicals, Inc. of Allentown, Pennsylvania ([www.airproducts.com](http://www.airproducts.com)); Linde AG ([www.Linde.com/Linde-Gas](http://www.Linde.com/Linde-Gas)), headquartered in Germany; and Praxair ([www.praxair.com](http://www.praxair.com)) of Danbury, Connecticut. The companies will assist the energy partners with hydrogen fuel infrastructure needs, particularly at the Partnership's Sacramento-area facility. All are global industry leaders in the production, distribution and technology of industrial gases, and all have experience developing or providing hydrogen fuel delivery systems for vehicle manufacturers.

Additional associate partners are the Alameda-Contra Costa Transit District (AC Transit, [www.actransit.org](http://www.actransit.org)), which operates a fleet of 700 public transit buses in the San Francisco Bay Area, and SunLine Transit Agency ([www.sunline.org](http://www.sunline.org)) which operates a fleet of 50 alternative-fueled buses in the Palm Springs area of southern California. Notable for their interest in advancing alternative-fueled buses, these transit agencies were invited to serve as test sites for the first phase of the Partnership's bus demonstration program. As part of that effort, next year each agency will acquire two fuel cell-powered buses and include them in regular revenue service on scheduled routes throughout their service areas. By 2003, the Partnership plans to deploy up to twenty fuel cell-powered buses.

"We're pleased to welcome these new partners and the wide range of fuel cell experience they bring to the table," said John Wallace, Chairman of the Partnership's Steering Committee and Executive Director of TH!NK Group, an enterprise of Ford Motor Company. "This will bolster our efforts here in California to demonstrate fuel cell vehicles and alternative fuel technologies, as well as heighten public awareness." For more information about the California Fuel Cell Partnership, please contact any of the company

spokespersons listed below:

CA Fuel Cell Partnership Joe Irvin 9 16-600-2564  
CA Air Resources Board Jerry Martin 9 16-322-2990  
CA Energy Commission Claudia Chandler 9 16-654-4989  
ARCO Cheryl Burnett 562-590-4493  
Ballard Debby Harris 604-4 12-4740  
DaimlerChrysler  
USA: Ann Smith 248-5 12-6502  
Germany: Annette Kliem +49-7 1 1 - 17-9327 1  
Ford Glenn Ray 3 13-248-5994  
Honda Art Gamer 3 1 O-783-3 163

Shell  
USA: Kitty Borah/ 7 13-241-4544  
Stacy Hutchinson  
London: Cerris Tavinor +44- 17 1-934-3045  
Texaco Tyra Metoyer 713-752-4784  
Volkswagen Tony Fouladpour 248-340-5064

New Partner:  
U.S. Department of Energy Tom Welch 202-586-5806

New Associate Partners:  
AC Transit Jaimie Levin 5 1 O-89 1-7244  
SunLine Transit Agency Tracy Daly 760-343-3456  
Air Products Venki Raman 6 1 O-48 1-8336  
Linde Rolf Trill, in Germany: (0 89) 74 46-1465  
Praxair Hope Dipierro 203-837-2573

The California Fuel Cell Partnership ([www.drivingthefuture.org](http://www.drivingthefuture.org)) is a voluntary effort to advance a new automotive technology that could move the world toward practical and affordable environmental solutions. The Partnership will demonstrate fuel cell-powered electric vehicles under real day-to-day driving conditions; will demonstrate the viability of an alternative fuel infrastructure technology; explore the path to commercialization; and increase public awareness of fuel cell electric vehicles. The Partnership will place over 50 fuel cell passenger cars and fuel cell buses on the road between 2000 and 2003.

SOURCE California Air Resources Board

CONTACT: Joe Irvin of the California Air Resources Board, 9 16-600-2564

URL: <http://www.pmewswire.com>

[\[Topic Index\]](#) [\[Document List\]](#) [\[Terms and Conditions\]](#)

Copyright 2000 LEXIS-NEXIS, a division of Reed Elsevier Inc. All rights Reserved.



---

[\[Topic Index\]](#) [\[Document List\]](#) [\[Terms and Conditions\]](#)

---

◀ Document 17 of 32 ▶

Copyright 2000 Business Wire, Inc.

Business Wire

January 21, 2000, Friday

**DISTRIBUTION:** Business Editors & Energy Writers

**LENGTH:** 594 words

**HEADLINE:** Hybrid Buses Equipped With Electrosorce Batteries Successfully Complete Year-Long Revenue-Service Tests in New York City's Manhattan District

**DATELINE:** SAN MARCOS, Texas, Jan. 21, 2000

**BODY:**

Electrosorce Inc. (Nasdaq:ELSI) announced today it has successfully completed a year-long revenue-service demonstration in hybrid-electric buses equipped with Electrosorce batteries.

Five Orion VI hybrid electric buses powered with Lockheed Martin's HybriDrive propulsion system have logged over 80,000 miles of daily revenue service during calendar year 1999. The daily service schedule required the buses to operate up to 18 hours per day, seven days per week, primarily in New York City's congested Manhattan business district. The successful demonstration is the culmination of over three years of cooperative development with Lockheed Martin and Orion Bus Industries of Mississauga, Ontario, Canada.

Still in daily revenue service, each of the buses uses a high-voltage string of Electrosorce 12 Volt-85 Amp Hour batteries to boost the constant-speed diesel-engine acceleration power, and to assist the bus braking system by absorbing kinetic energy through electrical regeneration.

Electrosorce Inc. CEO, Benny E. Jay, said, "Successful completion of this year-long revenue-service demonstration is a major milestone for the Company. We continue to support the daily service of these buses in Manhattan and look forward to additional opportunities in this exciting and superior, alternative mode of urban mass-transit."

Commenting on the project, Lockheed Martin's Hybrid Electric Vehicle program manager, Bill Schuhle, stated, "According to tests performed by an EPA-approved lab, the Orion VI 40-foot transit bus powered by Lockheed Martin's HybriDrive propulsion system produces significantly less hydrocarbons and carbon monoxide than buses fueled by compressed natural gas -- while producing comparable amounts of particulate matter and nitrous oxide and delivering over a 50% improvement in fuel economy."

Schuhle continued, "The combination of battery and diesel-engine power enables the hybrid bus to operate with greater total energy efficiency and significantly lower emissions than is possible with conventionally powered buses. Battery performance and reliability are critically important to realizing the advantages provided by the hybrid drive-train. The Electrosorce battery technology has performed admirably in the new and demanding environment of hybrid propulsion."

The Manhattan Transit Authority (MTA) of New York City, New York, has placed the first large-scale order for the new-technology buses. With deliveries beginning in 2001, MTA's 125-bus order will be built by Orion Bus Industries of Mississauga, Ontario, using the Lockheed Martin hybrid electric drive train.

Electrosource Inc. develops and manufactures lightweight, intelligent batteries for electric and hybrid-electric vehicles, engine-starting and telecommunication stand-by power applications. Additional information about the Company and its products can be found at its Web site [www.electrosource.com](http://www.electrosource.com).

This release contains forward-looking statements that involve risks and uncertainties. Actual results could differ materially from those discussed in this release. Risks include financial risks, development risks, manufacturing risks, uncertainty of market acceptance, delay in shipment or cancellation of orders, customer reorganization, as well as other risks that are detailed from time to time in the company's Securities and Exchange Commission filings.

For further information, contact B. E. Jay at 512/753-6525.

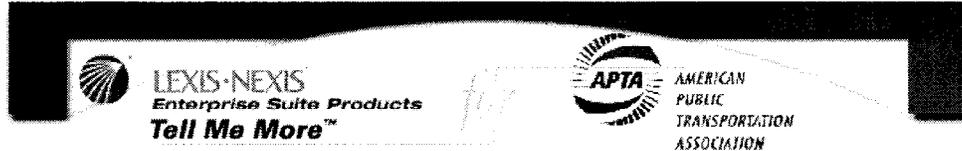
CONTACT: Electrosource Inc., San Marcos  
B. E. Jay, 512/753-6525

URL: <http://www.businesswire.com>

[\[Topic Index\]](#) [\[Document List\]](#) [\[Terms and Conditions\]](#)

---

Copyright© 2000 LEXIS-NEXIS, a division of Reed Elsevier Inc. All rights Reserved.



[\[Topic Index\]](#) [\[Document List\]](#) [\[Terms and Conditions\]](#)

◀ Document 18 of 40 ▶

Copyright 2000 PR Newswire Association, Inc.

PR Newswire

February 2, 2000, Wednesday

**SECTION:** FINANCIAL NEWS

**DISTRIBUTION:** TO BUSINESS, ENVIRONMENTAL, AUTO AND TRANSPORTATION EDITORS

**LENGTH:** 1250 words

**HEADLINE:** MTA New York City Transit to Demonstrate Johnson Matthey CRT(TM) Particulate Filter for Lowest Possible Emissions from Diesel Buses

**DATELINE:** WAYNE, Pa., Feb. 2

**BODY:**

Johnson Matthey's Environmental Products group announced that the MTA New York City Transit is the first U.S. transit authority to field test its Continuously Regenerating Technology or CRT particulate filter. It is a technology produced by the company's Catalytic Systems Division as an exhaust emission control technology for diesel powered urban buses. Requiring the use of ultra low sulfur fuel, the CRT particulate filter, which has been widely used in Europe, removes up to 90 percent of the particulate matter (PM), carbon monoxide (CO) and hydrocarbon (HC) emissions from diesel exhaust.

The New York City fleet demonstration program, previously announced by New York Governor George E. Pataki as part of \$7 million in grants, most of which will be used to pay for new clean-fuel buses, has now progressed from the planning and implementation phase to the demonstration phase of the program. "Under Governor Pataki's leadership, New York State has been an international leader in lighting air pollution and reducing emissions from motor vehicles," New York State Department of Environmental Conservation Commissioner John P. Cahill said. "As part of his commitment to reducing air pollution, the Governor has encouraged the development of innovative new technologies, including this first-in-the-nation effort to demonstrate the viability of a device that could dramatically cut pollution from buses and other diesel vehicles."

Emphasizing MTA's commitment to the environment, MTA Chairman E. Virgil Conway said: "We are committed under the direction and leadership of New York Governor George E. Pataki to pushing the technological envelope to improve the quality of our environment. By its nature, mass transportation is an environmentally friendly service because it reduces by the thousands the number of vehicles on the road on our city's streets and highways. The MTA is committed to finding, developing and using technology that will only make our environmentally friendly service cleaner to operate."

NYC Transit will receive \$1 million of the New York State funding to test the CRT particulate filter on 50 buses with two different model diesel engines at the Mother Clara Hale Depot at 146th Street and Lenox Avenue, Manhattan. The first ten (10) buses entered revenue service on February 1, 2000 with the balance to follow in the very near future. They will operate for a year in normal revenue service in Manhattan and the Bronx on ultra low sulfur fuel supplied by Equilon, a Shell-Texaco joint venture. At two points during the field trial, a number of buses will be subjected to comprehensive emissions testing.

Michael T. Cinaglia, General Manager of the Johnson Matthey Environmental Products group, said, "The

NYC Transit test is expected to verify the emissions reduction benefits of the CRT particulate filter, as well as its durability on buses operated in a rigorous urban duty cycle.”

“The CRT particulate filter has been successfully proven in several European countries on more than 6,500 buses, heavy-duty trucks and municipal vehicles. In total, the technology has accumulated hundreds of millions of miles,” Cinaglia said.

In support of the demonstration program, MTA NYC Transit President Lawrence G. Reuter said: “MTA NYC Transit’s aggressive bus emissions reduction plan has already succeeded in reducing our fleet’s generation of particulate matter in NYC to less than 1%. Still, we see the CRT Technology as an exciting additional weapon against pollution in our technological arsenal. We are hopeful and optimistic that the CRT Technology, which performed so well in European tests, will perform as well in one of the world’s toughest urban mass transportation environments.”

The CRT particulate filter is a patented emission control technology that contains a platinum-coated catalyst and a particulate filter, engineered as a totally passive emission control system.

The CRT particulate filter mounts in the bus exhaust system in the same location and general configuration as other typical exhaust after-treatment devices. It is made up of two chambers. The first chamber contains a ceramic substrate coated with a thin layer of platinum, which is a highly effective oxidation catalyst. The catalyst converts CO and HCs into carbon dioxide and water. The Johnson Matthey catalyst also oxidizes a portion of the nitrogen oxide in the exhaust to nitrogen dioxide (NO<sub>2</sub>), which is the key to the elimination of soot collected by the CRT particulate filter.

In the second chamber, the exhaust flows through a ceramic wall-flow particulate filter, where gaseous components pass through but soot is trapped on the walls of the filter, where it is destroyed by the NO<sub>2</sub> produced by the catalyst in the first chamber.

Cinaglia said unlike conventional exhaust filter systems, the CRT particulate filter will not clog through the accumulation of soot because the CRT particulate filter provides continuous cleaning (regeneration) of the filter. Also, the CRT particulate filter can regenerate with temperatures as low as 250 degrees Celsius, much cooler than the 600 degrees Celsius usually required for soot to burn, thereby eliminating the need for expensive and hard-to-maintain heating equipment.

In addition to Johnson Matthey and NYC Transit, the remaining partners in the fleet demonstration program include Coming International, Coming, NY, supplying the ceramic wall flow filters; the New York State Department of Environmental Conservation, with responsibility to help define and oversee the emissions testing of the buses; Environment Canada, Ottawa, Ontario, who will actually perform the emissions testing; Equilon, who will be producing the ultra low sulfur fuel; and RAD Energy Corporation, NYC Transit’s current local fuel supplier.

MTA New York City Transit is a public benefit corporation of New York State. It is one of five agencies of the Metropolitan Transportation Authority. NYC Transit operates the New York City subway system and a fleet of over 4,000 urban transit buses -- the largest fleet in North America. The buses travel approximately 120 million miles annually in revenue service throughout the five boroughs of New York City.

Traded on the London Stock Exchange, Johnson Matthey is a highly diversified global technology firm. The \$5 billion company is 180 years old. Johnson Matthey’s Environmental Products group of the Catalytic Systems Division, the world’s largest supplier of catalysts for the automobile industry, provides catalytic solutions for air quality problems created by mobile and stationary sources. The group designs and supplies catalysts and catalytic systems to control carbon monoxide, particulate, hydrocarbons, nitrogen oxides and volatile organic compounds.

For more information, contact Marty Lassen, Johnson Matthey Catalytic Systems Division, Environmental Products, 434 Devon Park Drive, Wayne, PA 19087- 1889; Tel: 6 1 O-34 1-3404; Fax: 6 1 O-97 1-3 116; or call the Johnson Matthey Toll-Free Emissions Hotline: 1-800-RX FOR Air. E-mail: [lassen@jmusa.com](mailto:lassen@jmusa.com); Website: <http://www.jmcsd.com>.

SOURCE Johnson Matthey

CONTACT: Marty Lassen of Johnson Matthey Catalytic Systems Division, Environmental Products,  
6 1 O-34 1-3404, or Fax, 6 1 O-97 1-3 116, or E-mail, [lassen@jmusa.com](mailto:lassen@jmusa.com)

URL: <http://www.prnewswire.com>

---

[\[Topic Index\]](#) [\[Document List\]](#) [\[Terms and Conditions\]](#)

---

Copyright© 2000 LEXIS-NEXIS, a division of Reed Elsevier Inc. All rights Reserved.

Bob DeBolt  
127 Mason St.  
Santa Cruz, CA 95060

July 14, 1999

*Dear Mike,*

Enclosed is an audio tape of an interview with Kala and Joshau Tickell discussing the use of vegetable oil as a fuel for diesel engines. Three billion gallons of vegetable oil are thrown away each year in the U.S.

The original diesel engine was designed to run on vegetable oil that requires only a slight chemical change to be used as a fuel and requires no modification of the engine. The vegetable oil used as diesel fuel is a **renewable** energy source, cheap to make, non-toxic, biodegradable and reduces air emissions up to 75%.

Santa Cruz Metro buses might be able to use vegetable oil, or a blend of it as a fuel in their diesel engines. It would help to reduce harmful emissions and promote a renewable source of energy.

Sincerely,

*Bob DeBolt*

**SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

## M E M O R A N D U M

**Date:** July 26, 1999  
**To:** Les White, General Manager,  
**From:** Hayward Seymore   
**Subject:** Biodiesel

This memo is in response to your audiotape entitled Vegetable Oil for Diesel Fuel. Vegetable oil for fuel is not a new concept. In my last position with Flint Mass Transportation Authority I conducted a 50,000-mile demonstration project in conjunction with the national Soy Diesel Development Board. The purpose of this project was to study the feasibility of vegetable oil as an alternative to CNG. The project started in April 1994, and was concluded some 15 months later.

During this period the MTA used a 70% diesel mix with 30% soybean oil to operate two test vehicles. The project was quite successful in regards to cleaner emissions in older diesel engines. However, there was no increase in fuel mileage and a fuel cost increase when you factor in the cost of trying to blend and mix soybean oil for bulk distribution. Keep in mind that this project was tried on two older generation diesel engines. Biodiesel, as it relates to new engine technology, has a couple of major drawbacks.

First, the manufacturers of new, clean-burning, electronically controlled engines will not provide warranty support in using a biodiesel product. There has been no long-term study on the effects on the new computer controlled engines. Secondly, you would not be given warranty support on rebuilt engines because manufacturers of the rebuilt components would not provide the warranty if used with a biodiesel product, again, for the same reasons.

While with the MTA, we studied all four fuel alternatives: LNG, CNG, propane and biodiesel. It was determined that in the short term a biodiesel blend would be a reasonable approach if, 1) we could keep the cost down, and 2) get manufacturers' warranty support. However, we did determine that in the long term the future is much more promising in the use of new technologies which are beyond the developmental stages, and some already in revenue service such as hydrogen-cell powered vehicle which literally has zero emissions.

If you have any further questions, please advise.

Hayward Seymore  
Manager of Fleet Maintenance

# SANTA CRUZ METROPOLITAN TRANSIT DISTRICT

**DATE:** February 11, 2000

**TO:** Board of Directors

**FROM:** Bryant J. Baehr, Manager of Operations  
Tom Stickel, Acting Fleet Maintenance Manager  
David Konno, Facilities Maintenance Manager

**SUBJECT: ARTICULATED VERSUS 40-FOOT BUSES**

## I. SUMMARY OF ISSUES

- As the Transit District begins its bus replacement program, decisions will need to be made concerning the length and type of bus purchased
- 60-foot (articulated) buses do offer increased capacity and a reduced fuel cost per passenger carried, however, bus cost is significantly higher, bus stops will need to be redesigned, the routes capable of accommodating a 60-foot vehicle are limited and facility cost will increase due to the size and maneuverability of the bus.
- 40-foot buses are limited in the number of passengers that they can carry, however, our current infrastructure is designed to accommodate the length of the vehicle, no additional facility design or costs are needed and manufacturers offer a variety of options.

## II. DISCUSSION

As the Transit District begins its bus replacement program and the preliminary design of Metrobase, decisions will need to be made concerning the length of bus we purchase. Currently, there are several types of vehicles in use by various transit systems. They include 30-foot, 35-foot, 40-foot and 60-foot (articulated) buses. Listed below are the positives and negatives of 40-foot versus 60-foot buses.

### 60-foot buses

60-foot buses offer the following positives and negatives:

#### **Positive**

- Capacity – ability to carry up to 120 passengers with one bus
- Lower fuel cost per number of passengers carried
- Lower maintenance cost if replacing two (2) buses

#### **Negative**

- If bus is being repaired and no 60-foot spares are available, two (2) buses must be used to carry the same capacity
- Increased per bus maintenance costs. An extra set of axles exist, training increases, separate parts inventory needed, special tools needed for turntable.
- Added facility costs. They include:

- Longer and/or drive-through maintenance bays needed
- Drive-through or longer bus washer needed
- Three-post lift needed vs. two-post for 40-foot
- Turning radius needs to be increased and additional (longer) parking slots are needed
- 60-foot paint booth vs. 40-foot
- Not currently available in CNG
- Bus constrained to a limited number of routes and corridors
- Limited number of manufacturers and options available
- Operators have a restricted view of the rear area leading to the unobserved negative behavior (vandalism)
- Bus Stops would need to be improved. Currently bus stops are developed for 40-foot buses.

#### **40-foot buses**

40-foot buses offer the following positives and negatives. They are:

##### **Positive**

- Buses will work on 80% of the routes currently operated by the Transit District
- No special facility modifications are necessary due to length of vehicle
- Bus stops are designed for 40-foot buses
- Multiple manufacturers are available with various options
- Choice of fuel systems

##### **Negative**

- Limited capacity due to length of vehicle

### **III. FINANCIAL CONSIDERATIONS**

The average cost of a 40-foot bus is \$280,000. The average cost of an articulated bus is \$400,000. According to Waterleaf Architecture & Interiors, an additional \$360,000 will need to be budgeted just to extend the maintenance repair bays. There will also be costs associated with the revision of the bus parking area, work areas and parts storage. As of February 4, 2000, those costs have yet to be determined.

### **IV. ATTACHMENTS**

Attachment A: WaterLeaf Letter to Assistant General Manager Mark Dorfman

# WaterRLEAF



RECEIVED

JAN 10 2000

Mr. Mark Dorfman  
Santa Cruz Metropolitan Transit District  
370 Encinal Street, Suite 100  
Santa Cruz, California 95060

January 5, 2000

Dear Mark,

Yesterday I talked with John Haake of New Flyer regarding the issue of CNG powered articulated buses. John is not aware of any manufacturers that are producing this type of vehicle. In his opinion, there is simply not enough demand across the country. I asked him about the odds of someone developing this type of vehicle by the time our facility comes on line in three years. He also offered his opinion that there might **never** be enough demand to warrant any manufacturer producing such a bus.

WaterLeaf has been working with Pierce Transit in Tacoma, Washington, recently. Pierce has operated a CNG fueled fleet of standard coaches for the past several years. I discussed the issue with Ron Shipley, Maintenance Director at Pierce, especially since they will be maintaining a new fleet of articulated vehicles from Sound Transit. Ron is not aware of any manufacturers for CNG articulated buses, and Sounds' fleet is diesel fueled.

Portland  
Seattle

Without the issue of CNG, there are a number of issues that can be considered when comparing articulated to standard buses.

## Pros

Articulated buses can handle half again the capacity of Standard 40' buses, without added drivers. This can serve to control labor costs while adding service on lines where the demand warrants articulated vehicles. In this event schedules between buses can remain as with 40 foot buses without loss of service as ridership increases.

Articulated buses are suited for longer routes, particularly where terrain and tight turning maneuvers aren't an issue.

For most city streets, maneuvering requirements for articulated buses are essentially the same as standard buses in terms of turning radius.

## Cons

Backing maneuvers for articulated buses are much more difficult and limiting.

Some manufacturer's articulated vehicles are more maintenance intensive than standard buses. Care in selection is important. For purposes of programming maintenance bays, a rule of thumb calls for one maintenance bay serving 12 standard buses versus only 8 articulated buses.

Even with selection of a relatively trouble vehicle, costs of maintenance for articulated buses tend to be higher.

Construction modifications to existing transit centers would be required to provide larger turn-outs. In a confined space, fewer turn-outs might result.

Architecture  
& Interiors

621 S.W. Morrison

Suite 125

Portland, OR 97205

Fax: 503/273-8891

Phone: 503/228-7571

Mr. Dorfman  
January 5, 2000  
Page 2

In the maintenance shop, extended length service bays will be needed for Inspection and Running repair. Likewise, extended bays will be needed for those bays with three-post lifts, Body and Paint, Chassis Dynamometer, Tire and Brake. Drive-through bays are preferred for articulated buses due to the difficulty of backing maneuvers.

If a \$150 per square foot cost is applied to maintenance building areas, and assuming each extended bay is approximately 400 square feet of increased size, an increase in construction cost of \$60,000 per bay can be expected. While we haven't concluded the program confirmation effort, six extended bays may be needed, even for a small number of articulated buses.

Space requirements for a separate set of parts for chassis, body, engine, etc. will result in increased Parts Storage areas. Again, added square footage here will result in added construction costs.

Site areas may need to be increased due to increased sizes of building footprints without any decrease in maneuvering space requirements on the entrance and exit ends of service bays.

Parking options for articulated vehicles are limited due to the difficulties of backing maneuvers.

Articulated buses are not suited for narrow road systems or roads with tight turning restrictions or steep slopes. Route selections are limited due to these types of issues.



Adding to the fleet mix will result in added training for mechanics, service personnel and operators.

For standard 35 and 40 foot buses, CNG vehicles can be provided with both below floor and roof mounted canisters. Roof mounted vehicles are preferred to minimize hazards under collision conditions. For articulated buses, sway stability of the vehicles will be a question for those vehicles with roof mounted CNG canisters. Due to space limitations, canisters will be mounted on the roof of both components of an articulated bus. Problems of piping linkages through the articulating joint need to be solved as well.

### **Recommendation**

If Santa Cruz Transit makes the decision to run a CNG fueled fleet, we recommend proceeding with the design of the facility based on current fleet and standard 35 and 40 foot vehicles without designing any provisions for articulated vehicles into the project.

Hopefully, this information will assist in your decision making process.

Sincerely,

WaterLeaf Architecture & Interiors

A handwritten signature in black ink, appearing to read 'Tom'.

Thomas O. Whittaker, Jr., AIA

# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

**DATE:** February 11, 2000  
**TO:** Board of Directors  
**FROM:** Leslie R. White, General Manager  
**SUBJECT: PUBLIC OUTREACH MEETING**

## **I. SUMMARY OF ISSUES**

- In 1995 the Board of Directors, based upon the Gannet-Flemming evaluation, selected the Lipton property on the West Side of Santa Cruz as the preferred site for the construction of the Consolidated Operating Facility.
- In 1996 the Board of Directors, based upon completion of Initial Study, adopted a Negative Declaration with regard to the Lipton property on the West Side of Santa Cruz.
- In 1998, the reconfigured site necessitated an amendment to the Initial Study and the Board of Directors adoption of an Amended Negative Declaration.
- The adoption of the two Negative Declarations and the acts of filing for Federal funding required public hearings to be held by the Board of Directors.
- Even though the Board of Directors has held a number of public hearings with regard to the MetroBase project, the adjoining residents of the area feel that there has not been an opportunity to comment with respect to the viability of the project.
- One method of affording the public an opportunity to comment on MetroBase is the scheduling of a public hearing with regard to the project in April 2000.

## **II. DISCUSSION**

In 1995, the Board of Directors selected the Lipton property as the preferred site for the construction of a consolidated operating facility. The implementation of this type of facility was estimated by Gannett-Flemming to allow the District to redirect over \$2.1 million into expanded service once the project was completed. In 1996, the Board of Directors completed an Initial Study and adopted a Negative Declaration with respect to the Lipton property and the MetroBase project. In 1998, a reconfigured site required the amendment of the Initial Study, the identification of additional mitigation measures, and the adoption of an Amended Negative Declaration utilizing the Lipton property for the site, for the MetroBase project.

The Board of Directors has held public hearings with regard to each of the actions that is taken in the adoption of Negative Declarations. Additionally, grant applications require public hearings be held so that the public has the opportunity to comment to the Board prior to an application for Federal funding be submitted. Additionally, the MetroBase project has been the topic of a

number of Board meetings open to the public so that information could be disseminated regarding the project.

In spite of all the actions taken by the Board of Directors, a significant portion of the neighboring residents on the West Side of Santa Cruz feel that there has not been adequate opportunity for them to express to the Board their concerns regarding the impacts that the MetroBase project would have. The outreach consultants employed by Metro have repeatedly indicated to staff members that it is important that the Board provide an opportunity for neighboring residents to express their concerns regarding MetroBase. At the present time, items before the City of Santa Cruz and the Board of Directors will provide clarity with regard to the MetroBase project. Issues relating to impact mitigation, future fleet propulsion, and traffic impacts will be further refined to a level that will be beneficial to individuals who have concerns with regard to this project. At the same time, it is important that neighboring residents have the opportunity to communicate directly to the Board. It is also important that people who will be impacted by the inability of Metro to expand or even sustain current service levels should MetroBase not be developed have an opportunity to outline their concerns. A public meeting/hearing held on the West Side in the evening would afford all interested individuals an opportunity to express themselves. If such a meeting is held, it is recommended that an opportunity for project history/description be provided, but that the majority of the time be devoted to public comment.

### **III. FINANCIAL CONSIDERATIONS**

None.

### **IV. ATTACHMENTS**

None.

# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

**DATE:** February 11, 2000

**TO:** Board of Directors

**FROM:** Bryant J. Baehr, Manager of Operations  
Tom Stickel, Acting Fleet Maintenance Manager  
David Konno, Facilities Maintenance Manager

**SUBJECT: TRANSIT SERVICE EXPANSION CAPABILITIES**

## **I. SUMMARY OF ISSUES**

- The Transit District has been in the position of expanding service over the last several years. Over 1,000,000 service miles and sixteen buses have been added since May 1998
- The infrastructure needed to support the expansion that has taken place and that is expected to take place needs to be addressed
- The major areas of concern are Maintenance Personnel, Bus Parking and Maintenance Bays
- Several ideas are being proposed to sustain additional service for a period of one (1) year

## **II. DISCUSSION**

For the last several years the Transit District has been in the position of expanding service. This was after many years of no additional service or the minor restructuring of existing service. 1,000,000 service miles have been added and the number of buses that we operate has increased by sixteen (16) since May 1998. The only addition of infrastructure since the expansion has been a temporary (undeveloped - dirt) parking area at Plantronics to accommodate the parking of 16 buses.

Currently, the Transit District owns 110 buses (ten buses are not on-site but are expected within the next three (3) months). The average age of the bus fleet is 11.48 years and that includes the thirty (30) 1998 New Flyer Low Floor buses received in April 1998. Buses have a federally recognized useful life of 12 years.

As of today, the Transit District has reached a point where infrastructure issues need to be addressed to continue our service expansion. The issues are: Personnel, Bus Parking, Maintenance Bays.

### **Maintenance Personnel**

As with other Transit Agencies, we are currently having difficulty in the recruitment of experienced bus or heavy equipment mechanics. Currently, the Transit District is recruiting for three (3) mechanic positions.

The issues concerning maintenance personnel are:

- Hiring of trained or partially trained maintenance personnel.

Our strategies to overcome the Maintenance Personnel issues include:

1. Initiate new ways of recruiting maintenance personnel. This will include a more aggressive local recruitment, recruiting from outside the State of California, promoting the Transit District at trade fairs, talking with trade schools and use of recruiting agencies.
2. Investigating the idea of starting, in conjunction with local and county government, an apprentice program that would train the participants for mechanic positions
3. Discuss with industry professionals their innovative way of recruiting skilled labor in a tight labor market. This may include addressing certain wage and benefit issues.
4. Investigate creating a scholarship program to technical schools for individuals to receive mechanic training.

To further address the above-listed issues, we are initiating a Peer Review of the Transit District's maintenance capacity. Maintenance professionals from other transit systems will conduct this review. This will allow for an objective assessment of our current situation and expansion capabilities.

### **Bus Parking**

The Transit District parks buses for revenue service at three (3) separate locations. They are River Street, Vernon Street and Plantronics. The three (3) parking lots that we use have a planned parking capacity of 73 buses. We overload the parking areas by 27 buses each night (this does not include the 10 buses scheduled to arrive in three (3) months or the two (2) historic buses). The issues with our current parking situation are:

- 27 buses are double stacked in parking areas that are not designed to accommodate the additional capacity and acts to impede maneuverability
- We have experienced an increase in incidental damage caused by the minimal maneuvering room
- There is an increase in the inefficient use of bus operator, mechanic and vehicle service worker labor due to time spent shuttling buses from location to location and finding a specific bus when needed

Strategies to overcome the parking issues can include:

1. Initiate discussions with Plantronics to expand the parking area that we lease
2. Examine moving equipment currently stored at the various yards to a consolidated storage area
3. Investigate the viability of a parking plan that allows for the movement of vehicles and is based on the time that the bus leaves the yard the next morning

4. Investigate on-street parking in the surrounding Harvey West area

### **Maintenance Bays**

A maintenance bay is the location where a bus gets repaired, diagnostic and maintenance equipment is available and where a mechanic can access his tools / parts. Repairing a bus is divided into two (2) categories - minor and major. Minor maintenance is considered a “running” repair that can be accomplished in a short period of time. These tasks includes: brake replacement, head light replacement, oil and filter changes, minor in nature repairs, tire changes and repairs, farebox maintenance, operator defect reports, engine tune-ups, wheelchair repairs and weekly safety inspections. Major maintenance includes engine, transmission and major component rebuilding / replacement. This type of work normally means that the bus will be out of revenue service for a longer period of time.

To accomplish the above listed tasks, the Transit District uses two (2) separate facilities. Minor repair is conducted at the Golf Club facility, which has four (4) minor maintenance repair bays, and the Dubois facility that has three (3) major maintenance bays. This represents a total of seven (7) maintenance repair bays. For comparison purposes, the District had a total of twenty-one (21) maintenance bays when the Watsonville facility was operational.

The issues concerning Maintenance Bays include:

- Lack of maintenance bays to repair buses,
- Lack of area for the storage of parts needed at the Dubois location, and
- Thirty (30) 1998 New Flyer Low Floors buses are exiting their warranty period
- Language in the SEIU labor agreement that prohibits the establishment of a weekend swing / evening shift.

Strategies to overcome the Maintenance Bay issues can include:

1. Investigate the multi-shift use of the major maintenance facility to handle minor repairs which will be a result of service expansion (will require purchase of 2 hoists at \$44,000 each)
2. Consider leasing an additional 1400 sq ft of space at 111 Dubois for the storage of parts. The cost will be \$5,392.00 for the remaining fiscal year and 12,779.04 each additional year of a lease.
3. Initiate discussions with the Vehicle Maintenance Unit (VMU) to address the swing and evening shifts on the weekends. We met with the leadership of the VMU unit on February 2, 2000 and they are agreeable to discussing this issue. This would allow for the continued use (24 hours per day) of the minor repair facility.

We are currently working on above listed issues with the goal of overcoming them so service expansion can continue at the pace our customers would like to see and that the Transit District has the ability to sustain.

### **III. FINANCIAL CONSIDERATIONS**

The additional lease of space at 111 Dubois would cost \$12,779.04 on an annualized basis. The additional items discussed will have a cost implication that is not know at this time. We will be

addressing the additional cost items through the yearly budgeting process and / or staff reports to the Board of Directors for your consideration.

**IV. ATTACHMENTS**

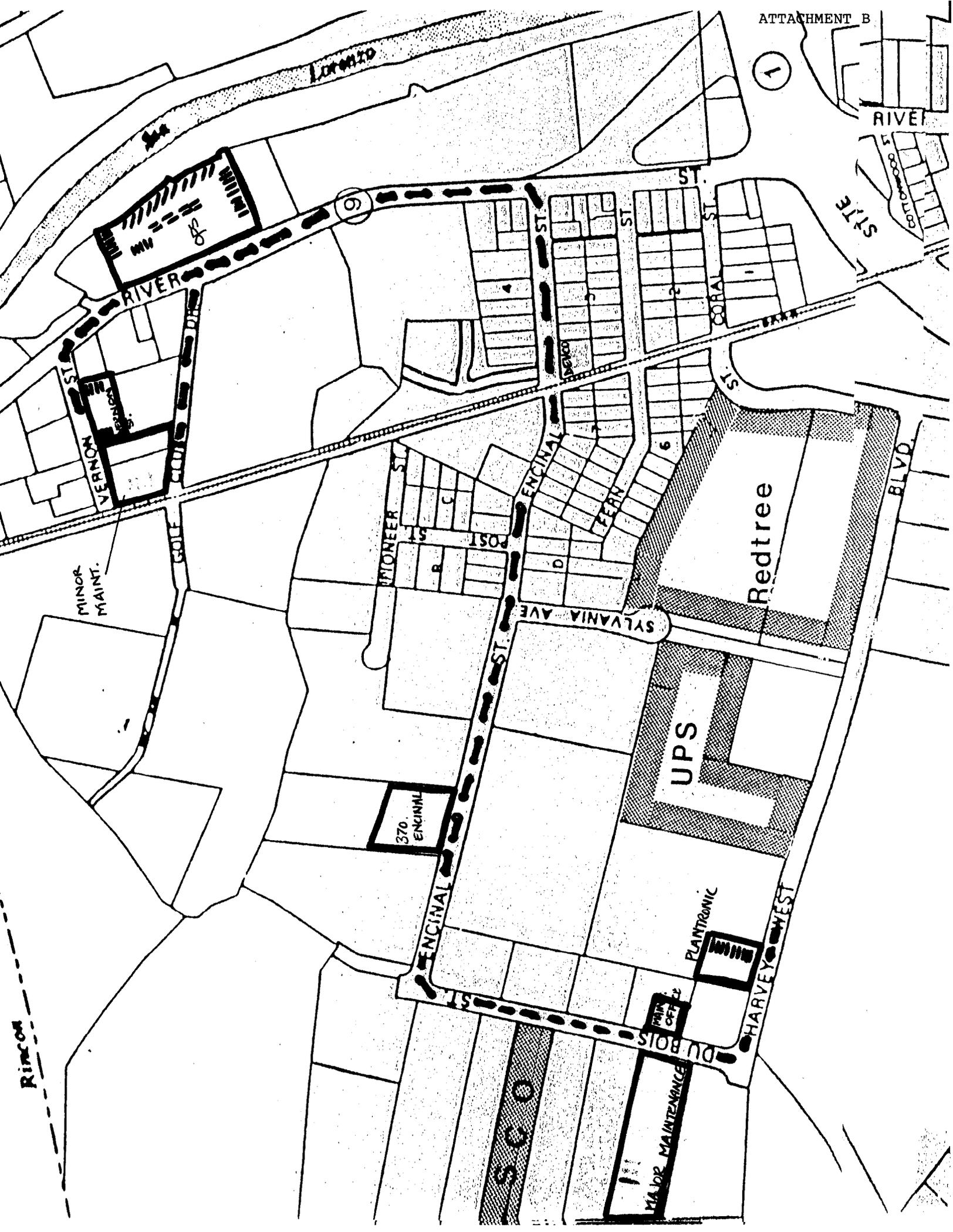
Attachment A: Bus Fleet Summary

Attachment B: Facilities Locations

## Santa Cruz Metropolitan Transit District Bus Fleet

# of Vehicles	Year/Manufacturer	Comments
7	1979 Flxible	Will be retired this year
<b>15</b>	1981 Gillig	
1	1981 New Flyer	Formerly used on Highway 17 service – now in local service
10	1984 Gillig	Rehabilitated Sam Trans Buses (no engine or transmission work scheduled as part of the rehabilitation)
3	1984 Gillig	
8	1984 GMC – RTS	Golden Gate buses – used on Highway 17
25	1988 New Flyer	
7	1989 New Flyer	Used on Highway 17
4	1992 Champion	25 foot mini-bus
30	1988 New Flyer	
<b>110 Active Fleet</b>		

1	1951 GMC	Historic Bus
1	1974 GMC	Historic Bus
<b>112 Total Buses</b>		



Lorenzo

1

RIVER

STE

COLONIA

ST.

RIVER

9

ST.

ST.

ST.

ST.

ST.

VERNON ST. SERVICES

MINOR MAINT.

GOLF CREEK DR.

PIONEER ST.

POST

ENCINAL

FEARN

6

Redtree

BLVD.

SYLVANIA AVE

ST.

370. ENCINAL

ENCINAL ST.

UPS

PLANTRONIC

HARVEY WEST

DU BOIS

MAJOR MAINTENANCE

Rincon

SCO

# SANTA CRUZ METROPOLITAN TRANSIT DISTRICT

**DATE:** February 11, 2000

**TO:** Board of Directors

**FROM:** Bryant J. Baehr, Manager of Operations  
Tom Stickel, Acting Fleet Maintenance Manager  
David Konno, Facilities Maintenance Manager

**SUBJECT: LOW FLOOR BUSES VS. HIGH FLOOR BUSES**

## I. SUMMARY OF ISSUES

- The Transit District will be in the position of purchasing new buses very shortly
- A decision will be necessary concerning the style (High floor – Low floor) of bus to be purchased
- There are positives and negatives to both styles
- An interactive process will be undertaken to solicit input from our customers and user groups concerning the type of bus to be purchased

## II. DISCUSSION

In addition to making a decision as to the length of the vehicle purchased by the Transit District, a decision will have to be made concerning the height of the bus to be purchased. The two (2) styles that currently exist are: high floor and low floor. The main difference between the two centers on the height of the bus from the ground. High floor buses have steps that the customers use to enter the bus and a mechanical lift for wheelchair customers. Low floor buses are close to the ground, do not have steps to enter the bus and have a wheelchair ramp instead of a mechanical device that lifts the wheelchair from the ground.

Listed below are the positive and negative issues associated with each type of vehicle.

### Low Floor Buses

#### Positive Aspects

- Minimal maintenance to the ramp used to board wheelchair customers
- Wheelchair ramp can be manually deployed should the automated system fail. Bus will not be “out of service” or unable to pick up wheelchair customers due to wheelchair lift failure
- Bus operator is in an elevated chair position
- Bus is friendly to seniors, individuals with walkers and mothers with carriages
- Passenger “trips and falls” diminish with the elimination of front door stairs

**Negative**

- Wheelchair ramp angle is more difficult to board when street curb is not available (rural areas)
- Seating capacity is reduced due to the low floor design
- The bus operator must climb a step to reach the operator seat
- Passenger visibility is decreased due to the low floor design
- Road "crowns" at some locations cause "bottoming out".

**High Floor Bus**

**Positive Aspects**

- Increased seating capacity
- Wheelchair lift deploys in all areas

**Negatives Aspects**

- Increased mechanical (wheelchair lift) maintenance needed
- Passenger "trips and falls" increase when customers need to use stairs when entering and exiting the bus
- Wheelchair lift failure requires evacuation of wheelchair customers (average time is 30 minutes)

Initially, there was some negative feedback from our wheelchair customers concerning the maneuvering room inside the bus and the wheelchair ramp. Over time, and with some education on the ramp dynamics, these concerns have all but disappeared. We have not received a complaint on the New Flyer Low Floor buses in the past year. An interactive approach and feedback from our customers and user groups will be initiated prior to the purchase of any new vehicle.

**III. FINANCIAL CONSIDERATIONS**

High Floor and Low Floor buses are in the same general price range.

**IV. ATTACHMENTS**

**Attachment A: NONE**

# SANTA CRUZ METROPOLITAN TRANSIT DISTRICT

**DATE:** February 11, 2000  
**TO:** Board of Directors  
**FROM:** Mark J. Dorfman, Assistant General Manager  
**SUBJECT: FIVE YEAR CAPITAL/OPERATING PLAN**

## I. SUMMARY OF ISSUES

- The Transit District needs to update the Capital and Operating Program for the next five years.
- Attachments have been provided for the Board to analyze Operating Expenses, Revenues, and Capital Expenses for the next five years.

## II. DISCUSSION

The purpose of this paper is to provide the Board of Directors with a Five Year Projection of Operating Costs; a Five Year Projection of Capital Funding that staff expects to be available, a Five Year Capital Expenditure Program living with our funding projections; and a Five Year Capital Expenditure Program, assuming an aggressive State and Federal Legislative Program.

Attachment A is the calculation of the unobligated Fund Balance. This number becomes the starting point for all of the fiscal planning that will be discussed today. Based upon the numbers provided by Finance the District will have \$1,976,210 in reserves on June 30, 2000.

Attachment B is the Five Year Projection of Operating Costs. The current year budget is shown in the first column, with a Projected Budget for FY 00-01 in the second column. The remaining four years are increased by an inflation rate that is shown in the last column of the table. Assumptions contained in this table include both Sales Tax and TDA will grow at a rate of 4%. Benefits are projected at 5%. On the Expense side, most expenses are expected to grow at 3% per year, labor costs at 4%, and Paratransit at 12%. ADA Paratransit continues to provide some of the most uncertainty in the District's budget process. While 12% growth exceeds that of most budget items, it is well below the recent growth being experienced.

All current service, including the TDA Supplemental service is included as baseline. Additionally, this scenario limits expansion to approximately \$150,000 of new service in each of the out years throughout the period. This would not allow for any major increases in Highway 17 or University services. A small fund transfer is annually included to the Capital Budget. This figure has not been increased by inflation. Operating Costs will increase from \$26.5 million in FY 99-00 to \$31.8 million in FY 04-05. The five year Operating Budget is out of balance by

about \$223,055. Should Paratransit costs exceed the 12% figure budgeted, it could absorb the service expansion funding.

Attachment C shows the expected flow of revenues into the District over the next five years, both Capital and Operating. The assumptions used for FTA funding is the amounts contained in TEA-21 with some growth in the last year. The use of Operating funds have been straight lined at \$505,614 for each of the five years, totaling \$2.5 million for the five years period. This use of federal funds for operating purposes will be discussed in a separate item on today's agenda. The remaining \$5.3 million is available for Capital expenses. The Capital Plan also estimates STP/CMAQ funds in the amount of \$1.2 million per year. This is an aggressive estimate, but is slightly less than the projection used in the last year's plan. It is based upon the projections of funding availability from the SCCRTC, and an assumption of a 30% share to the District. STA funding is conservatively estimated at \$700,000 for each of the years in the plan. This funding is used as local share to match grants and to purchase locally funded items. Also, in the fifth year of the plan, \$1,484,000 of SB45 funding is projected. This assumes that the District will receive 28% of the estimated \$5.3 million that would come to the area.

Attachment D is the Five Year Spending Plan for Capital Needs that can be funded from the revenues shown in Attachment C. An assumption is made in this plan that COF is fully funded and not part of the Capital needs for the next five years. The priorities used in spending these funds is first to first replace buses, then purchase Paratransit vans, address some bus stop rehabilitation needs, continue to improve MIS equipment, purchase support equipment, non-revenue vehicles, and miscellaneous local capital. This does not meet all of the needs of the District, but is an attempt to deal with the most pressing needs based upon the available funds. Assuming that the District continues on a Diesel fuel path, this plan will allow for the purchase of 21 forty-foot buses, 4 thirty-five foot buses, 14 Highway 17 buses, 29 paratransit vans, \$850,000 of bus stop rehabilitation, \$316,128 of Bus Stop Shelters, \$424,515 of MIS equipment, \$144,471 of support equipment, \$451,869 of non-revenue vehicles, and \$400,000 of miscellaneous local capital. The total Capital Program totals \$17,414,179. Last year, this funding was not able to replace all the eligible district vehicles (assuming 7 Flexibles are retired), but with the enhanced funding from the MTIS decision, this will allow for full replacement plus three expansion buses.

Attachment E is a Five Year Projection of Anticipated and Earmark Funds. This funding projection totals \$32,787,399. The areas for increase are \$7,500,000 in Federal Earmark Funds (\$1,500,000 per year), \$6,000,000 of State Earmark Funds, and some additional local matching funds.

Attachment F is a Five Year Spending Plan that assumes a State and Federal Earmark Funding Program. This would entail seeking out and receiving earmarks or other special funds to fund these items. The estimated amounts are what District staff feels could be generated. Using similar priorities from Attachment D, we are able to buy 27 forty-foot buses, 5 thirty-five foot buses, 16 buses for Highway 17 and 31 paratransit vans. This program allows for the expenditure of \$440,600 for bus stop shelters, \$2.25 million for bus stop rehabilitation, \$4,791,389 for an AVL/Radio System, \$428,016 for MIS equipment, \$188,906 for support

equipment, \$510,796 in non-revenue vehicles, \$400,000 for miscellaneous local capital, and \$6.0 million for an expansion of METRO Center. The total funds expended under this aggressive program totals \$32,876,206.

In order to project the impact of a decision to move to a CNG fuel source it is necessary to look at the grants and funds that are available for new bus purchases. Attachment G shows that the District currently has funding for 24 new buses. A decision on low-floor vs. high-floor, and Articulated vs. 40-foot, and CNG vs. Diesel need to be made for the District to pursue these buses. Should a CNG decision be made, delivery of the buses would be delayed until MetroBase is available. The current mix of vehicles is 14 40-foot and 10 60-foot vehicles. For comparative purposes, all 40 foot diesel buses would allow for 27 buses to be purchased, a net gain of three. If CNG 40-foot vehicles are purchased, approximately 23 buses could be purchased, a loss of one bus.

Attachment H shows the various purchase options stratified by Diesel and for CNG. Under the diesel fuel strategy, there would be 36 vehicles left to procure. The Anticipated Revenue Option would allow for 39 buses to be purchased, resulting in a net increase of three expansion buses to the fleet. Assuming that the Anticipated + Earmark Revenues are received, a total of 48 buses could be purchased. This would result in 12 expansion buses to the fleet.

If a CNG Fueling strategy is assumed, the funding for each of the above assumptions would not go as far. In the Anticipated Revenue Option, all of the District's buses would not be replaced. There would be seven (7) that would not be replaced. In the Anticipated + Earmark Revenue Option, all of the District's buses would be replaced.

### **III. FINANCIAL CONSIDERATIONS**

The considerations for the Board to consider are whether the Operating and Capital Budgets fit within their priorities, and whether the balance between Capital and Operating priorities are valid. There is always flexibility between budgets to accommodate different scenarios.

### **IV. ATTACHMENTS**

Attachment A	Reserve Fund Balance Calculation
Attachment B	Five Year Projection of Operating Costs
Attachment C	Five Year Projection of Anticipated Revenues
Attachment D	Five Year Projection of Capital Costs – Anticipated Revenues
Attachment E	Five Year Projection of Anticipated + Earmark Revenues
Attachment F	Five Year Projection of Capital Costs – Anticipated + Earmark Revenues
Attachment G	Approved Grants for Buses
Attachment H	Impact of CNG Decision on Bus Purchases

## RESERVE FUND BALANCE CALCULATION

Available Net Assets at June 30, 1999	\$ 10,033,982	
Transfer from Operating Budget, FY 99-00	\$ 450,519	
FY 99-00 STA Allocation	<u>\$ 781,410</u>	
Reserve Balance, FY 99-00		\$ 11,265,911
Less Cash Flow Reserve	\$ (2,600,000)	
Less Worker's Compensation Reserves	\$ (430,000)	
Less Insurance Reserve	<u>\$ (75,000)</u>	
Reserve Balance Available, FY 99-00		\$ 8,160,911
District Funded Capital Projects, FY 99-00	\$ (627,640)	
District Share of Current Projects with Approved Grant Funding	\$ (1,545,061)	
District Share of MetroBase Grants	<u>\$ (4,012,000)</u>	
Estimated Balance Available for New Projects at June 30, 2000		<u>\$ 1,976,210</u>
Adjusted Fund Balance at June 30, 2000		\$ 1,976,210

**FIVE YEAR PROJECTION OF OPERATING COSTS**

	FY 99-00	FY 00-01	FY 01-02	FY 02-03	FY 03-04	FY 04-05	
<b>REVENUE</b>							
Passenger Fares	\$ 3,058,053	\$ 3,119,214	\$ 3,204,548	\$ 3,291,589	\$ 3,380,371	\$ 3,470,929	2%
Service Improvement	\$ -	\$ 22,500	\$ 22,500	\$ 22,500	\$ 22,500	\$ 22,500	
Spec Transit Fares	\$ 1,653,000	\$ 1,686,060	\$ 1,719,781	\$ 1,754,177	\$ 1,789,260	\$ 1,825,046	2%
Paratransit Fares	\$ 200,000	\$ 224,000	\$ 250,880	\$ 280,986	\$ 314,704	\$ 352,468	12%
Purch Transp Rev/Hwy 17	\$ 795,309	\$ 811,215	\$ 827,439	\$ 843,988	\$ 860,868	\$ 878,085	2%
Advertising Income	\$ 134,000	\$ 158,000	\$ 175,000	\$ 180,000	\$ 180,000	\$ 180,000	0%
Rent Income	\$ 95,400	\$ 138,000	\$ 138,000	\$ 138,000	\$ 138,000	\$ 138,000	0%
Interest Income	\$ 770,000	\$ 700,000	\$ 700,000	\$ 700,000	\$ 700,000	\$ 700,000	0%
Sales Tax	\$ 13,900,000	\$ 14,595,000	\$ 15,324,750	\$ 16,090,988	\$ 16,895,537	\$ 17,740,314	5%
TDA Funds	\$ 4,674,062	\$ 4,907,765	\$ 5,153,153	\$ 5,410,811	\$ 5,681,352	\$ 5,965,419	5%
TDA Supplement	\$ 150,000	\$ -	\$ -	\$ -	\$ -	\$ -	0%
FTA Sec 5303	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	0%
FTA Sec 5307	\$ 505,614	\$ 505,614	\$ 505,614	\$ 505,614	\$ 505,614	\$ 505,614	0%
FTA Sec 5311	\$ 39,697	\$ 39,697	\$ 39,697	\$ 39,697	\$ 39,697	\$ 39,697	0%
Other Grant Funds	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0%
Other Income	\$ 52,865	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	0%
Pass Through Funds	\$ 450,000	\$ -	\$ -	\$ -	\$ -	\$ -	0%
<b>TOTAL PROJ REVENUE</b>	<b>\$ 26,548,000</b>	<b>\$ 26,992,065</b>	<b>\$ 28,146,363</b>	<b>\$ 29,343,350</b>	<b>\$ 30,592,903</b>	<b>\$ 31,903,072</b>	
<b>EXPENSE</b>							
Payroll	\$ 12,771,446	\$ 13,282,304	\$ 13,813,596	\$ 14,366,140	\$ 14,940,785	\$ 15,538,417	4%
Retirement	\$ 785,220	\$ 1,068,233	\$ 1,110,962	\$ 1,155,401	\$ 1,201,617	\$ 1,249,682	4%
Med/Dent/Vision/Life/LTD	\$ 2,649,492	\$ 2,781,967	\$ 2,921,065	\$ 3,067,118	\$ 3,220,474	\$ 3,381,498	5%
Workers Comp	\$ 1,373,823	\$ 1,415,038	\$ 1,457,489	\$ 1,501,213	\$ 1,546,250	\$ 1,592,637	3%
Payroll Taxes	\$ 178,558	\$ 185,700	\$ 193,128	\$ 200,853	\$ 208,888	\$ 217,243	4%
Other Benefits	\$ 26,806	\$ 27,342	\$ 27,889	\$ 28,447	\$ 29,016	\$ 29,596	2%
Services	\$ 1,679,341	\$ 1,575,221	\$ 1,622,478	\$ 1,671,152	\$ 1,721,287	\$ 1,772,925	3%
Fuels & Lubes	\$ 890,969	\$ 917,698	\$ 945,229	\$ 973,586	\$ 1,002,793	\$ 1,032,877	3%
Other Mobile Materials	\$ 148,142	\$ 152,586	\$ 157,164	\$ 161,879	\$ 166,735	\$ 171,737	3%
Rev Vehicle Parts	\$ 570,718	\$ 587,840	\$ 605,475	\$ 623,639	\$ 642,348	\$ 661,619	3%
Materials & Supplies	\$ 391,325	\$ 403,065	\$ 415,157	\$ 427,611	\$ 440,440	\$ 453,653	3%
Utilities	\$ 244,245	\$ 251,572	\$ 259,120	\$ 266,893	\$ 274,900	\$ 283,147	3%
Casualty & Liability	\$ 165,250	\$ 170,208	\$ 175,314	\$ 180,573	\$ 185,990	\$ 191,570	3%
Settlement Costs	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	0%
Other Misc/Taxes	\$ 254,180	\$ 261,805	\$ 269,660	\$ 277,749	\$ 286,082	\$ 294,664	3%
Leases & Rentals	\$ 533,209	\$ 549,205	\$ 565,681	\$ 582,652	\$ 600,131	\$ 618,135	3%
Hwy 17 Program	\$ 412,827	\$ -	\$ -	\$ -	\$ -	\$ -	3%
Contract Paratransit	\$ 2,321,930	\$ 2,600,562	\$ 2,912,629	\$ 3,262,144	\$ 3,653,602	\$ 4,092,034	12%
Service Improvement/98-99	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	4%
TDA Supplement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	4%
Service Improvement/99-00	\$ 150,000	\$ 156,000	\$ 162,240	\$ 168,730	\$ 175,479	\$ 182,498	4%
Service Improvement/00-01	\$ -	\$ 150,000	\$ 156,000	\$ 162,240	\$ 168,730	\$ 175,479	4%
Service Improvement/01-02	\$ -	\$ -	\$ 150,000	\$ 156,000	\$ 162,240	\$ 168,730	4%
Service Improvement/02-03	\$ -	\$ -	\$ -	\$ 150,000	\$ 156,000	\$ 162,240	4%
Service Improvement/03-04	\$ -	\$ -	\$ -	\$ -	\$ 150,000	\$ 156,000	4%
New Programs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	4%
<b>Subtotal Oper Expense</b>	<b>\$ 25,647,481</b>	<b>\$ 26,636,345</b>	<b>\$ 28,020,274</b>	<b>\$ 29,484,021</b>	<b>\$ 31,033,786</b>	<b>\$ 32,526,381</b>	
Studies/Prog - Grant	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0%
Transfer to Capital	\$ 450,519	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	0%
Pass Through Programs	\$ 450,000	\$ -	\$ -	\$ -	\$ -	\$ -	0%
Alloc to Cap Reserve	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0%
Alloc to Wkr Comp Res	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0%
Alloc to Insur Reserve	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0%
Reductions to Balance	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0%
COF Savings	\$ -	\$ -	\$ -	\$ -	\$ (1,000,000)	\$ (1,000,000)	
<b>TOTAL PROJ EXPENSE</b>	<b>\$ 26,548,000</b>	<b>\$ 26,936,345</b>	<b>\$ 28,320,274</b>	<b>\$ 29,784,021</b>	<b>\$ 30,333,786</b>	<b>\$ 31,826,381</b>	
Projected Revenue	\$ 26,548,000	\$ 26,992,065	\$ 28,146,363	\$ 29,343,350	\$ 30,592,903	\$ 31,903,072	
Projected Expense	\$ 26,548,000	\$ 26,936,345	\$ 28,320,274	\$ 29,784,021	\$ 30,333,786	\$ 31,826,381	
Balance (Deficit)	\$ -	\$ 55,720	\$ (173,911)	\$ (440,671)	\$ 259,117	\$ 76,691	
Cumulative Balance (Def)	\$ -	\$ 55,720	\$ (118,191)	\$ (558,863)	\$ (299,746)	\$ (223,055)	
Paratransit Percentage	9%	10%	10%	11%	12%	13%	

**FIVE YEAR PROJECTION OF ANTICIPATED REVENUES**

	<b>FY 00-01</b>	<b>FY 01-02</b>	<b>FY 02-03</b>	<b>FY 03-04</b>	<b>FY 04-05</b>	<b>TOTALS</b>
<b>Santa Cruz UZA</b>	1,285,723	1,389,784	1,493,316	1,597,800	1,693,668	7,460,291
<b>Watsonville UZA</b>	551,109	595,713	640,091	684,877	725,970	3,197,760
<b>Subtotal</b>	1,836,832	1,985,497	2,133,407	2,282,677	2,419,638	10,658,051
<b>Used for Operating</b>	505,614	505,614	505,614	505,614	505,614	2,528,070
<b>Formula Capital Available (5307)</b>	-	-	715,793	1,777,063	1,914,024	4,406,880
<b>STP Funds</b>	450,000	450,000	450,000	450,000	450,000	2,250,000
<b>CMAQ Funds</b>	750,000	750,000	750,000	750,000	750,000	3,750,000
<b>SB 45 Funds</b>	-	-	-	-	1,484,000	1,484,000
<b>Subtotal External Funding</b>	1,200,000	1,200,000	1,915,793	2,977,063	4,598,024	11,890,880
<b>Formula Capital from STA</b>	-	-	178,948	444,266	478,506	1,101,720
<b>STP/CMAQ Local Share from STA</b>	155,473	155,473	155,473	155,473	155,473	777,364
<b>100% Local Capital from STA</b>	-	-	-	-	-	-
<b>Remainder available from STA</b>	544,527	544,527	365,579	100,262	66,021	1,620,916
<b>Subtotal STA Funding</b>	700,000	700,000	700,000	700,000	700,000	3,500,000
<b>20% General Fund Formula</b>	-	-	-	-	-	-
<b>20% General Fund Match for SB 45</b>	-	-	-	-	371,000	371,000
<b>STP/CMAQ General Fund</b>	-	-	-	-	-	-
<b>100% Local Capital General Fund</b>	450,519	300,000	300,000	300,000	300,000	1,650,519
<b>Subtotal General Fund</b>	450,519	300,000	300,000	300,000	671,000	2,021,519
<b>Total Capital Funds</b>	2,350,519	2,200,000	2,915,793	3,977,063	5,969,024	17,412,399
<b>Capital Spending Plan</b>	2,365,808	2,199,372	2,907,003	3,984,055	5,957,941	17,414,179
<b>Unfunded Balance</b>	(15,289)	628	8,790	(6,992)	11,083	
<b>Cumulative Balance</b>	(15,289)	(14,661)	(5,871)	(12,863)	(1,781)	

**FIVE YEAR PROJECTION OF CAPITAL COSTS - ANTICIPATED REVENUES**

	FY 00-01		FY 01-02		FY 02-03		FY 03-04		FY 04-05		TOTALS
	Qty	Amount									
<b>Consolidated Operating Facility</b>		-		-		-		-		-	-
<b>Low Floor Buses - 40 Foot</b>	2	611,820	1	315,087		-	3	1,002,828	15	5,164,566	7,094,302
<b>Low Floor Buses - 35 Foot</b>		-		-	4	1,274,557		-		-	1,274,557
<b>Low Floor Buses - 60 Foot</b>		-		-		-		-		-	-
<b>Highway 17 Buses - Enhanced</b>	3	967,788	4	1,329,096	2	684,484	5	1,762,547		-	4,743,915
<b>Paratransit Vans</b>	6	333,720	5	286,443	5	295,036	8	486,220	5	313,004	1,714,423
<b>Bus Shelters</b>		-		-	20	94,412	25	121,555	20	100,161	316,128
<b>Bus Stop Rehabilitation</b>	14	140,000	11	110,000	20	200,000	20	200,000	20	200,000	850,000
<b>AVL/Radio System</b>		-		-		-		-		-	-
<b>Farebox System</b>		-		-		-		-		-	-
<b>MIS Equipment</b>	4	88,992	3	68,746	4	94,412	4	97,244	3	75,121	424,515
<b>Support Equipment</b>		-		-	3	70,809	2	48,622	1	25,040	144,471
<b>Non-revenue Vehicles</b>	5	133,488		-	4	113,294	6	175,039	1	30,048	451,869
<b>Miscellaneous Local Capital</b>	9	90,000	9	90,000	8	80,000	9	90,000	5	50,000	400,000
<b>Total</b>		2,365,808		2,199,372		2,907,003		3,984,055		5,957,941	17,414,179
Available		2,350,519		2,200,000		2,915,793		3,977,063		5,969,024	17,412,399
Surplus/Shorfall		(15,289)		628		8,790		(6,992)		11,083	227,388
Balance		(15,289)		(14,661)		(5,871)		(12,863)		(1,781)	

**FIVE YEAR PROJECTION OF ANTICIPATED + EARMARK REVENUES**

	<b>FY 00-01</b>	<b>FY 01-02</b>	<b>FY 02-03</b>	<b>FY 03-04</b>	<b>FY 04-05</b>	<b>TOTALS</b>
<b>Santa Cruz UZA</b>	1,285,723	1,389,784	1,493,316	1,597,800	1,693,668	7,460,291
<b>Watsonville UZA</b>	551,109	595,713	640,091	684,877	725,970	3,197,760
<b>Subtotal</b>	1,836,832	1,985,497	2,133,407	2,282,677	2,419,638	10,658,051
<b>Used for Operating</b>	505,614	505,614	505,614	505,614	505,614	2,528,070
<b>Formula Capital Available (5307)</b>	-	-	715,793	1,777,063	1,914,024	4,406,880
<b>STP Funds</b>	450,000	450,000	450,000	450,000	450,000	2,250,000
<b>CMAQ Funds</b>	750,000	750,000	750,000	750,000	750,000	3,750,000
<b>SB 45 Funds</b>	-	-	-	-	1,484,000	1,484,000
<b>Federal Earmark Funds</b>	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	7,500,000
<b>State Earmark Funds</b>	0	1,000,000	0	500,000	0	600,000
<b>Subtotal External Funding</b>	2,700,000	3,700,000	3,415,793	9,477,063	6,098,024	25,390,880
<b>Formula Capital from STA</b>	-	-	178,948	444,266	478,506	1,101,720
<b>STP/CMAQ Local Share from STA</b>	155,473	155,473	155,473	155,473	155,473	777,364
<b>100% Local Capital from STA</b>	-	-	-	-	-	-
<b>Remainder available from STA</b>	544527.2789	544527.2789	365579.0289	100261.5289	66021.37389	1620916.489
<b>Subtotal STA Funding</b>	700,000	700,000	700,000	700,000	700,000	3,500,000
<b>20% General Fund Formula</b>	-	-	-	-	-	-
<b>20% General Fund Match for SB 45</b>	-	-	-	-	371,000	371,000
<b>STP/CMAQ General Fund</b>	-	-	-	-	-	-
<b>100% Local Capital General Fund</b>	450519	300000	300000	300000	300000	1650519
<b>Local Match Federal Earmark</b>	375,000	375,000	375,000	375,000	375,000	1,875,000
<b>Local Match State Earmark</b>	0	0	0	0	0	0
<b>Subtotal General Fund</b>	825,519	675,000	675,000	675,000	1,046,000	3,896,519
<b>Total Capital Funds</b>	4,225,519	5,075,000	4,790,793	10,852,063	7,844,024	32,787,399
<b>Capital Spending Plan</b>	4,217,606	5,104,809	4,846,971	10,802,446	7,904,374	32,876,206
<b>Unfunded Balance</b>	(15,289)	628	8,790	(6,992)	11,083	
<b>Cumulative Balance</b>	(15,289)	(14,661)	(5,871)	(12,863)	(1,781)	

**FIVE YEAR PROJECTION OF CAPITAL COSTS - ANTICIPATED + EARMARK REVENUE**

	FY 00-01		FY 01-02		FY 02-03		FY 03-04		FY 04-05		TOTALS
	Qty	Amount	Qty	Amount	Qty	Amount	Qty	Amount	Qty	Amount	
<b>Consolidated Operating Facility</b>						-		-		-	-
Low Floor Buses - 40 Foot	11	3,365,010		-	2	649,080		-	14	4,820,262	8,834,351
Low Floor Buses - 35 Foot		-	1	309,358	2	637,278		-	2	676,089	1,622,725
Low Floor Buses - 60 Foot		-		-		-		-		-	-
Highway 17 Buses - Enhanced		-	8	2,658,191		-	5	1,815,423	3	1,089,254	5,562,868
Paratransit Vans	5	278,100	5	286,443	4	236,029	10	607,775	7	438,206	1,846,552
Bus Shelters		-		-	20	94,412	30	145,866	40	200,323	440,600
Bus Stop Rehabilitation	45	450,000	45	450,000	45	450,000	45	450,000	45	450,000	2,250,000
AVL/Radio System		-		-	0.5	2,360,290	0.5	2,431,099		-	4,791,389
Farebox System		-		-		-		-		-	-
MIS Equipment	2	44,496	5	114,577	3	70,809	3	72,933	5	125,202	428,016
Support Equipment		-	3	68,746	3	70,809	1	24,311	1	25,040	188,906
Non-revenue Vehicles		-	5	137,493	7	198,264	6	175,039	0	-	510,796
Miscellaneous Local Capital	8	80,000	8	80,000	8	80,000	8	80,000	8	80,000	400,000
METRO Center Expansion	-	-	1	1,000,000		-	5	5,000,000		-	6,000,000
<b>Total</b>		4,217,606		5,104,809		4,846,971		10,802,446		7,904,374	32,876,206
Available		4,225,519		5,075,000		4,790,793		10,852,063		7,844,024	32,787,399
Surplus/Shortfall		7,913		(29,809)		(56,178)		49,617		(60,351)	(88,807)
Balance		7,913		(21,896)		(78,074)		(28,457)		(88,807)	

## APPROVED GRANTS FOR BUSES

Grant	Buses Approved		Funding	Unit Costs	Diesel/ 40 Foot	CNG/ 40 Foot
CA-90-X873	8	40-foot	\$ 2,500,000	\$ 312,500	8	6.7
CA-90-X873	2	40 foot	\$ 790,694	\$ 395,347	2	2.1
CA-90-X902	4	40 foot	\$ 1,217,666	\$ 304,417	4	3.2
FY 99-00 CMAQ	10	60-foot	\$ 4,181,841	\$ 418,184	13	11.2
	24	<b>Number of Buses</b>			27	23.2

# IMPACT OF CNG DECISION ON BUS PURCHASES

## Diesel Fuel Strategy

		Model Year	Replacement Date
30	New Flyer Low Floor	1998	2010
10	Gillig Rehabs	2000	2007
27	Diesel 40 Footers	2002	2014
67	Total		

36	Fleet Left to Replace
----	-----------------------

39	Anticipated Revenue
3	Expansion Buses

48	Anticipated +Earmark
12	Expansion Buses

## Compressed Natural Gas Strategy

		Model Year	Replacement Date
30	New Flyer Low Floor	1998	2010
10	Gillig Rehabs	2000	2007
23	CNG 40 Footers	2003	2015
63	Total		

40	Fleet Left to Replace
----	-----------------------

33	Anticipated Revenue
(7)	Expansion Buses

40	Anticipated +Earmark
0	Expansion Buses

# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

**DATE:** February 11, 2000

**TO:** Board of Directors

**FROM:** Mark J. Dorfman, Assistant General Manager  
Elisabeth Ross, Finance Manager

**SUBJECT: RESERVES AND FEDERAL OPERATING ASSISTANCE**

## **I. SUMMARY OF ISSUES**

- The District applies for and receives Federal formula operating assistance, which requires compliance with a number of Federal rules and regulations.
- In order to qualify for Federal operating assistance, the District must demonstrate a deficit in operating revenues each year.
- Over the past several years, the District has experienced higher operating revenues and lower operating expenses than budgeted, largely due to high sales tax revenue and personnel vacancies.
- The District maintains three reserve funds, in addition to a cash flow reserve: capital funding reserve, workers compensation reserve and insurance reserve.
- To maintain eligibility for Federal operating assistance and to fund the District's capital improvement program, each year the extra sales tax funds have been retired to the capital funding reserve. For the past two years, funds have also been retired to workers compensation reserves and insurance reserves from savings in those accounts.
- The District may choose not to apply for the formula operating funds, which represents approximately \$550,000 per year, and instead apply all federal assistance to the Capital Program. This would ease compliance with Federal regulations and programs, which would then only apply to capital projects. However, it could potentially create an operating deficit.

## **II. DISCUSSION**

The District has historically applied for and received Federal formula operating assistance, which requires compliance with a number of Federal rules and regulations. Because operating assistance impacts the day-to-day operating budget, these regulations apply to all aspects of District operations. Purchasing is particularly affected. Some potential vendors do not bid on District procurements due to the lengthy purchasing requirements, including numerous certifications. Also, the District is required to prepare an annual Disadvantaged Business Enterprise program with follow-up reports. Under current Federal rules and regulations, the District can use all of its Federal formula funding for operating or capital purposes. If the District did not apply for and receive Federal operating assistance, and used it for capital

purposes, the Federal regulations would only apply to capital projects for which the District received Federal funding.

In order to qualify for Federal operating assistance, the District must demonstrate an operating deficit each year. When revenues appear to exceed expenses at year end, which has happened recently due to high sales tax revenue and low operating expenses resulting from personnel vacancies, the extra sales tax revenue is retired to capital reserves to preserve the operating deficit and maintain eligibility for operating assistance. This has provided the District with additional funding for the on-going capital improvement program.

As detailed in Attachment A, general operating assistance (Section 5307) is currently around \$500,000 per year and rural operating assistance (Section 5311) is approximately \$36,000 per year. This represents about 2% of current operating revenues. For the past five years, operating assistance from both sources received by the District totaled less than \$3 million. If the District chooses not to accept Federal operating assistance, the same amount could then be claimed for capital expenditures.

In the 1980's, as the District increased service, most funding was allocated to service improvements and system expansion. Minimal amounts were retired to capital reserves, and those amounts were expended towards the District share of a few large capital projects such as the Metro Center and Watsonville Transit Center. In the spring of 1990, following the 1989 Loma Prieta earthquake, the District was forced to delay payment to vendors in order to make payroll. Later in the year, the District implemented the major downsizing of the system. Following these events, a cash flow reserve was established in the amount of \$2,600,000 so that funds would always be available in the treasury for processing payroll and paying current invoices in the event of major funding shortfalls.

In 1998, the Board of Directors authorized establishment of two additional reserves, one for workers compensation and one for liability insurance. These reserves are funded from savings when expenses do not meet the budgeted amounts for these accounts. The reserve funds will protect the District in years when large claims payments are required for workers compensation and for casualty and liability losses.

### **III. FINANCIAL CONSIDERATIONS**

The Federal operating assistance currently provides \$505,614 in Section 5307 funds and \$36,604 in Section 5311 funds, annually. Eliminating the use of Federal operating assistance would increase the annual operating deficit, unless replacement funds are identified. By accepting Federal capital funding in lieu of operating funding, some local capital monies may be made available to fund operating expenses.

### **IV. ATTACHMENTS**

**Attachment A:** Operating Assistance Apportionments

F:\users\ADMIN\filesyst\B\BOD\Board Reports\2000\02\op asst reserv.doc

**ATTACHMENT A  
OPERATING ASSISTANCE APPORTIONMENTS  
1991 - 1999**

<b>FISCAL YEAR</b>	<b>OPERATING BUDGET</b>	<b>I--OPERATING SECTION 5307</b>	<b>ASSISTANCE-I SECTION 5311</b>	<b>TOTAL ASSISTANCE</b>	<b>PERCENT OF OPERATING BUDGET</b>
<b>1991-92</b>	<b>\$ 18,379,678</b>	<b>\$ 651,076</b>	<b>\$ 22,769</b>	<b>\$ 673,845</b>	<b>3.67%</b>
<b>1992-93</b>	<b>\$ 19,148,692</b>	<b>\$ 1,579,165</b>	<b>\$ 18,441</b>	<b>\$ 1,597,606</b>	<b>8.34%</b>
<b>1993-94</b>	<b>\$ 18,817,671</b>	<b>\$ 1,456,181</b>	<b>\$ 26,816</b>	<b>\$ 1,482,997</b>	<b>7.88%</b>
<b>1994-95</b>	<b>\$ 17,838,943</b>	<b>\$ 664,221</b>	<b>\$ 27,185</b>	<b>\$ 691,406</b>	<b>3.88%</b>
<b>1995-96</b>	<b>\$ 18,424,126</b>	<b>\$ 505,166</b>	<b>\$ 22,612</b>	<b>\$ 527,778</b>	<b>2.86%</b>
<b>1996-97</b>	<b>\$ 21,301,108</b>	<b>\$ 505,355</b>	<b>\$ 23,695</b>	<b>\$ 529,050</b>	<b>2.48%</b>
<b>1997-98</b>	<b>\$ 21,786,294</b>	<b>\$ 505,614</b>	<b>\$ 27,618</b>	<b>\$ 533,232</b>	<b>2.45%</b>
<b>1998-99</b>	<b>\$ 23,424,979</b>	<b>\$ 505,614</b>	<b>\$ 36,604</b>	<b>\$ 542,218</b>	<b>2.31%</b>

# SANTA CRUZ METROPOLITAN TRANSIT DISTRICT

**DATE:** Friday, February 11, 2000  
**TO:** Board of Directors  
**FROM:** Kim Chin, Planning and Marketing Manager  
**SUBJECT: CONTINUED USE OF BUS ADVERTISING**

## I. SUMMARY OF ISSUES

- METRO currently contracts with Obie Media to sell interior and exterior advertising space on its fleet of buses.
- The 5-year contract, effective from December 1, 1997 to November 30, 2002, guarantees METRO a minimum fixed amount each year, or 50% of gross advertising revenues if greater.
- To date, 50% of gross revenues have been less than the guaranteed minimum.
- METRO received \$120,000 from transit advertising for the December 1, 1998 to November 30, 1999 contract year.

## II. DISCUSSION

### Advertising Space

The contract with Obie Advertising permits the contractor to sell transit advertising on the interior and exterior of buses. This consists of interior cards placed on overhead slots, and external advertising that consists of “Full Wraps” (both sides and back of bus), “Queens” (street side and curb side of bus), “Kings” (curb side of bus), and “Back-attacks” (rear of bus). Each placement commands a different rate. Attachment A “2000 Transit Advertising Rates” outlines the different rates.

Currently, there are a total of 237 external advertising spaces available. Approximately 164 or 70% have been sold leaving a balance of 73 unsold spaces. Attachment B “External Advertising – Summary by Space Type” outlines sold and unsold spaces.

While, no interior space has been sold so far, METRO utilizes this space for “Transit Tips” which provide transit information to passengers. These are placed without charge to the District. In addition, METRO has coordinated the “Mobile Muse” Program with the county to place artwork from local artists on the interiors. These are also placed without charge on a space available basis.

### Advertisers

Approximately 33 clients advertise on the exterior of buses. In addition, METRO has placed recruitment advertisements on the exteriors, and is also in the process of placing an additional

number of advertisements promoting the District. Attachment C “External Advertising – Summary by Advertiser Type” shows how the utilization of transit advertising by existing clients. Approximately 59 or 36% are health related, 46 or 28% are non-profits, 32 or 20% are auto related, 19 or 11% are for-profits, and 8 or 5% are METRO related. Attachment D “List of Obie Clients (As of January 31, 2000)” shows current transit advertising clients.

### **Payment**

The terms of the contract with Obie Advertising specify that METRO is to receive a guaranteed minimum amount, or 50% of gross revenue if greater, for each year of the contract. So far, 50% of the gross revenues from advertising sales has been less than the guaranteed minimum. For the contract year December 1, 1998 – November 30, 1999, Obie paid METRO \$120,000.

Attachment E “Advertising Revenue For each Year of the Contract” shows historical payments and anticipated minimums through November 30, 2002.

### **Operational and Safety Considerations**

To ensure that advertisements do not interfere with the safe operations of the buses, Obie is prohibited from installing any material that would impede or cover up safety signs or coach numbers. In addition, no advertisements can interfere with the operation of any access doors or panels.

### **Approval of Advertising Material**

METRO has the right to approve all advertising materials and their manner of presentation. The contract prohibits advertising promoting the sale of alcohol and tobacco. No advertising that is false, misleading or deceptive, clearly defamatory, likely to hold up to scorn or ridicule any person or group of persons, obscene or pornographic, or advocates imminent lawlessness or violent action, or is contrary to the best interests of METRO is allowed.

Automobile related advertising has so far been accepted by METRO as an allowable form. Both Monterey Salinas Transit (MST) in Monterey and the Valley Transit Authority (VTA) accept auto advertising.

### **Fleet Not Included In Advertising**

METRO at its option, may choose to include additional buses in the fleet available for transit advertising. Currently, this does not include the 8 buses from the Golden Gate Transit District busses recently purchased to operate the Highway 17 and service, or the 10 buses from the San Mateo Transit District (SAMTRANS) that are being refurbished to replace aging intra-county buses. The 7 buses previously assigned to Discovery Tours to operate the Highway 17 service are also not included in the advertising fleet.

### **III. FINANCIAL CONSIDERATIONS**

Metro expects to receive a minimum of \$144,000 from transit advertising for the period December 1, 1999 to November 30, 2000.

### **IV. ATTACHMENTS**

- Attachment A:** “2000 Transit Advertising Rates”
- Attachment B:** “External Advertising – Summary by Space Type”
- Attachment C:** “External Advertising – Summary by Advertiser Type”
- Attachment D:** “List of Obie Clients (As of January 31, 2000)”
- Attachment E:** “Advertising Revenue For Each Year of the Contract”

# 2000 Rates

## Santa Cruz, CA

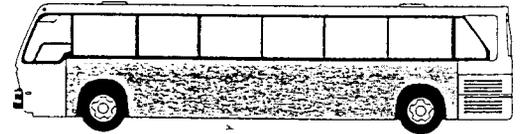
### Short Term Signature Products

Details...

- Rates represent space only.
- Rates are per unit and based on 4 week billing periods.
- 1/2 week minimum required.
- 5 unit minimum required.
- Please contact your Obie Media account executive to verify display size, availability, and art/production requirements.

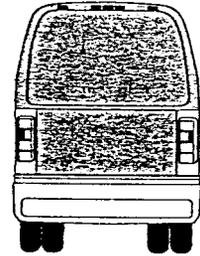
**Half-Side\***

# of Units	Rate
1	3815

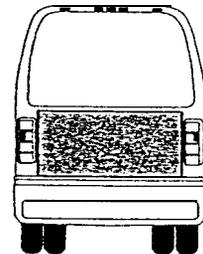


**Back Attack\***

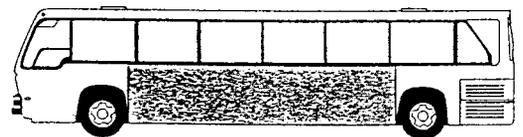
# of Units	Rate
1	\$670



# of Units	Rate
1	\$485



# of Units	Rate
1	\$585



\*\$250 installation and removal charge per display.



1362 Pacific Avenue, Suite 217  
Santa Cruz, California 95060

PHONE (831) 425-7173  
(800) 233-6243  
FAX (831) 425-7174

www.obie.com

4-4c.1a

Icons are for reference only.

# 2000 Rates

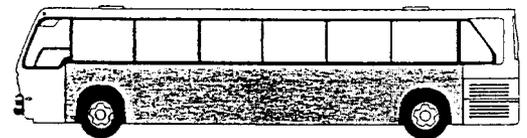
## Santa Cruz, CA

### Signature Products

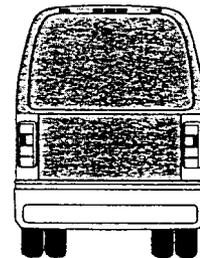
#### Details...

- Rates include space, design, production and installation.
- Rates are per unit, based on 4 week billing periods and a 52 week contract.
- Foil, reflective, exotic vinyl, extensions, and other embellishments are available at additional cost.
- Please contact your Obie Media account executive to verify display size, availability, and art/production requirements.

# of Units	Rate
1	\$740

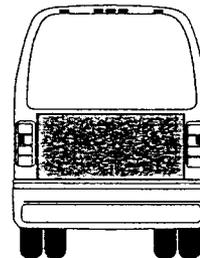


# of Units	Rate
1	\$610

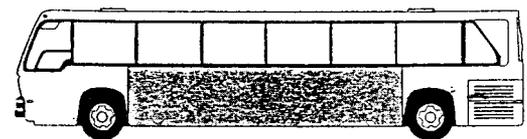


#### Super Tail

# of Units	Rate
1	\$440



# of Units	Rate
1	\$530



1362 Pacific Avenue, Suite 217  
Santa Cruz, California 95060

PHONE (831) 425-7173

(800) 233-6243

FAX (831) 425-7174

www.obie.com

4-4c.2a

Icons are for reference only.

# 2000 Rates

## Santa Cruz, CA

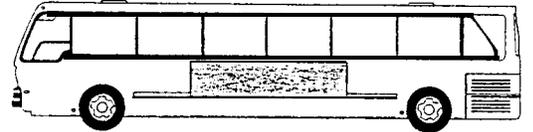
### Traditional Products

#### Details...

- Rates represent space only.
- Rates are based on 4 week billing periods.
- 14% continuity discount for 52 week contracts
- Please contact your Obie Media account executive to verify display size, availability, and art/production requirements.

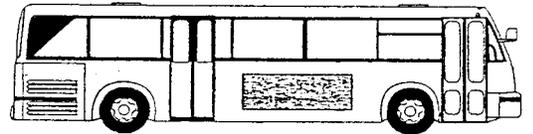
#### King 30" x 144"

Showing	#Units	Rate
Unit	1	\$320
25	20	6,400
50	30	9,600
100	50	16,000



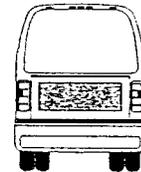
#### Queen 30" x 88"

Showing	#Units	Rate
Unit	1	\$270
25	20	5,400
50	30	8,100
100	50	13,500



#### Taillight 21" x 70"

Showing	#Units	Rate
Unit	1	\$270
25	20	5,400
50	30	8,100
100	50	13,500



1362 Pacific Avenue, Suite 217  
Santa Cruz, California 95060

PHONE (831) 425-7173  
(800) 233-6243  
FAX (831) 425-7174

www.obie.com

4-4c.3a

Icons are for reference only.

# 2000 Full Wrap Rates

## 52 Week Details...

- Rate includes space, design, production, installation and insurance.
- Rates are per unit, per 4 week billing period and are based on a 52 week contract.
- Please contact your Obie Media account executive to verify display size, availability, and art/production requirements.

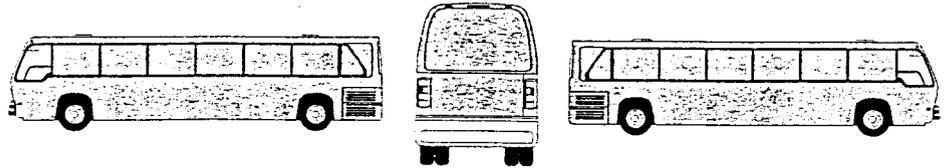
## 28 Week Details...

- Rates represent space only.
- Rates are per unit, per 4 week billing period and are based on a 28 week contract.
- \$2,000 installation and removal charge per display.
- \$8,000 repaint charge.
- Please contact your Obie Media account executive to verify display size, availability, and art/production requirements.

## General Details...

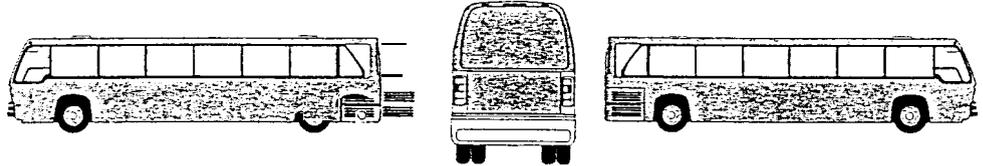
- Please contact your Obie Media account executive to verify display size, availability, and art/production requirements.
- Products shown may not be available in all markets.
- Rates shown may not apply to all markets.

# Units	52 Weeks	28 Weeks
1	\$2,995	\$3,495

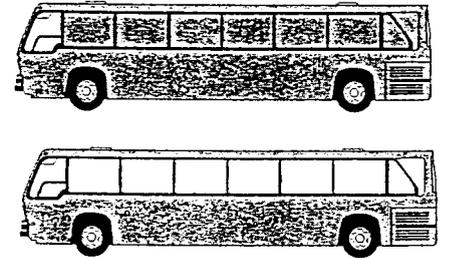


## Full Wrap - No Window Coverage

# Units	52 Weeks	28 Weeks
1	\$2,495	\$2,995



# Units	52 Weeks	28 Weeks
1	\$1,550	\$2,050



\*Also available without window coverage.



(800) 233-6243

www.obie.com

4-4c.4a

Icons are for reference only.

# 2000 Rates

## Interior Displays

### Details...

- Rates are per display and based on 4 week billing periods.
- 52 week contracts: Rate includes space, design, and production.
- Contracts less than 52 weeks: Rate represents space only.
- All sizes/products may not be available in all markets.
- Please contact your Obie Media account executive to verify display size, availability, and art/production requirements.

### Transit Interior Cards sizes vary

	11" x 17"	11" x 28"	11" x 35"	11" x 42"	11" x 52"	11" x 56"
Space	\$15	\$20	\$30	\$30	\$35	\$35
Production	\$10	\$30	\$30	\$30	\$30	\$30
Minimum	25	25	25	25	25	25

### Light Rail Interior Cards sizes vary

	10-3/4" x 17"	10-3/4" x 28"
Space	\$15	\$20
Production	\$10	\$30
Minimum	25	25

### Bulkheads 21-3/4" x 21"

	21-3/4" x 21"
Space	\$35
Production	\$40
Minimum	15

### Take Ones 3-1/2" x 5"

	3-1/2" x 5"
Space	\$20
Production	Provided by client
Minimum	n/a

### MetroLink Ceiling Cards/Decals 9-1/2" x 18"

	9-1/2" x 18"
Space	\$15
Production	28
Minimum	25

### Portal Cards 26" x 18"

	26" x 18"
Space	\$35
Production	28
Minimum	15

### Cabinet Cards 11" x 18"

	11" x 18"
Space	\$30
Production	28
Minimum	10



(800) 233-6243

www.obie.com

4-4c.5a



**External Advertisements - Summary By Space Type**

<b>Space Type</b>	<b>Total Spaces</b>	<b>Total Sold</b>	<b>Total Unsold</b>
"Queen" - Street Side	181	161	20
"King" - Curb Side	60	52	8
"Back Attack" - Rear of Bus	81	50	31
"Queen" - Curb Side	15	1	14
<b>All Types</b>	<b>237</b>	<b>164</b>	<b>73</b>



<b>External Advertising - Summary By Advertiser Type</b>					
<b>Advertiser Type</b>	<b>Total Sold</b>	<b>"Queen" - Street</b>	<b>"King" - Curb</b>	<b>"Back Attack" - Rear Bus</b>	<b>"Queen" - Curb</b>
METRO	8	3	0	5	0
Auto Dealers	17	13	0	4	0
Auto Accessories/After Market	15	5	0	10	0
Sub Total - Auto	32	18	0	14	0
Health	59	22	36	1	0
Institutional - Profit	19	1	14	3	1
Institutional - Non Profit	46	17	2	27	0
<b>All Types</b>	<b>164</b>	<b>61</b>	<b>52</b>	<b>50</b>	<b>1</b>



**List of OBIE Clients (As of January 31, 2000)**

Burger King  
YWCA  
Doctors on Duty  
California Milk Advisory Board  
KWAV 97 FM  
Marina Motor Company  
Cellular One  
Western Staffing Services  
Watsonville Auto Center  
North Bay Ford Lincoln Mercury  
Oak Tree Villa  
Metro Santa Cruz Newspaper  
Hairlinz  
Plantronics  
KCBA Fox TV  
Defensa De Muje  
Big Brothers Big Sisters  
Dominican Hospital  
Wilson's Tire Service  
SC County Health Services Agency  
Merry Maids  
Watsonville Community Hospital  
SC County Symphony  
Salinas Air Show  
Tycho Networks  
Shogun Japanese Restaurant  
Volks Cafe  
Santa Cruz Auto Body  
Ocean Chevrolet  
Shakespeare of Santa Cruz  
UCSC Summer Session  
Second Harvest Food Bank  
Monterey Bay Area Contractors



<b>Advertising Revenue For Each Year of Contract :</b>	
First Year, 12/97 - 11/98	\$100,000
Second Year, 12.98 - 11/99	\$120,000
Third Year, 12/99 - 11/00	\$144,000
Fourth Year, 12/00 - 11/01	\$168,000
Fifth Year, 12/01- 1 1/02	\$1801000
* All amounts are guranteed minimums	

