Second Nature

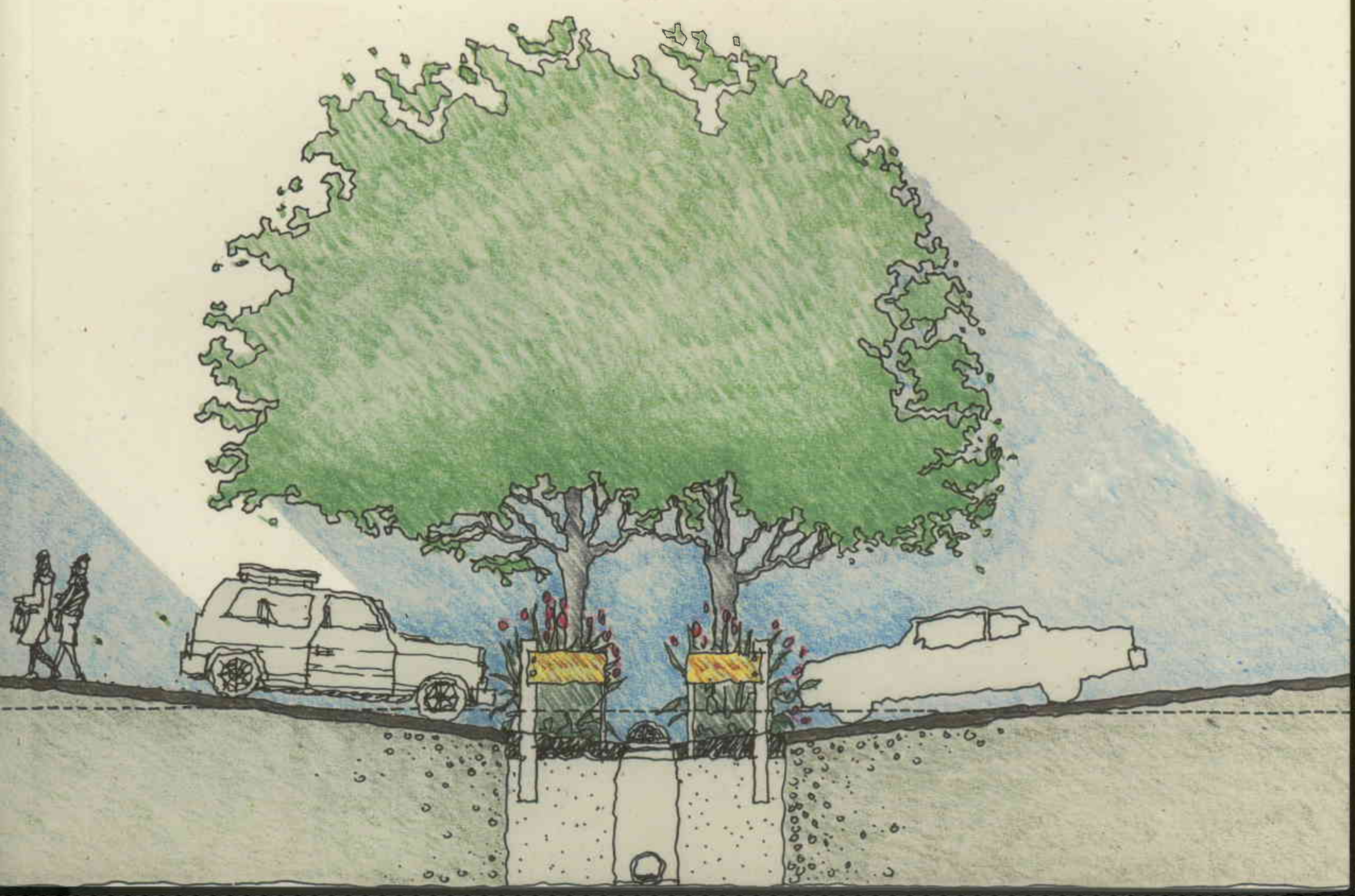
ADAPTING LA'S LANDSCAPE FOR SUSTAINABLE LIVING

TREEPEOPLE

Commentary by Paul Hawken

Preface by Andy Lipkis

Edited by Patrick Condon and Stacy Moriarty



T·R·E·E·S

Trans-Agency Resources for Environmental and Economic Sustainability

SPONSORED BY

The U.S. Forest Service/ National Urban and Community Forestry Advisory Council (NUCFAC)

The City of Los Angeles

The City of Santa Monica

The U.S. Environmental Protection Agency

The Los Angeles County Department of Public Works

The Metropolitan Water District of Southern California

The Los Angeles Urban Resources Partnership

The Southern California Association of Governments

Environment Now

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Edited by
Patrick Condon and Stacy Moriarty
with
PS ENTERPRISES

Design by Deborah Daly

PRINTED BY
MWD
METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

How to Keep Up with Our Progress

The T.R.E.E.S. Project has a web site http://www.treepeople.org/trees that details every aspect of the project. The site includes a cistern model, information on the demonstration site, this illustrated book, and a self-guided Home Forester workshop with tips for applying the Best Management Practices (BMPs). It also includes a way to stay in touch with TreePeople. We look forward to hearing from you.

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A Word About Our Sponsors

The T.R.E.E.S. Project is about creating connections—between families, communities, organizations, and agencies at all levels of government—so that together we can create the nurturing and sustainable lifestyles we require to survive and thrive.

Before becoming a part of T.R.E.E.S., most of the participating government agencies worked on their separate part of the Los Angeles infrastructure independent of one another. As a result of the T.R.E.E.S. Project, we now have a model that demonstrates the rapid progress that can be achieved through a unified, systemic approach to meeting the costly, environmental challenges of our city.

As you will read in the Executive Summary, profound levels of implementation of sustainable systems have already occurred in the short time since the design charrette—on which this book is based—took place in May of 1997. This would never have been possible without the willingness of our sponsors to create new protocols for working together in innovative ways.

The first agency to offer its assistance was the U.S. Forest Service. Once we received their grant, TreePeople set about assembling an interagency advisory task force to bring together national, state, and local agencies that each play an essential role in dealing with our urban environment.

All of the people involved needed to be educated and informed about the T.R.E.E.S. concept of integrated ecosystem management before they were ready to look at collaborating with other departments, developing a program, and identifying funds and resources. But when the implications and ramifications of such an approach were fully grasped, cooperation was forthcoming.

We are deeply grateful to the following organizations who joined with TreePeople to form Transagency Resources for Environmental and Economic Sustainability:

The U.S. Forest Service/National Urban and Community Forestry Advisory Council (NUCFAC)

This agency served as the lead sponsor and awarded the challenge grant that enabled us to create the multi-agency T.R.E.E.S. partnership.

The City of Los Angeles

Funding was provided by the Stormwater Management Division of the Department of Public Works, and the Department of Water and Power. Initial inter-departmental coordination was provided by the Department of Environmental Affairs, and leadership was provided by the Board of Public Works. Other active agencies include the Bureau of Sanitation, the Street Tree Division and the Recreation and Parks Department. The City Council resolution authorizing city participation was introduced by Councilmember Ruth Galanter.

The City of Santa Monica

Funding was provided by the Environmental and Public Works Management Department and the Community and Cultural Services Department.

The U.S. Environmental Protection Agency

T.R.E.E.S. was a special project of Region 9 and was managed by the Clean Water Division.

The Los Angeles County Department of Public Works

This department has combined authority for flood control, water conservation, environmental protection, waste management and other aspects of County infrastructure. The DPW provided funding for the charrette and this book. Based on the results of the first phase of the T.R.E.E.S. Project, they have now launched a study of sustainable systems to handle flooding problems in the Upper and Lower Sun Valley Watersheds.

The Metropolitan Water District of Southern California

The MWD provided assistance in public education programs by preparing printed materials and a video of the charrette and demonstration site construction process. The MWD also published this book.

The Los Angeles Urban Resources Partnership

This organization provided funding for the public education and signage at the Demonstration Site.

The Southern California Association of Governments

Provided large amounts of data for the Cost-Benefit Analysis.

Environment Now

Provided the total funding for the T.R.E.E.S. Cost-Benefit Model and is also assisting with the first real-world implementation of T.R.E.E.S. Best Management Practices at the 400 schools in the L.A. Unified School District which are scheduled for re-paving under Proposition BB.

Preface

Los Angeles is a great city in a beautiful environment. But it was built with little understanding or appreciation for the power and function of nature and its cycles. Environmental problems, compounded by human behavior, take a heavy toll on our city's economy and ecosystem and thus on the health and safety of all residents.

In natural systems, rainfall is caught by trees or shrubs and released slowly into the ground. This cycle produces nutrients, fresh water and clean air. Even in a semi-arid landscape like Los Angeles, the ecosystem was once in balance, providing everything that native people, plants, and animals needed for a sustainable life.

We have interfered with the natural cycles of energy and water by sealing the soil with thousands of square miles of concrete and asphalt. In this artificial system, rainfall is channeled to our roadways where it picks up oil, asbestos, pesticides, animal wastes and other pollutants and washes, as a toxic soup, down our storm drain system directly out to our beaches and bays.

With well over 60% of the city's surface covered with pavement, very little of the sun's energy is absorbed by vegetation. Instead, it heats up the pavement, and thus the air, needlessly overtaxing air conditioners that must struggle against this excess heat at huge costs—in terms of dollars, extra fuel burned at power plants, and extra air pollution from those power plants.

Leaves, twigs, branches and lawn trimmings, rather than returning to the soil as mulch, are instead shipped to landfills where they constitute 30% of the waste stream. Vast quantities of water are imported from distant regions and even other states to irrigate our lawns, while turning these other regions into deserts. Yet the 15 inches of rain that falls on Los Angeles every year, if captured, could meet more than half of our city's annual needs. Because it is handled as a problem rather than a resource, very little of the rainwater that falls on our city is available to refresh the soil and replenish our groundwater.

We spend hundreds of millions of dollars on massive flood control projects that are, in part, caused by our wasteful attitude toward the rain. To deal with flood control, and the other ills of modern urban life—like closing landfills, air pollution, energy waste and unemployment—we have created massive bureaucracies, all working very hard but independent of one another.

The T.R.E.E.S. Project was conceived as a means of overcoming this lack of coordination. It proves that there are enormous economic, environmental and social benefits to be gained through a cooperative approach to designing our urban landscapes as functioning mini-watersheds.

T.R.E.E.S.—Trans-Agency Resources for Environmental and Economic Sustainability—is creating cross-jurisdictional and cross-disciplinary connections between those people and institutions responsible for component parts of the urban ecology, especially in the areas of energy, water, waste removal, and air quality systems. The T.R.E.E.S. Planbook enumerates and demonstrates the diverse benefits to be derived from such a unified, cost-effective approach to managing our environmental challenges.

The architectural and landscape designs and retrofits described in this book could solve our environmental dilemmas, beautify our city, and fulfill our dream of sustainability for Los Angeles in the 21st Century. We believe that a system-wide retrofit with designs such as these, if fully implemented over time, would yield benefits to justify the costs, including:

- Reduction of fresh water imports to Los Angeles by 50%;
- Dramatic reduction of pollution flowing into Santa Monica and San Pedro Bays;
- Removal of the 100-year flood threat on the Los Angeles River;
- Elimination of green waste from the waste stream, leading to a reduction of landfill content by 30%; and
- Significant improvement in air quality.

In the T.R.E.E.S. vision for the future of Los Angeles, public utilities, flood control and water agencies will work together to achieve these goals. As many as 50,000 people will be trained to work in the new "green industry" re-landscaping property, building and installing cisterns, and monitoring and maintaining these systems. The air will be cleaner because thousands of trucks now used to transport green waste to landfills will be idled. Water bills will shrink and energy bills will also drop.

We are convinced that these goals are now within our reach. The purpose of the T.R.E.E.S. Project is to provide tangible evidence that this is so and to start us on the path of implementation.

We hope the information contained in this book will be of great use and interest to many different groups and individuals, including the government agencies that manage our environment; the politicians who struggle to develop ways to improve our environment; environmental groups who need communication tools and technical support; developers who wish to practice the highest form of sustainable development; educators who work to teach people that environmental problems often begin and end at home; and members of the general public who want to participate in making their local and regional environment a healthier place in which to dwell.

Andy Lipkis
President of TreePeople

Executive Summary

The T.R.E.E.S. Story

Urban and community forestry hold the key to saving our cities in ways we could not have envisioned twenty-five years ago when TreePeople first started. What began as simple tree planting, has grown into a project that extends to urban infrastructure management.

Through programs like those offered by TreePeople—including citizen-activist training, public and youth education, and community-based research—we have discovered a set of principles and practices that will enable us to re-invent cities in the new century. By following these principles and implementing a set of urban forest-based Best Management Practices (BMPs), our cities can become economically and environmentally sustainable as well as aesthetically uplifting and enlivening for all who dwell there.

This book for the T.R.E.E.S. project introduces a selection of landscape redesigns and architectural 'retrofits' that can help solve many of our region's most serious environmental problems. The book also includes a benefit analysis that lists the cost value per year—over a thirty year period—for a full remediation of the five typical land uses in Los Angeles for which these BMPs were designed.

The intention of those who came together in 1997 to develop these BMPs was to create a set of designs that would be so attractive, compelling and sensible, they would spark a widespread desire to implement them throughout the City. As you will read, this goal is already closer to realization.

We knew at the outset that the way to gather the consensus and momentum to propose and facilitate such a city-wide transformation was to forge links between disciplines, bureaucracies, businesses, community and environmental groups and to gain public support through heightened awareness. If we are to successfully manage our ecosystem as an urban forest watershed, we need both multi-agency partnerships and an educated, empowered citizenry.

This unified, systemic approach represents a new paradigm. It requires profound new levels of education about how to live in a wholesome relationship with nature. It casts individuals and families in the role of stewards. It also allows agencies to serve as educators, facilitators, and monitors rather than as enforcers.

A SYSTEM-BASED APPROACH TO URBAN FOREST WATERSHED MANAGEMENT

The T.R.E.E.S project developed out of frustration that the profound benefits of planting trees, and of managing our local resources more efficiently and effectively, were not fully recognized or utilized. Trees can save water, clean the air, and revitalize communities but it was clear we needed to do more than plant and care for trees.

A sustainable environment requires that we stop the leaking away of our natural resources—including wildlife, nutrients, energy, money, water, and the energy of people who either do not participate or whose participation is not coordinated so as to maximize its value. We also must find ways to involve and employ more people to help maintain the integrity and sustainability of the city.

Money always seems available to construct large-scale public infrastructure projects that attempt to solve problems caused by urban development. An example is the flood threat on the lower portions of the Los Angeles River. These projects, however, tend to be single-purpose. They usually leave the local population out of the picture and often exacerbate other linked problems. We must begin to spend public money in a way that integrates the management of all of our resources so we can build a beautiful, sustainable environment and enjoy a thriving economy.

The T.R.E.E.S. Project is designed to prove the technical and economic feasibility of accomplishing this integration. We set out to show that the waste of resources, like water flowing out of a river, could be redirected so that urban forest watershed-based projects would be economically sustainable.

The T.R.E.E.S.. Project aims to:

1). Re-design urban sites to function as miniature urban-forest watersheds;
2). Demonstrate that the designs actually work;
3). Make evident the economic viability of the integrated watershed approach;
4). Bring together key agencies and stakeholders to plan the financing and implementation of a large-scale retrofit of the watershed.

1. Re-design urban sites to function as miniature urban-forest watersheds

The BMPs described in this book were developed at a 'charrette'—or cross-disciplinary workshop—that took place in May of 1997. For that occasion, TreePeople brought together 75 of the nation's most talented and forward-thinking landscape and building architects, engineers, hydrologists, urban foresters, government officials, and community leaders to work in an intensive, fully-integrated process to accomplish in four days what might otherwise have taken months.

Charrette participants sought to address a number of broad areas of concern for Los Angeles. These included: the excessive consumption of potable water; the difficulty of flood management; the resultant pollution of storm drains, beaches, and bays; the high rate of air-cooling energy consumption with its direct relationship to air pollution (and possibly to global warming); the massive amount of green waste which has contributed to the closure of landfills; the desertification of outlying regions from which we import water; inner city urban blight with its disheartening impact on residents; and youth unemployment.

The intention of the charrette was to fulfill two primary goals:

1. To show how regional policy objectives may be achieved more efficiently through building and retrofitting sites for improved environmental function. This required developing BMPs suitable for testing at demonstration sites or by government agencies, including workable prototypes for alternative flood control technologies capable of removing the 100-year flood threat on the Los Angeles River.
2. To provide an inspirational vision that illuminates the relationship between sustainable landscape designs and an enhanced quality of life for all Los Angeles residents.

The outcome of the charrette process was more than a set of BMPs. It was a collection of designs capable of addressing all of these issues at once—by retrofitting residential, public, commercial, and industrial properties to function as urban forest micro-watersheds. For less than it costs to supplement our piecemeal strategies to fight with nature's cycles, charrette participants discovered that we can achieve sustainability, beautify the environment, and employ our citizens to become caretakers of their own urban forest environment.

To date, only one of our five sites—the single-family dwelling—has received a full retrofit (as described in the second section of this summary). The BMPs created for the other four sites are detailed in this book and are mentioned in brief below.

As you read of these designs, it is important to understand that given the short time allowed at the charrette, none of them are complete. Additional design and engineering work would be required before they could be built as shown. But the designs provide points of departure for later work and demonstrate broadly applicable principles.

The Multi-Family Site is an abandoned set of buildings which are now being rehabilitated for low cost housing. The site is located near industry and freeways. The bulk of the site is a parking lot. Under the T.R.E.E.S. proposal, all stormwater is treated on site by directing it through sand and grass filters and through composted mulch from the green waste on site. The first half inch of rain permeates into subsurface storage under the parking lot which is raised over a bed of gravel. The site thus is able to handle four inches of on-site runoff. (This site was also the focus of another charrette hosted by Global Green USA, to develop sustainable designs for the interior of the buildings).

The Public Site, Crenshaw High School, is currently two-thirds paved. The only areas unpaved are the athletic fields and a central courtyard lawn. The proposed retrofit includes converting the adult school parking lot into an oak grove with parking on a permeable surface under the trees. Riparian swales both absorb and direct rain runoff to cisterns under the football field. Both the football field and baseball fields can be flooded for as long as three days during a 100-year storm event without creating runoff into the storm drain system.

Gray water from the athletic showers and from rainwater stored in the cistern is sufficient for all irrigation needs even after the installation of low flow showerheads in the gyms. Crushed stone parking lots are porous so as to filter pollution as the water seeps into the ground. Strategically placed trees shade air conditioning equipment on the south and west sides of the buildings. There is enough water storage on site not only to take care of a 100-year flood event, but to handle the runoff from an additional 25 acres of paved land from the surrounding neighborhood.

The Commercial Site includes a convenience commercial building with three small businesses, and a Jiffy Lube automotive oil-changing service on the adjacent parcel. Commercial buildings line the street, but the neighborhood around this heavily developed commercial area consists of well-maintained single-family homes and several schools.

Taking advantage of permeable subsoils on this site, the underlying strategy for the design and management is as follows: to make the site surfaces more permeable to facilitate water infiltration and to enhance flood control; to reduce the requirement for irrigation water by installing drought-tolerant plants; to capture, store, and re-use rainwater for irrigation; to capture and remove pollutants from stormwater runoff; and to maximize the use of trees and plant cover for aesthetic purposes, energy conservation, and reduction of air and water pollution.

The Industrial Site is located next to Ballona Creek. Under the T.R.E.E.S. proposal, the creek is re-channeled and widened, with less concrete, to increase flood control and recreational opportunities. Parking lots are reconstructed with permeable paving materials and the creek edge is landscaped to include a pedestrian walk.

Rainwater from the roof is used for flushing toilets and landscape irrigation. The water storage tanks and 'green wall' shade the walls and roof of the building to help lower air conditioning energy needs.

2. Demonstrate that the designs actually work

After the charrette, the basic designs were given to engineers at CH2M Hill for conversion into BMPs for the demonstration site and for use in stormwater programs now being implemented across the city and county.

Four BMPs were installed at our demonstration site—a single-family home in South Central Los Angeles. These include two modular, 1800 gallon cisterns—made from recycled plastic—for capturing rainwater from the rooftop both to reduce stormwater runoff and for use in landscape irrigation during dry months.

A berm was placed around the front and back lawns to retain up to 9 inches of stormwater as it percolates into the groundwater table. A dry well was installed to capture polluted runoff from the driveway and send it through a sand filter before directing it further down the well for ground water recharge.

A mulched swale was also installed in the backyard to convey water away from the house and to filter out pollutants. The swale is designed to attractively *consume* all of the garden or *greenwaste* that is generated on the site, completely removing it from the waste stream. The whole site is designed to handle a 100-year flood event.

The demonstration site was formally opened on August 13, 1998 at a ceremony attended by representatives of sponsoring agencies and other distinguished guests. To begin the process of educating the public about the T.R.E.E.S. vision, we created a flash flood on this property—in the midst of the region's driest season—which generated national news coverage by the leading print and electronic media in Los Angeles.

We will be monitoring the efficacy of the BMPs at the demonstration site for some time to come and will make improvements as needed. The site now serves as a working model for agency officials, engineers, landscape architects, property managers, gardeners, and the general public and will enable them to examine the efficacy of these systems for implementation on other sites.

3. To demonstrate the economic viability of the integrated watershed approach

Aside from proving that an urban forest retrofit was technically feasible, the T.R.E.E.S. Project sought to prove that it was also economically feasible. To achieve this goal, we created a Cost-Benefit Analysis to allow urban planners to evaluate the socioeconomic and natural resource-related consequences of implementing urban forestry BMPs in the Los Angeles area. By so doing, we could ensure that these practices would be given reasonable consideration as alternatives to conventional design strategies. We hired Jeff Wallace, one of the early members of Silicon Graphics Computer Systems, to design and manage the process, and the firm of Jones & Stokes Associates, Inc. to help conduct the analysis.

The Cost-Benefit Analysis evaluates the BMPs in relation to such conditions as water quality and availability, flood control, air quality, energy demand, greenwaste supply, capital and operational costs, social benefits, and environmental impacts.

In its preliminary form, the Cost Benefit Analysis served as a basis for the BMPs that were developed at the design charrette. The briefing reports subsequently underwent a review by staff members from such organizations as the Air Quality Management District, the Coalition for Clean Air, the U.S. Forest Service, the Los Angeles Bureau of Sanitation, the U.S. EPA, and various academic institutions. With their comments incorporated, additional feedback was received from focus groups attended by agency decision-makers and other technical experts.

We then recognized the need for an interactive tool that would make it possible for planners and urban foresters everywhere to prove the economic case for urban forestry. Using the research accomplished for the Cost Benefit Analysis (which ultimately involved over 200 people and generated 16,000 pages of material), Jeff Wallace created the Cost Benefit Model with funding provided by Environment Now.

The model is an interactive computer program that makes it possible to select specific geographic areas to determine the environmental and economic benefit of using chosen BMPs. Because the Cost Benefit Model involves a geographic information system (GIS) interface, users can work with geographically-referenced study areas within Los Angeles County ranging from a single census block to the entire county.

The model shows the multiple, systemic benefits and costs associated with an individual BMP or combination of them: It quantifies the energy, air quality, flood control, and pollution-prevention benefits and also calculates the number of jobs that would be created as a result of implementing the BMPs.

Thus, a Los Angeles city planner could select a neighborhood block and by a few clicks of the mouse discover how planting a certain number of trees might affect energy costs for the area. Or a city councilmember's field representative could highlight a council district and readily generate data on how using BMPs to decrease stormwater runoff and prevent flood damage would also save energy, prevent air pollution, and produce a specific number of local employment opportunities. Because the Cost-Benefit Model indicates the full-range of environmental and economic benefits that result from any particular strategy, it makes evident other possible funding sources and potential partners who are likely to share an interest in participating in a given project.

4). Bring together key agencies and stakeholders to plan the financing and implementation of a large-scale retrofit of the watershed.

The next phase of the T.R.E.E.S. Project is to create a multi-agency Implementation Board to devise a strategic outreach, education, and implementation plan that can facilitate broad acceptance and use of the BMPs throughout Los Angeles.

The Board will consist of core T.R.E.E.S. Project stakeholders, including leaders of government agencies, the building trades, environmental organizations, businesses and other groups. The goal of the Board will be to accomplish the following tasks:

- Identify and develop capital funding mechanisms.
- Identify institutional and other barriers to achieving wide-scale implementation of the T.R.E.E.S. Project concept.
- Develop strategies for overcoming these barriers.
- Create permanent pathways for ongoing interagency implementation of BMPs.
- Determine the timeline for phased project implementation.
- Devise a comprehensive public education and outreach plan.
- Facilitate and manage the stakeholder participation process.
- Issue a comprehensive final report that will be disseminated to urban foresters and decision-makers throughout the country, as well as to local officials, agencies, and professional groups.

This book and the Cost-Benefit Model will serve as tools for this process. Working in teams, the stakeholders will create strategies; build a consensus of commitment among their peers, agencies and organizations; and then hold a conference in which a final T.R.E.E.S. Project report will be released.

PROGRESS SINCE THE CHARRETTE

The Cost-Benefit Model has proven to be an invaluable tool, allowing for the rapid progress made since the charrette. An example of one opportunity that would have been lost, if not for the Cost Benefit Model, involves the planned repaving of school yards in the Los Angeles Unified School District. This area collectively represents one of the largest tracts of paved land in the combined Los Angeles River and Ballona Creek watersheds.

Greening the Schools

In 1997, Los Angeles voters approved Proposition BB—a $2.5 billion bond for school repair that allocates $187 million simply for replacing aged asphalt play-yards with new asphalt at 400 schools. Under the leadership of the Proposition BB Oversight Committee, TreePeople and other interested parties were able to use data from the T.R.E.E.S. Cost-Benefit Analysis and Model to persuade the Board of Education to authorize the use of trees, lawns, green spaces and permeable surfaces on up to 30% of the surfaces that had been scheduled for repaving.

Environment Now, the local foundation that funded development of the Cost Benefit Model, also financed creation of the engineering specifications required to enable every campus to function as a watershed. In addition, Environment Now is helping to underwrite our recruitment of various other funding agencies to contribute the extra money necessary to change the performance of the campuses from sources of pollution and dangerous flooding to places of respite and restoration—as well as stormwater retention and utilization.

Overall, approximately 20 million square feet of heat-retaining asphalt will be replaced with strategically-planted shade trees and other forms of vegetation. This will ultimately result in cooler temperatures on campuses leading to energy conservation and lower energy costs, improved air quality, the reduction of rainwater runoff into storm drains, and the beautification of school yards.

The redesign of many of these schools is already underway, and T.R.E.E.S. is providing the School Board with a package of recommended BMPs that will enable each campus to function as a mini-watershed—if fully implemented. TreePeople is also participating in the development of a workshop to train a group of landscape architects and construction managers from the Los Angeles Unified School District in the use of these T.R.E.E.S. BMPs.

Currently, the School Board's budget for this project is limited to $3/sq.ft. which will cover only the planting and maintenance of trees and lawns. However, rather than posing an obstacle, this limitation creates an opportunity to demonstrate the mutual advantages to be derived through interagency cooperation in the pooling of resources to achieve shared goals.

By using the Cost Benefit Model, T.R.E.E.S. can make evident to various related agencies how each will be served by supporting the fuller retrofit of the schools. This more extensive retrofit includes the use of cisterns, vegetated swales, retention grading, and various other means for increasing water retention on site and filtering pollutants out of stormwater runoff.

Based on this data, the Flood Control division of the Los Angeles County Department of Public Works has already expressed its willingness to add funds where a fuller retrofit of a particular school can help in the abatement of a local flooding problem. T.R.E.E.S. is also pursuing avenues for additional funding with other agencies whose goals will be advanced through the full retrofit of specific campuses.

The effectiveness of energy conservation through strategic tree planting has been well defined by the Cost Benefit Model. Now this system is being put to the test by the Los Angeles Department of Water and Power (DWP) in its 'Cool Schools' program—a 40-campus pilot project for the Los Angeles Unified School District.

The DWP has allocated approximately $3 million ($40,000 per school) for this pilot program; and TreePeople, along with three other community-based organizations (Northeast Trees, L.A. Conservation Corps, and the Hollywood Beautification Team), will be working to implement the program over a sixteen month period. These 40 campuses will serve as models for a district-wide school greening program. Some of the BMPs designed at the T.R.E.E.S. charrette specifically for schools will be implemented at two additional schools so that they may serve as demonstration sites for sustainable practices.

Flood Control

On November 25, 1998, Carl Blum, the Deputy Director of the Los Angeles County Department of Public Works and the head of Flood Control, launched a study of alternative multi-purpose solutions to a local flooding issue in the Upper and Lower Sun Valley Watersheds. The Department had designed a $42 million storm drain to solve the problem. If the alternative solutions prove feasible, the funds will instead be used to implement the BMPs from the T.R.E.E.S. Project, along with other multi-purpose, urban forest-based solutions. Mr. Blum hired Michael Drennan, an engineer who participated in the T.R.E.E.S. charrette, to facilitate the study.

The Sun Valley watershed comprises approximately 50 square miles (2,680 acres) and includes 8,000 homes, plus multi-family dwellings, commercial and industrial sites, schools, open land, and gravel pits. Through use of the Cost Benefit Model, a mix of BMPs will be tested to determine the best way to retain all water on site.

Planning for the Future

Prior to the T.R.E.E.S. project, the urban forest was not considered critical infrastructure. The early work of the T.R.E.E.S. Project, and much hard work by the Community Forest Advisory Council, has changed that. The City of Los Angeles has finally declared the urban forest an essential element of city infrastructure and has added it to the new General Plan. This means that funding for planting, tree maintenance, and management of the urban forest should receive a far higher priority than ever before.

THE WAVE OF THE FUTURE

Fulfilling the vision of a sustainable city will not take new money but a different way of allocating what is already being planned. Funds are spent every day on both new projects and redevelopment that could instead be made available for watershed improvement. For instance, the Los Angeles area anticipates an investment of up to $20 billion over the next ten years in water supply, flood control and stormwater pollution facilities. This money could be invested more efficiently in sustainable systems like those described in this book rather than on a peripheral canal.

A Request for Proposal issued by the U.S. Environmental Protection Agency in January of 1999 states:

U.S. EPA needs surveys estimate that, over the next 20 years, we will have to spend nearly $140 billion each on our drinking water and wastewater (including storm water) infrastructures. Further, our current investment in wastewater infrastructure alone approaches $1.8 trillion. With such a large investment at stake, we would be remiss in not seeking the best possible solutions to our infrastructure challenges."

The major differences between the solutions spelled out herein, and the huge engineered fixes of the past are that the T.R.E.E.S. approach requires more time for implementation and a high degree of public awareness and participation. However, we are convinced that the multiple benefits of safety, pollution prevention, economic development, and beauty resulting from this approach far outweigh the benefits of single-purpose projects.

The truly good news is that stakeholder agencies are beginning to agree. They have invested time and money in sponsoring the T.R.E.E.S. Project and are now ready to authorize more to build demonstration projects that will test and improve on these approaches.

KEYNOTE ADDRESS

PAUL HAWKEN

Speakers' Comments from Annual TreePeople "Grove" Reception and Second Nature Charrette Kick off at the Getty Center, Los Angeles, May 14, 1997

Paul Hawken is a businessman, environmentalist and author. He has founded several companies including Smith & Hawken, the garden retail and catalog company. He serves as Chairman of The Natural Step, a non-profit educational foundation whose purpose is to develop and share a common framework comprised of easily understood, scientifically-based principles that can serve as a compass to guide society toward a sustainable future. Mr. Hawken is the author of several books published in over 50 countries, including the best-selling, Ecology of Commerce *(1993).*

His book, Growing a Business, *became the basis of a PBS series which Mr. Hawken hosted and produced. The program explored socially responsive companies and is shown on television in over 115 countries.*

Thank you, Andy, for inviting me to speak here tonight.

Andy Lipkis is one of my heroes because there are very few people in the world who are "doing it."

What is Andy doing? That's the question. What is "it"? Andy is tackling the "Big One." This "Big One" is not simply a reframing or redesigning or re-imagination of industrial society. It is the process of creating a new and viable path to the future for humanity.

This path is one that no single architect, designer, or person can describe or foresee by him or herself. We will create it together, but it will require individual leadership and courage. This has happened once before in recent history, at the onset of the Industrial Revolution. In that instance, courage was not required. Nevertheless, it was truly revolutionary because it completely upset the established order of things and created new ways for humans to live, work and prosper. It also created a terrible legacy of devastation and suffering which in effect brings us together tonight.

Imagine addressing the British Parliament in 1750 and saying, "I have this great idea. I'm going to improve the productivity of human beings by a factor of one hundred or two hundred in the next thirty years." You would have been thrown out and branded as daft and idiotic. That was impossible. But of course it wasn't impossible. It happened and the results are all around us.

The results produced a civilization that works extraordinarily well in many respects, but in other ways it works very badly. Here's the problem: industrialism is *extraordinarily* inefficient and getting more so all the time. And this is the paradox. The conundrum of the industrial age is the contradiction between the efficiency and elegance of our industrial components, and the inefficiency and squalor of the larger industrial society.

We can see this contradiction everywhere: in this room, in our technology, in our cars, our houses, and our buildings. We see that, individually, the components of industrialism have become better and more efficient every year. But, in fact, the system as a whole is becoming less efficient. It's a "systems" problem. When you try to optimize the components of a system, you *pessimize* the overall system itself. And it happens because we're not thinking in terms of the *larger* system, which is our planet and the living systems that support us.

It seems to me that what you're doing in this charrette is beginning to think of L.A. as a system, which indeed it is whether we act on it or not. It still operates as a system but now it is deeply concealed. I'll give you an example of just how hidden it is.

Andy Lipkis and I were asked to talk with the U.S. Forest Service a couple of years ago regarding a watershed management project they were working on in the San Bernardino National Forest. One of the things we discovered was that the staff there *did not know* that the major rivers in the L.A. basin—the ones now paved by the Army Corps of Engineers—were once banked rivers where water flowed year round. Not only do we not see L.A. as an interconnected system populated by people and other forms of life, but we have lost our ecological memory of what was here and, therefore, of what the possibilities are for the future.

The industrial system is similar. We know what it produces and we consume it—some of us all too avidly. We have learned over a couple of hundred years to transform natural resources into tools, services, products, engines, highways, buildings, infrastructure, and technologies that make people more productive. But there is a cost. The cost is that every living system on earth is in decline and the rate of decline is speeding up. There is no exception to that. There are regional exceptions for sure. We hope L.A. will be one soon. But, in fact, there are no global-scale exceptions to this rule. Industrial systems, including municipalities, are destroying all living systems.

If you doubt it is you, consider this: an average US citizen requires 1.3 million pounds of material a year to support an average life style. The biggest part of this is the 780,000 pounds of water used every year per capita in this country. This figure does not include water used for agricultural purposes, nor does it include stormwater runoff.

Think about how much you actually see or touch of this 1.3 million pounds. Not so much really. But, that amount is what is generated on your behalf. This amounts to over 100 semi-tractor trailer loads of material used by the average family of four every year. And most of you here are "above average." So that's the basic system: efficient in the components but enormously inefficient as a whole.

The success and shadow of industrial civilization have created two completely different ways of looking at the world: one way I call "Blue" and the other "Green." The Blues symbolize business and are represented by the *Wall Street Journal*, *Business Week*, *Forbes* and other business publications. The Greens do not have a daily newspaper with two and a half million circulation. But they do have newsletters, NGO reports, books, journals and flyers. There are about 10,000 groups in the United States that are oriented around green issues. Most are grassroots organizations. Some that you hear about are large, but most of them are very small.

The media portrays the relationship between Blues and Greens as an irreconcilable argument between two disparate points of view.

And those arguments play out as anti- and neo-Malthusian: people who have predicted doom-and-gloom and have been wrong, and those who say that the world is better and point to the past as proof.

The Greens do say "yes" and are not as pessimistic as portrayed, but there is definitely a Malthusian side. I think it was Garrett Hardin who said, "Anybody who's been buried 173 times can't be dead yet." This, of course, refers to Thomas Malthus. From the Greens point-of-view, the dynamics Malthus wrote about are still very much in play.

The Blues talk about economic growth—that the countries that are the most prosperous are doing the most to clean up their environment. Ergo, we should promote economic growth. The Greens talk about material sufficiency, cutting back, and the health of the environment.

Blues emphasize human resources but they don't live up to it very well because they are the ones who are re-engineering, downsizing and restructuring corporations, which is all about getting rid of people. Nevertheless, the rhetoric plays very well to people, and business is seen as pro-work, pro-jobs. The Greens often focus on the depletion of natural resources and keystone species. They get enmeshed in the spotted owl vs. hardworking logger arguments and find themselves appearing to be indifferent to human resources.

Because the Blues see the world as improved, they are much easier to listen to. We don't want to see the world as going backward. The argument between the two seems endless: less government, more government; increased output, reduced output; population as a resource vs. population as a problem. The Blues trust economic models, almost maniacally, and the Greens trust ecological models.

And finally, there is an issue with two awkward terms: *substitutability* (Blues) and *complementarity* (Greens). Substitutability means if we run out of a resource, not to worry, because there's more somewhere else in some other form. If we run out of copper, there'll be fiber optics; if we run out of oil, there'll be natural gas; if we run out of gas, there'll be nuclear power. The point is that shortages are not to be feared in the environment because we're so ingenious and clever that every time we create a new substitute, we create new industries, jobs, technologies, etc.

The other side of substitutability is complementarity. Complements are like this: If you are up in the Rocky Mountains, and it's late fall or early winter, and you are in a remote location, you need three things—warmth, food and water. They are all complements. You take away one and the others can't substitute for it. You have no water, but you have dry food; you're going to die. You have food and water but no warmth; you're going to die. You have warmth and water but no food; you will still die. You need all three. That's what a complement is. Thus, the limiting factor in a complementary system is that resource which is in lowest supply or the most scarce.

In a substitution model, if something diminishes, it promotes the use of alternative resources. Systems, it seems, are not substitutable.

They are characterized by complementarity between crucial parts working together, providing what is called *nature's services.*

Thinking in terms of systems and complementarity allows us to think of nature in a very different way. What we know, as previously stated, is that all living systems are in decline, and their rate of decline is accelerating. If that is the case and nature and its functions are complements, then the relationship between society and nature must change quite dramatically. We are beginning to understand that nature is not a repository of commodities that we transform into useful goods. We are beginning to see nature as a flow of services, as *natural capital*. Natural capital provides us with these complementary services, not just materials.

On May 15, 1997, *Nature*[1] magazine published an article that states there is a flow of $30 to $50 trillion a year into the global economy from nature's services. Now the world GDP is approximately $27 trillion dollars a year. We're talking about a flow of value coming in from nature that is almost twice the yearly value of the economic flow of the entire global industrial system. The problem is that these services are not replaceable. These are not single commodities like coal. These are interconnected living systems that cannot be replaced once lost. Unfortunately we don't understand how the systems that provide these services work. We don't see that our actions threaten these systems, and that our under-valuation of one part of the system can threaten the whole. For example, you can do topsoil management in the Red River Valley, but it won't do you any good if climate change produces a five-hundred-year storm.

I have been consulting lately with major corporations—one of the largest in the world being one of them—trying to help them get a handle on this new way of thinking. This is one of the world's premiere engineering firms. My question to them was this: "You are businessmen. You believe in substitutability. Which of these natural systems can you substitute for? Which technologies can replace these ecosystem services? And, if they can be replaced, how much will it cost?" And so we went over this list very slowly, one by one by one. At the end they agreed that there wasn't a single system that could be replaced —at any cost.

So these are the services that are flowing into our economy. Some are the services that are flowing down the paved L.A. River into San Pedro Bay. These are the services that are being diminished, destroyed or prevented from flowing back into nature by our industrial systems, in the way they are presently designed. These services are diminishing and we are now up against a new set of limits: the limits to nature's services. This diminishment, then, is becoming the limiting factor to societal development and economic well-being. In other words, the loss of living systems and decline of nature's services represent a new

1. Costanza, R.; d'Arge, R.; de Groot, R.; Farber, S; Grasso, M.; Hannon, B.; Limburg, K.; Naeem, S.; O'Neill, R.V.; Paruelo, J.; "The value of the world's ecosystem services and natural capital," Nature, Vol 387: 253-260, May, 1997

pattern of scarcity that the world is only just beginning to comprehend. Society has encountered limiting factors before, but this one—the limits on nature's services—is, as I said at the beginning of this talk, the "Big One." Let's go back to our example in the Rocky Mountain —water, food, warmth. In my example those are the limiting factors. How do you increase limiting factors? By *investing* in increasing them. It is that simple. You invest in what is called natural capital, foremost of which is the watershed. When Industrialism began, there was a relative shortage of people. Sounds odd now but that was the case then. We invested and created myriad ways to increase the productivity of human beings. We are still doing that. And we were successful.

This design charrette is about re-imagining Los Angeles.

So when we talk about sustainability or *restoration*, which is the term I prefer, we're talking about how a society can shift from a system that emphasizes human productivity to one that emphasizes the productivity of natural capital. And we—Andy and the other participants in this charrette—are standing up in front of a mythical Parliament and saying, "In the next thirty or forty years we can increase the productivity of our natural systems by ten, fifty, or a hundred times." And nobody will believe us because there is no framework of understanding, just as there was none at the beginning of the Industrial Revolution. But that's exactly what we have to do.

This gives rise to the following thesis: the world is moving from an era in which *man-made* capital was the limiting factor to human development to one where *natural* capital is the limiting factor. It is not human capital we lack; it is living systems. It's not fishing boats; it's fisheries. It's not sawmills; it's forests. It's not tractors; it's viable and arable land. The limiting factor has become—irrevocably—nature's services. To overcome a limiting factor you need to maximize the productivity of the limiting factor in the short run, while investing in increasing its supply in the long run. That's exactly what TreePeople is doing for the city of Los Angeles, even if L.A. doesn't know that it needs it yet. TreePeople is maximizing productivity of the limiting factor in the short run.

There is an important human factor to all this as well. When the limiting factor changes, it then becomes very important to change human behavior. The behavior that used to be economic becomes un-economic at that point.

But old habits die hard. That is why you get the Blues saying, "This always worked before. Why are you talking this way? Look around you. Be grateful. Don't be so critical. We worked so hard for you." And this attitude prevents the Blues from realizing that a behavior that used to be economic is now un-economic.

So economic logic remains the same. We're not talking about reinventing economics; we're actually talking about sticking to that same logic. But the pattern of scarcity in the world changes. It's not *stuff* that is scarce. It's not *materials*. It's not human productivity. What is now scarce are nature's services.

This design charrette is about *re-imagining* Los Angeles. But what is it that we are imagining? Is it an image of a city where trees grow and water flows? No, that's just the beginning. We are talking about restoring an entire working system. This is the city that got paved over. This city got *roaded* over. This city got *parking-lotted* and *transported* over. This city has been devastated. It's like almost every other city in America except worse. So if you can make it happen here, you can make it happen anywhere.

I am asked sometimes—especially by younger people—if, given the rapid decline of the environment worldwide, whether there is enough time to turn things around. I don't know, but I believe we have enough time to do what we need to do, but no more. So we don't need to panic, but we *do* need to get right to work. It is in this sense that I agree with the poet, Adrienne Rich, who wrote, "I cast my lot with those who, year after year, with no special powers, choose to reconstitute the world." And that's what you're doing: reconstituting the world. It's going to take out-of-the-box thinking. And it's going to take in-the-box thinking too, but with new boxes.

It's going to take you, in the next four days, to places where you don't know how to go. It's going to provide you, as city officials, both elected and appointed, with new ways to see and re-imagine your city. This charrette isn't about being safe; it's about being courageous. It's not about being secure; it's about doing the right thing.

"I cast my lot with those who year after year, with no special powers, choose to reconstitute the world."
—Adrienne Rich

David Whyte, a poet, speaks of the classic American executive who works hard all his life. In his mind, some Dickensian-like ghost of the future takes the executive to his tombstone and scratches off the moss to read his epitaph, which says, "He made his mortgage payments."

I tell you that story because another friend of mine, William Merwin, another poet, tells of the day he left Robert Graves' household, where he was a tutor. As he left his employ, Graves turned to him and said, "You have one story to tell in your life and only one story."

And so my question to you is this: What is your story? What story do you want to tell in your life? Los Angeles is your place. You don't know *who* you are unless you know *where* you are. So this four days is about finding out where we are here in Los Angeles. Where are we? What does it do? What did we cover up? What does it want to become? How beautiful can it be?

We don't know. What is your story? What is L.A.'s story? What is the real story? That is your work, your story.

When I say again that this is the "Big One," imagine somebody saying to you, "I want you to design an industrial system and you have a couple of hundred years to build it. When you're done, this system should put endocrine disrupters into basically every animal and human, pollute the air, sully the water, change the climate, destroy living systems, put five million men in prison, make people commute an hours a day on freeways breathing poisonous gases, and pave over an area the size of Ohio and Pennsylvania with a toxic slurry of gravel and

Imagine a city that is so covered with trees it looks like a forest from an airplane.

oil. I also want your kids to play with toys containing carcinogens. I want your food to contain unknown hazardous chemicals that have never been fully tested on humans for their health effects. I want you to dam and destroy as many rivers and forests as possible and please, while you're at it, could you help cause the world to lose 6 million acres of arable land every year to desert? When you have accomplished that, I want you to introduce 70,000 other synthetic chemicals into the environment, cause the greatest rate of species extinction in 65 million years, and create energy systems whose radioactive wastes must be guarded for 250,000 years—25 times longer than human civilization—before they are safe. Could you design such a system?" You couldn't. Nobody can imagine designing such a system. But that is exactly what we did anyway.

So here's the "Big One": Can you now imagine a world that really works?

Imagine a world where the resources are not scarce, but sufficient to all. Imagine a world where there are more jobs than people, a planet where forests are increasing, topsoil is being formed, wetlands are thriving, coral reefs are growing, fisheries are healthy, and the atmosphere is not affected by our activities below. Imagine a city with tree-lined rivers, promenades and restaurants alongside, and bays that are as pure as oceans anywhere. Imagine a city that is so covered with trees, it looks like a forest from an airplane. Imagine, for a moment, a city that has become whisper-quiet. Hydrogen-powered hybrid electric cars exhaust only water vapor. Open space corridors have replaced unneeded freeways. Houses pay part of their mortgage costs by the energy they produce. Imagine a city where there are no active landfills. Imagine worldwide forest cover is increasing; atmospheric CO_2 levels decreasing for the first time in 200 years; effluent water leaving factories cleaner than the water coming into them. Imagine industrialized countries reducing resource use by 80 percent while improving the quality of life; dams being dismantled; environmental regulations regarded much like blue laws—as unneeded, quaint, and anachronistic; living standards doubling worldwide; and a vibrant business sector depending upon and promoting these developments. Is this the vision of a *utopia*? A Panglossian fantasy? In fact, the scenario is neither. The changes described could occur within as short a period as fifty years, as the product of economic and technological trends that you can implement and put in place.

I know that we might be tempted to look at it and think, "Oh my God! Who made this mess called Los Angeles?" It's like Frank Lloyd Wright once said: "If we shook the United States, everything loose would end up in L.A." Maybe, but at least it's loose, right? And it's not like Boston. Please do something. Re-configure the loose stuff and re-imagine it in such a way that this city of Los Angeles truly becomes the City of Angels. Thank you very much.

Ruth Galanter is Los Angeles City Councilwoman from Council District 6.

Ladies and gentlemen, it is my great hope that the work that you are doing here will be presented in a form that will not only allow you to dream, and me to dream, and my colleagues to dream, but that will also allow those of us who are charged with overseeing the future development of the city to translate that dream into simple instructions; instructions that we can incorporate into planning codes, building codes, and the various regulatory instruments by which we manage the growth and change of our city.

You know, everybody in California is an environmentalist. We live in a stunning natural region that none of us wants to see degraded. The most ardent environmentalists in California are the 3rd and 4th graders. These boys and girls, as we have now learned, won't take any nonsense from their parents or brothers and sisters when they see them doing something that they think harms the planet. We have seen these boys and girls change the attitudes of their families, insisting that they get serious about recycling. And now you KNOW that mom is ALWAYS going to put the aluminum can in the recycling bin because she is going to get nailed the minute she doesn't!

So our hope is that we can, with the help of the children, perform the same miracle for water conservation that we have for recycling household waste.

So our hope is that we can, with the help of the children, perform the same miracle for water conservation that we have for recycling household waste. The water that we have now is all the water we will ever have. And as our population continues to expand, we will almost certainly have to figure out a way to get by with much less water per person than we have become accustomed to. We are already in a position where we have to make better use of the water we've got. This will most certainly become more and necessary as the next few year pass.

But we can do all this. We can make these changes. All of this can be done, but it requires somebody thinking about it and someone asking the critical question and then getting the rest of the people, the public officials who are charged with the responsibility to direct and control growth in particular, to realize that these folks are not unrealistic dreamers with unrealistic proposals. Rather they are serious and accomplished individuals who have spent a lifetime studying these problems. Individuals who understand that there are actually very dangerous economic implications associated with our ignorance of these burgeoning problems. And if we ignore them any longer we do so at our peril.

So what it takes is asking the questions, asking questions and providing some attempt at answers, even if the answers are incomplete. And you know ladies and gentlemen that it is very hard for me to imagine, in this day and age, why there are not many more people asking these questions and providing some sort of positive vision for the future. It just seems to me that we should have caught on by now.

What we need, and what I really hope will come out of your experience here, is something that we can show people! Some physical vision of how we can change our way of doing business that works! What we really need from you, and from your vision, are simple, practical, and enforceable rules. But first, before we get to the regulations, we need the vision behind them. Your job is to come up with the grand vision and, second, to come up with the specific pieces from which this vision will be built.

FELICIA MARCUS

Felicia Marcus is the Region 9 Administrator for the U.S. Environmental Protection Agency.

Above all else, one thing that becomes clear when we study the many complex and pressing environmental and social problems of our time: It is that it takes not just one thing, but many things to solve them. First and foremost it takes vision. It also takes strength, moral strength, strength of character. It also requires us to expend a lot of our creative energy in figuring out how to actually make things happen in the complex and fractured world we live in.

I believe that the key to solving any environmental problem is to first recognize that the problem doesn't exist out there, away from us as people. The problem *is us* as people. It's a problem *for us*. Any environmental problem is, at its core, about how we behave as a people and how we work together to solve the problems that we create.

THE DESIGN CHARRETTE

The four-day Second Nature Design Charrette brought together engineers, landscape architects, building architects, urban foresters, and other experts to develop sustainable landscape designs for specific residential, commercial, industrial, and public properties that are representative of those found in the Los Angeles region. Most people are not familiar with the word charrette. A charrette is a design activity in which participants are assigned a very complicated design project and are asked to complete it within a very short period of time. Members of the school of architecture at the École des Beaux-Arts in Paris coined the phrase at the end of the nineteenth century. The faculty at this school would issue problems that were so difficult that only a few students could complete them. When the allotted time elapsed, a push cart, or *une charrette*, rolled past the drafting tables where the students continued to work. The students would throw their drawings into the cart in various stages of completion, for to miss it meant an automatic grade of zero. The participants in the *Second Nature Design Charrette* produced the proposals and most of the illustrations contained in this book in a similar environment to that of the École des Beaux-Arts. We allowed them only three days to produce complete designs that would otherwise take several weeks or months. The "cart" came by at 5:00 p.m. on Saturday, May 17th, the evening of the charrette public presentation.

Charrettes of this type have several major advantages over other problem-solving design activities. For one, they elicit the most creative solutions for addressing the most difficult problems, from the most accomplished designers, in the most compressed period of time possible. Under no other circumstances, would these individuals come together to stimulate each other, teach each other (and their student partners), and compete with each other to produce the best possible answers to a design problem. Charrettes also create an exciting and fertile atmosphere for collaboration between members of different disciplines. Too often these people don't talk to each other, even when they are working on very similar problems in the same location. Charrettes encourage members of different disciplines to communicate across the boundaries of their field in order to come up with holistic and appropriate design solutions.

An important cautionary point must be made, however. Given the short time allowed, no one should think of the designs produced at this charrette as complete. It is especially important not to assume that the technical questions have been worked out to the point where any of these designs could be built as shown. Much more design and engineering work is required. These designs are beginnings, rather than endings, and they provide points of departure for later work. They demonstrate broadly applicable principles rather than describe specific plans relevant to specific sites. The exception to this rule is the T.R.E.E.S. Demonstration Site, where many of the ideas from the Second Nature Design Charrette have been implemented. The plans for this site were later elaborated upon by a team of landscape architects and engineers before they began to renovate the site itself. A similar process would be required if any of the other four sites were retrofitted or if these plans were to be adapted for use at other sites.

CHARRETTE GOAL:

The goal of the charrette was to demonstrate how retrofitting individual urban sites as functioning mini-watersheds would help to solve our region's most serious environmental problems.

CHARRETTE OBJECTIVES:

1. To show how regional policy objectives may be achieved more efficiently through building and retrofitting sites for improved environmental function.
2. To develop ideas for workable prototypes as well as best management practices suitable for later testing at demonstration sites or by government agencies.
3. To provide a compelling and inspirational vision of a more sustainable urban landscape.
4. To create cross-jurisdictional and cross-disciplinary connections between those people and institutions who are responsible for component parts of the urban ecology (especially its energy systems, water systems, waste removal systems, and air quality control systems).
5. To illuminate the connection between more sustainable sites and an enhanced quality of life for all citizens.
6. To support and inform Los Angeles' many citizen-based environmental groups.

Five design teams were assembled for the charrette. Each team included two landscape architects, one building architect, one civil engineer, and one urban forester or plant specialist. Many of the team members came from Southern California, others were recruited for their particular expertise from other parts of North America.

Each of the five teams worked on a different site. We chose our five sites with the idea of providing a representative sample of the most common types of sites in the Los Angeles-area. These sites include a single-family home, a multi-family complex, a commercial and retail center, an industrial site, and a public school.

Each team attempted to improve the ecological performance of its site with regard to each of the five environmental challenges discussed below. Each site had reasonable targets for water conservation, stormwater run off mitigation, air-cooling energy cost reductions, air quality improvements, and green waste reduction. These targets were based on the best data available and were keyed to publicly established targets for environmental improvement.

FIVE ENVIRONMENTAL CHALLENGES FOR LOS ANGELES

Challenge 1: Excessive Consumption of Potable Water

Rates of Use

Southern Californians have an almost unquenchable thirst for water. Our history is one of going longer and longer distances in order to get more and more water. All of the water imported to our region is fit to drink, yet less than 2% of it is actually consumed by humans. Almost all of the rest goes to flushing toilets, washing clothing, bathing, landscape irrigation, and industrial processing.

All residential uses combined account for 59% of all water consumed in Southern California. The average use of fresh water per day is 256 gallons per dwelling unit with, on average, about 75 gallons per day being used for outside uses, primarily for irrigation.

The commercial sector accounts for about 19% of all water used. The average use of fresh water is 80 gallons per day per employee, with 23 gallons of this being used for outside purposes.

The industrial sector accounts for about 6% percent of all water used. The average use of fresh water per employee is 103 gallons per day per employee, with 13 gallons of this being used for outside purposes.

The public sector accounts for about 6% of all water used. Virtually all of this water is used for irrigation.

The remaining 9% is attributable to "unaccounted uses" (e.g. not metered, system losses, etc.). 3

Cost-effectiveness

Southern California water customers in all sectors are charged approximately $0.004 per gallon of water consumed.[4] There is much debate about the extent to which this figure represents either the true cost of bringing a gallon of water to the consumer and to what extent

3. MWD, Urban Water Management Plan, 1990.
4. City of Los Angeles, Proposed Water Rates, 1992.

this figure factors in the environmental costs to the various watersheds that are tapped for this purpose. Given this lack of clarity, and for the sake of this exercise, team members were told to feel comfortable valuing water at up to $0.01 per gallon.[5] At that rate, an 80% reduction in off-site water imported for irrigation would be worth about $219 per year per dwelling unit. A 40% reduction in the volume of water imported for domestic consumption produces an additional benefit of about $264 per dwelling unit. These figures may serve as a useful guide in assessing the cost-effectiveness, over time, of the proposed solutions.

Whatever the actual cost of imported water, the West Basin Municipal Water District is seeking to reduce water importation by 50% by 2020, at which time it is expected that the population of the region will increase by over 25%.[6] Obviously, the performance of the region's sites will need to improve dramatically in order to meet this goal.

Reduction Strategies Employed by the Design Teams

The five charrette teams suggested a variety of strategies for reducing water use. Low-flow showers, faucets, and toilets can dramatically reduce the use of water at little cost, and most teams assumed that this equipment would be installed. For site irrigation most teams adopted a strategy for capturing rain water in cisterns for later application to lawns and planting beds. The commercial site team suggested that the need for any irrigation could be virtually eliminated by using native plants which, once established, can easily withstand the long summer dry season.

Challenge Two: Flood Management

The Los Angeles River has always been prone to flooding. Billions of dollars have been spent to channel this river in order to protect the valuable properties along its route. Presently, there is concern that in the event of a 133-year storm, the Los Angeles River will overflow its banks, inundating much of Los Angeles County in the process. Government officials have proposed adding concrete parapet walls to the river banks. These walls will rise up to 8 feet above grade along southern sections of the river and cost up to a quarter billion dollars. The existing system is no longer adequate because the Los Angeles urban landscape has become increasingly impermeable. Sites send stormwater into the storm drains immediately, taxing the Los Angeles River's flow capacity as soon as it rains. If this discharge rate can be reduced, and the flood level lowered, then the present system could handle a major rain event such as a 133-year storm.

5. Conservation rates in the real world, Thomas W. Chesnutt and Janice A. Beecher, *Journal AWWA*, February 1998 Vol. 90, No. 2

6. Southern California Council on Environment and Development (SCCED), Summary Indicators for 1997.

Run off Rates

Presently, downtown Los Angeles averages about 80% impervious material. With this degree of impermeability, the peak run off rate per urban block (300 X 600 ft.) is 2,020 gallons per minute. Compare this with Hacienda Heights, which averages about 30% impervious material. Hacienda Heights has a peak run off rate per urban block of 1,257 gallons per minute. [7]

Reduction Strategies Employed by Charrette Design Teams

The storms that cause the most damage occur after a series of back-to-back storms when the ground is saturated and when even lawn surfaces have run off rates approaching those of asphalt. Teams were asked to plan for this "worst-case" situation, as it represents the conditions under which floods occur. The Army Corps of Engineers uses a 133-year "design storm" of 9.78 inches in a twenty-four-hour period.[8] The alternative systems proposed by the charrette design teams were designed to hold at least three inches of this 133-year design storm, since a 30% reduction in peak run off throughout the Los Angeles County Drainage Area would obviate the need for the parapet walls on the Los Angeles River. [9]

All five teams included some kind of hybrid cistern to both conserve water and to partially alleviate flooding. Cisterns that collect rain also reduce the amount of water flowing to the rivers, and thus help alleviate flooding. All five teams also made changes that enhanced their respective site's performance with regard to flood management only. Generally, these changes had to do with strategies that held water in the soil, in the plants, in mulch beds, in infiltration and recharge basins, and in other inexpensive locations where later retrieval was not a concern.

Since the rains that cause flooding come almost entirely during December, January, February, and March, the problem becomes one of balancing the desirability of storage capacity against the desirability of limiting cost. Each team struggled to reserve cistern or dry well capacity when floods threatened. Most teams developed ways to empty these storage areas in advance of flooding, so that storage areas would be available when needed the most.

7. Linear regression of data for subareas by Jones and Stokes Associates, Inc. is based on information contained in: U.S. Army Corps of Engineers. Los Angeles County Drainage Area, Final feasibility Interim Report, Part I: Hydrology Technical Report, Base Conditions. December 1991. Los Angeles District, Los Angeles, CA.

8. Los Angeles County Drainage Area (LACDA) Master Environmental Impact Report, 1994, Woodward-Clyde Consultants: Santa Ana, CA., prepared for the Los Angeles County Department of Public Works.

9. Estimate based on the current capacity of the Los Angeles River channel (approximately 125,000 cfs)., relative to the projected flow resulting from a 133-year storm event (approximately 178,000 cfs). Data source is the U.S. Army Corps of Engineers. Los Angeles County Drainage Area Review, Final Feasibility Interim Report, Part I: Hydrology Technical Report, Base Conditions. December 1991. Los Angeles District, Los Angeles, CA.

Cost-effectiveness

The cost-effectiveness of on-site flood management strategies is very difficult to calculate. However, for our purposes we determined that if on-site storage systems were widespread enough to reduce peak urban run off rates during storm events by 30%, then the parapet walls being built on the Los Angeles River would no longer be required. We estimate that there are about one-quarter million acres in individual sites in the urban portion of the Los Angeles River watershed, and we accept the projected cost for the parapet walls to be a quarter billion dollars. Therefore the value per acre in avoided public costs of water holding systems would be $1,000. While this number probably will not, by itself, "pay" for the on site-storage system, it can, when combined with other benefits in other areas, be of considerable importance. This figure includes neither the value of reducing the strain on existing drainage systems (ie., those not needing upgrading)[10] nor the value of avoiding the more frequent threats of local area floods on the Los Angeles River tributaries and channels that would be the result of adopting these strategies on a wide scale. Presently the flood management system for the Los Angeles River tributary storm lines and channels is designed to accommodate only the 25 year flood. This analysis suggests that local area flooding will occur with much greater frequency than will wide scale inundation from the Los Angeles River. On-site retention of stormwater would, logically, be even more effective at preventing frequent and very costly local area flooding.

Challenge Three: Water Pollution

Most urban stormwater run off flows directly into the San Pedro and Santa Monica Bays without being treated. The suspended solids, trash, fecal matter (mostly from pets), and chemicals (mostly from cars) that sit on the region's sites and streets are washed into the storm drains with the first winter rain. The first strong rain of winter always causes the most problems at the beaches, forcing frequent closures. In 1995 the beaches of Santa Monica Bay received an "F"-rating on 39% of the days that it rained.[11] If present trends continue, the number of "F"-rated days is expected to rise to 52% of rainy days by the year 2020.[12] On most rainy days far too much water is discharged into the bays to be effectively treated. Some treatment capacity has been, and will continue to be, installed to treat water that flows in the system on "dry flow" days. However, this limited treatment system will, at best, solve only a small part of the problem.

10. The annual stormwater construction and maintenance costs for cites in the watershed area equals $72 million. (Source: Jones and Stokes Associates, Inc., from public records).This amounts equals $225/acre/year, an amount which has not been, but could be, added to the cost benefit numbers used by the design charrette teams.
11. Southern California Council on Environment and Development (SCCED), Summary Indicators for 1997.
12. Ibid.

Reduction Strategies Employed by Charrette Design Teams

All design teams incorporated strategies, systems, and devices for pollution mitigation. In most cases they were integrated with design strategies employed for water retention and flood management. In some cases polluted water from nearby streets was taken onto the site and bio-remediated. Design strategies include, but were not limited to, vegetated swales and filter strips, recharge areas located under parking lots, holding tanks and cisterns under playfields, surface area holding ponds, turf grass filters, and riparian retention and treatment areas.

Cost-effectiveness

The cost effectiveness of pollution control strategies is difficult to quantify, as no one has seriously considered alternatives to off-site end-of-the-pipe strategies for solving this problem. Plans exist to use "excess" capacity in sanitary treatment plants to treat stormwater when flow rates are low (eg., residual flows, groundwater seepage, hydrant flushing, water from residents washing cars, some industrial water wastes, etc.). The cost of treating stormwater in central facilities will likely be close to the cost of treating an equal amount of sanitary waste. The cost of treating sanitary waste is now estimated to be approximately $1.37 per 100 cubic feet.[13] Assuming that the average urban site has a run off coefficient of 0.7, every 1 acre of urban land discharges 38,088 cubic feet of water into the storm system per year. The cost of treating this amount of storm discharge would therefore be $522 per acre per year. It should be noted that no one is seriously considering treating all of the stormwater discharged from these sites. At most, officials are proposing to treat the first tenth of an inch of each storm. Clearly, this end-of-the-pipe strategy will not solve the problem of water pollution in the bays and on the beaches. Without some way of controlling the lion's share of this discharge, by the year 2020 we can expect the beaches of Santa Monica Bay to be unswimmable on more than half of the days following storms and on 15% of dry days (two to three months per year total). Thus, it seems clear that if this problem is to be solved at all, it will be solved on the urban sites and city streets where it originates.

Challenge Four: Building Energy Use

In Los Angeles, more electric energy is used to cool buildings than for any other purpose. The demand for cooling is not spread evenly over the year or evenly over the day. The peak demand occurs when it is hot outside, and everyone turns on his or her air-conditioner at once.

13. Figure is a rough estimate based on best information available from Hyperion personnel. Much research remains to be done to determine a more precise figure. The absence of such a figure makes planning for pollution mitigation difficult, and the assessment of alternative strategies even more difficult.

During peak periods, over 40% of electricity consumed goes to air-conditioning. The electrical system that serves the region must be built to supply this peak demand. New capacity is always being added to the grid for this purpose, and such additions are many times more expensive per unit than is maintaining the old capacity. Thus, the real cost of the energy needed to supply this peak demand is much greater than is the average cost of electric energy. Meanwhile, those who live far from the cooling Pacific breezes, and who cannot afford (or do not choose to have) air-conditioning, bake in poorly designed and unshaded homes. Finally, power plants are major producers of CO_2, the "greenhouse gas" produced by burning fossil fuels. Reducing our production of greenhouse gasses to 1990 levels, as required by the Tokyo Treaty on Global Warming, would be facilitated if we cut our peak demand for air conditioning. Trees and vines can be the means for this reduction.

Reduction Strategies Employed by the Charrette Design Teams

This charrette focused primarily on site-related retrofit strategies rather than on construction techniques for the buildings themselves. Designers were asked to explore ways of reducing peak-load energy consumption, primarily through the use of on-site systems, site structures, and plants. Since air temperature affects cooling demand, designers used heavy tree planting to reduce the ambient air temperature, not just on the site, but also throughout the city, in an attempt to reverse the energy-wasting heat island effect. Dramatic improvements in our local climate would result if most of our city's sites included large shade trees. For example, neighborhoods in Houston that still retain a virtually continuous overhead canopy, enjoy air temperatures several degrees lower than those of the adjacent downtown area. Each degree reduction in air temperature significantly reduces the demand for air-conditioning. Ironically, in Los Angeles, where plants seem to be everywhere, a very small percentage of the land surface is shaded by trees. In residential areas the figure is less than 20%, and in commercial and industrial zones there is virtually no tree canopy at all. The average canopy cover in the City of Los Angeles is about 10%.[14]

Preventing the direct rays of the sun from striking the building is even more important than is lowering ambient air temperature. In the summer months, when cooling demand is greatest, the sun strikes east and west walls for many hours, heating building surfaces to temperatures far above that of the air. Much of this extreme heat build-up is radiated back into the structure. Peak cooling energy demand occurs in the afternoon, when the sun is striking west facing walls. Thus, it is especially critical to protect these particular walls. The strategic planting of trees is the most effective means of shading building surfaces from the sun. Vine-covered trellises, as well as vines that adhere to building surfaces, are also effective if planting trees is either not pos-

14. From aerial photo interpretation as part of this project.

sible or is otherwise inappropriate. All five design teams found ways to add green to their sites, thus cooling and moisturizing the air, providing shade, and lowering energy use.

Cost-effectiveness

Emerging research allows us to quantify some aspects of the cost benefits associated with tree planting. Generally, tree planting has two benefits: the reduction of pollution and the reduction of energy demand for heating and cooling. On average, mature urban trees reduce the amount of carbon dioxide (CO_2) in the air by about 115 pounds per year.[15] They do this in two ways:

(1) by using CO_2 in photosynthesis, and

(2) by lowering the amount of CO_2 released into the atmosphere by power plants by reducing demand for electricity through shading buildings and lowering air temperatures.

Of (1) and (2), (2) is many times more important per urban tree than is (1). The California Energy Commission has estimated that reduced CO_2 emission has a dollar value of $920 per ton per year.[16] Thus, for the purposes of this charrette, it was suggested that each tree has a yearly value of $52.90, or a lifetime value over a thirty-year "amortization period" of $1,587. This value is far in excess of the cost of installing a shade tree.

Challenge Five: Green Waste

Green waste consists of grass clippings, leaves, and branches removed from sites as part of normal landscape maintenance. On average, each household in the Los Angeles region generates 1.3 tons of green waste per year.[17] This represents roughly a third of all household waste. Removing organic material from sites prevents trees from recycling their own detritus. In forest systems, the forest floor is thick with decayed remnants of leaves and branches. This thick organic layer (humus layer) eventually decays and returns to the tree as food. It also improves the structure of the soil over time, making it increasingly capable of supporting trees. Urban trees would be healthier if this natural cycle could be emulated. Thirty-three percent less waste would be delivered to the landfill if green waste was somehow returned to the soil of the site. The often heavy and sterile soils of the Los Angeles region would gain improved fertility, aeration, and water-storing capacity if green waste was allowed to work its way back into the soil.

15. Nowak, D.J. 1993. Atmospheric Carbon Reduction by Urban Trees. Journal of Environmental Management, 37, 207-217.
16. California Energy Commission. 1992. 1992 Electricity Report, Air Quality. Sacramento, CA.
17. Integrated Urban Forestry Inc. (n.d.). Greenwaste Reduction Implementation Plan. Laguna Hills, CA.

Reduction Strategies Employed by the Charrette Design Teams

Systems, areas, and devices for returning composted waste into the soil are a feature of each of the designs. In some cases, mulch beds do double-duty as water storage areas. Deep mulch beds can store copious amounts of water (up to 60% of their volume) and hold it for a very long time. It was suggested that plants capable of withstanding this unusual hydrological situation be employed in these areas.

Cost-effectiveness

Direct cost-benefits associated with keeping green waste on-site are not insignificant. The cost of hauling and tipping the 1.3 tons of green waste generated by the typical Los Angeles region dwelling is $81 per year.[18] This figure does not include labor costs related to gathering and collecting the waste for pickup. On a per-acre basis, a figure of $648 for a typically landscaped site (the school site, for example) can be used as a reasonably accurate guide to cost.[19] Perhaps of more significance, the Southern California Association of Governments is committed to steady increases in the percentage of household wastes recycled. Presently, 25% of all household waste is recycled. The plan calls for that figure to rise to 67% by the year 2020.[20] These reduction targets have been given the force of law in AB 2020, the legislation that requires all solid waste to be reduced by 50% by the year 2020. If that target is to be reached, virtually all green materials will need to be kept out of the waste stream. The only truly logical place to put this "green waste" is back on the site, thus transforming green waste into a "green resource."

18. Ibid.
19. This figure based on known per acre costs for typical residential sites.
20. Southern California Council on Environment and Development (SCCED). 1997. *State of the Local Environment and Economy, Summary Indicators for 1997*. Santa Monica, CA.

The Dollar Value of Enhanced Ecological Performance

We might all agree that no one can really put an accurate dollar value on the environment. However, in the absence of an ascribed dollar value, the cost of environmental impacts have, until recently, been penciled in at zero. But with an environmental crisis becoming more and more immediate, many of the direct costs of our wasteful practices are becoming evident.

For this charrette we used the direct costs that were available as the basis for our cost-benefit framework. In some cases, when there were no actual costs available (e.g., stormwater pollution), we used the costs of mitigating analogous environmental impacts (e.g., septic discharge). We believe that our approach to determining costs is quite conservative. Most experts who attempt to ascertain the "full cost" of environmental degradation place it much higher. Yet even on the conservative basis of immediate and avoided costs, a strong argument can be made for the cost-efficiency of the designs presented in this book. A "full-cost" assessment would only make our argument many times stronger. We used our best estimate of immediate and avoided costs per unit improvement in each of five environmental issue areas.

Each team was challenged to enhance the ecological performance of its site based on the size of their respective sites. Upon successfully meeting the performance thresholds for each of the five issue areas, they were able to rationalize spending up to about $202,800 per acre for the strategies, systems, and devices needed to bring about performance improvements. We compiled all of the cost-benefits per unit performance improvement (discussed above) on the matrix shown below. This matrix was provided to each charrette participant and established the cost-benefit envelope for each team's design proposals.

Cost-Benefit Matrix

Issue	Amount Changed/	Unit	Estimated value per year	Estimated value per 30 years	Estimate of 30- year value per acre [21]
Water for irrigation	80% reduction	Per dwelling unit	$219.00	$6,570.00	$52,560.00
Water for Domestic Consumption	40% reduction	Per dwelling unit	$264.00	$7,920.00	$63,360.00
Flood Management	Hold three inches of water during flood emergency	Per acre	$1,000.00[22] (r.e. parapet walls)	$10,000.00[23]	$10,000.00[24]
Water Pollution	Bio-remediate all first-flush water on site	Per acre	$522.000	$15,660.00	$15,660.00
Air pollution	Strategic shade for structures, general planting for heat island	Per acre, 20 trees strategically placed @ 52.90/tree	$1,058.00	$31,740.00	$31,740.00
Green waste	Recycle all green waste on-site	Per dwelling	$81.00	$2,430.00	$19,440.00
	Total value of all remediation strategies to apply to construction and maintenance per acre			=	$192,760.00

21. For simplicity, this thirty-year amortization figure assumed zero interest and constant dollars.
22. This figure was derived just from the cost of the concrete parapet walls proposed for the Los Angeles River. No costs for local flooding or costs for sizing storm systems for quick discharge is included. Real costs are much higher.
23. Assumes the inclusion of other end-of-the-pipe investments required during this period.
24. This figure is not changed since we are assuming that the savings derived by not installing the concrete parapet walls is a one-time-only occurrence.

Single-Family Home Site

1828 West 50th Street, Los Angeles, CA

This property now serves as the T.R.E.E.S. demonstration site and has been retrofitted based on the ideas generated by the charrette team.

PROTOTYPE

This is a typical older single-family home located on a 50' x 150' lot.

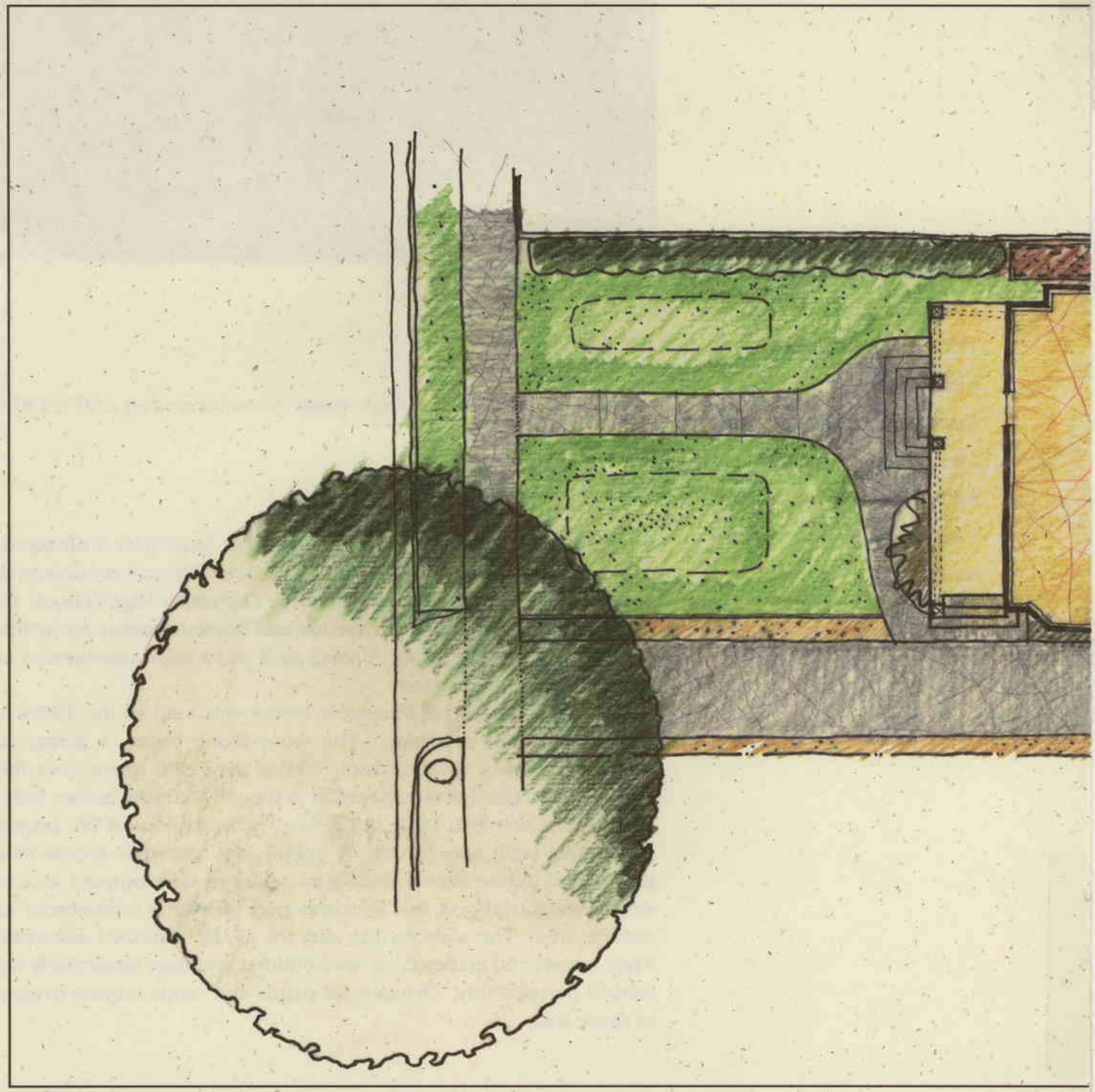
SITE PROFILE

The single-family home site is located at 1828 West 50th Street in the Crenshaw district of Los Angeles. This middle- to low-income area is in south central Los Angeles, near the Crenshaw High School. Convenient bus stops at Western Avenue and Slauson Avenue are within a few blocks of the property. A small park and a small commercial area are also a few blocks away.

The Craftsman-style bungalow house was built in the 1920s and remains in good condition. The wood-frame house, a garage, and paved areas cover approximately 60% of the 7,500 square foot, 50 ft. x 150 ft. lot. This lot configuration is typical for most homes built in Los Angeles between 1920 and 1950. The remainder of the property consists of lawn and shrubs. A public alley provides access to the garage and public access to utilities. Before development as a residential neighborhood, this land was part of a large commercial agriculture area. The soils on the site are of the Hansford association. They are over 60 inches deep, well drained, and have moderately rapid subsoil permeability. Ornamental plants and crops require irrigation in these soils.

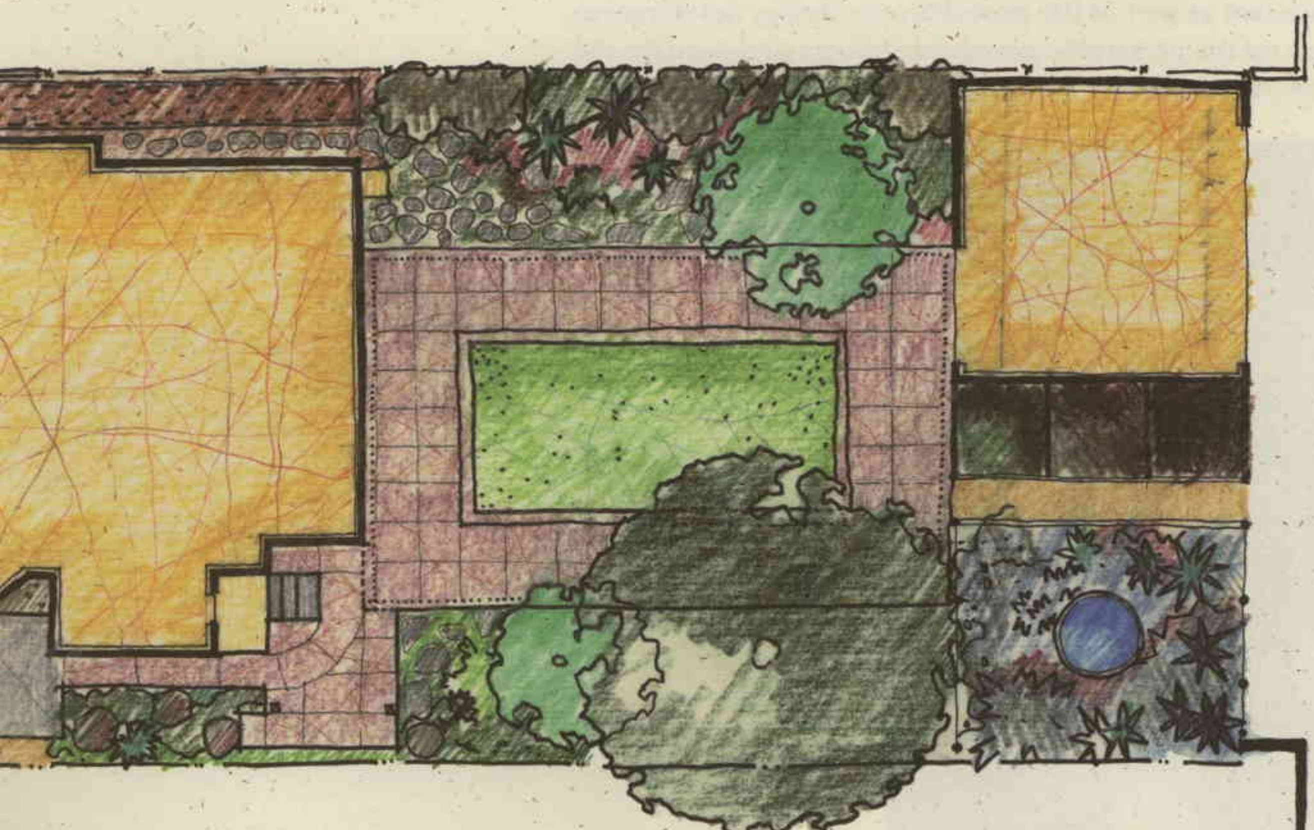
This property now serves as the T.R.E.E.S. demonstration site and has been retrofitted based on the ideas generated by the charrette team. The late home-owner, Mrs. Rozella Hall, participated in the project by keeping a journal of energy and water use, costs, and landscape maintenance practices. The information collected in the demonstration project will serve as a basis for a more complete assessment of the costs and benefits of retrofitting a typical Los Angeles-area home.

Below: Plan produced by the charrette single-family Home team. The team proposed retention grading for both the front and back lawns, a vegetated swale at the east property line, and a cistern to capture rain water (indicated by the circle west of the garage).



SITE DESIGN PROPOSALS

This design team had the benefit of working directly with the client in the knowledge that their design, or some variation of their design, would be built as the T.R.E.E.S. Demonstration Site. The owner of the home, Mrs. Hall, allowed TreePeople to retrofit her home in order to demonstrate what would happen if homes were designed to work with—not against—the city's natural cycles of water and waste.

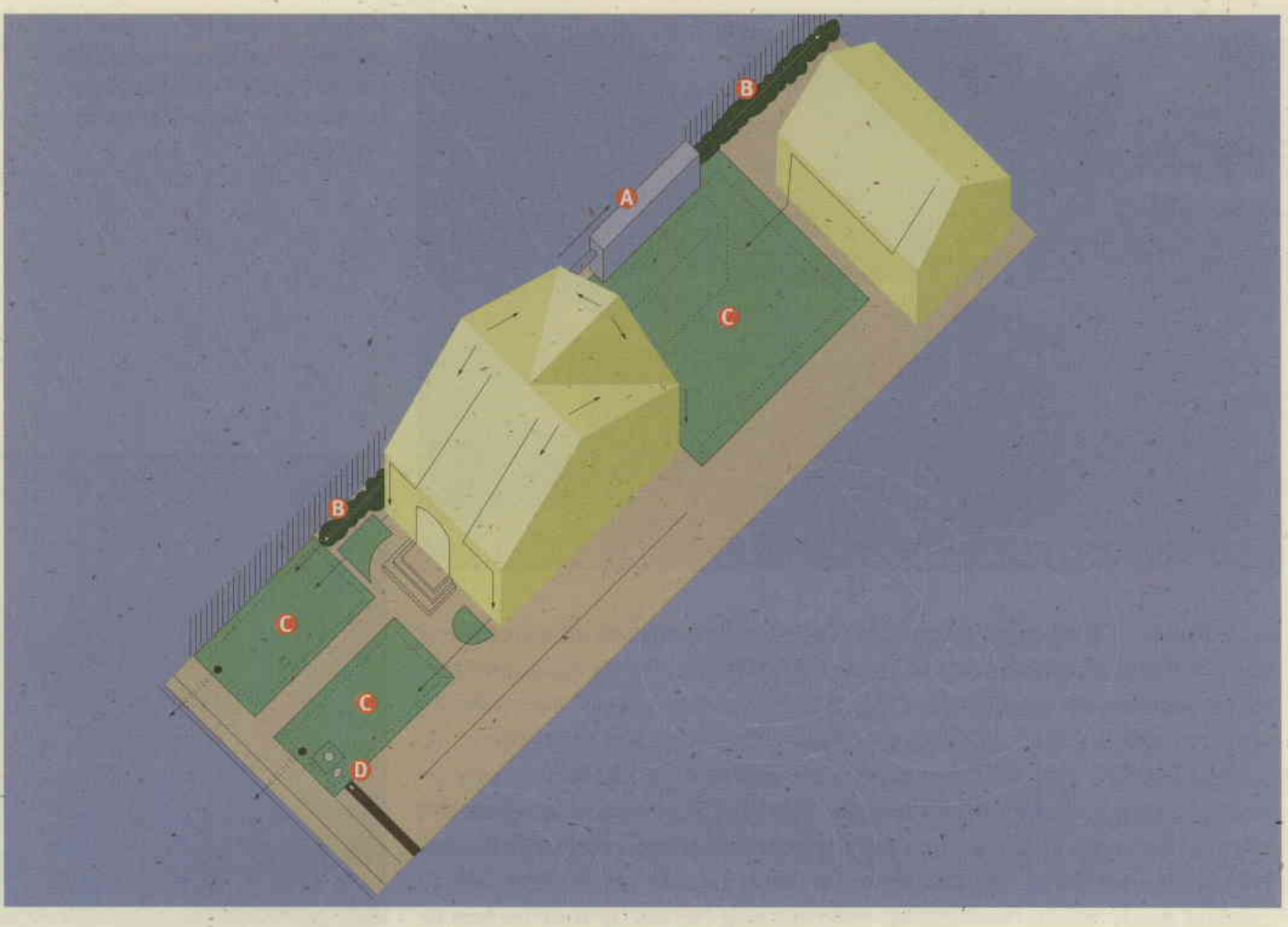


Mrs. Hall had limited ability to perform extensive yardwork, or to hire others to do it for her. Consequently, the design team produced a design that would meet all of the environmental performance requirments without requiring a burdensome amount of work for the homeowner. The design strategy is simple. A cistern is installed on the site to capture rain water. Water captured in the cistern is later used to irrigate the lawns. The lawn areas themselves are depressed to allow rain water that by-passes the cistern to collect and be absorbed in the grass and soil below. The native soils underneath these lawns are relatively free of clay particles and consequently are able to quickly absorb large amounts of water. Water from the driveway is also directed into the soil.

The plan for the site produced at the charrette illustrates many of the elements that are now constructed on the site including retention grading, a vegetated swale, and a cistern. These elements are part of the final demonstration site design. A fourth element, the driveway drywell, is included as part of the post-charrette design development and is a variant on the permeable pavement strategy proposed for the driveway at the charrette.

Each 1,800 gallon cistern unit was prefabricated off site and lifted over the house by a crane.

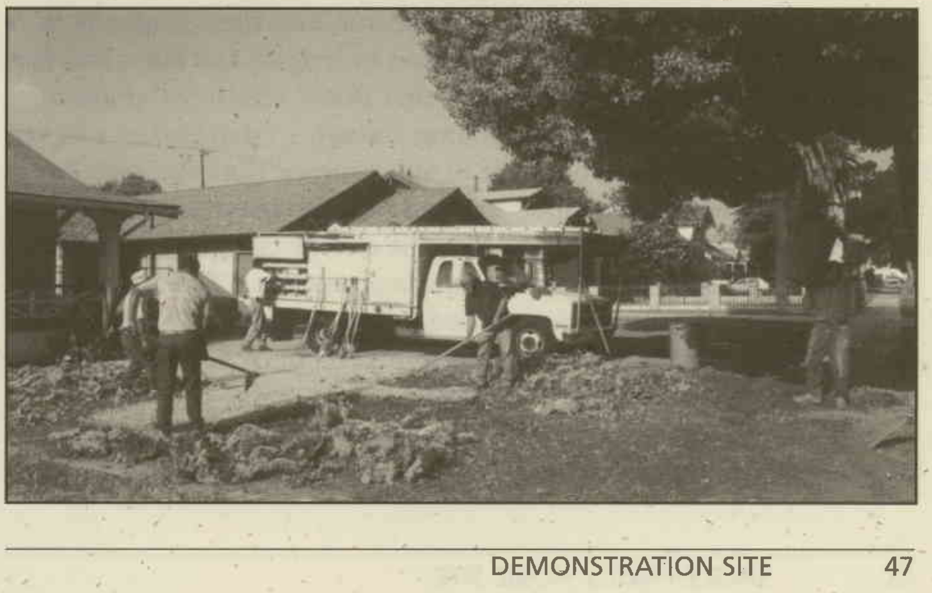
The operation of the demonstration site is illustrated in the axonometric diagram on page 47. Rain falling on the hard surfaces of the site (the roofs and pavement) is directed to depressed lawn areas (C),



Axonometric diagram of the T.R.E.E.S. demonstration site as built. Arrows indicate direction of water flow. Best Management Practices (BMPs) on the site are indicated with the letters A - D.

or cistern (A). Overflow amounts are carried by the vegetated swale (B) which also serves to accept green waste from the site. Water flowing down the driveway to the street is intercepted by the driveway drywell (D).

The design strategy maximizes the storage of rain water on the site lot while minimizing the amount of earth that may require removal



Most of the front yard was reconfigured to hold, rather than shed, rainwater.

Workers preparing to install low maintenance, drought-resistant plants. Note the low earth berm surrounding the center portion of the yard.

from the site. Low maintenance is a must at this site, so all equipment and plantings that are installed function with little or no maintenance. These constraints notwithstanding, the demonstration site successfully captures and holds all of the water falling during a two-inch storm. To accomplish this end, all water panels are designed as shallow retention basins. Safety considerations require that the maximum elevation differential be kept at six inches for the sides of these retention basins. This is accomplished by lowering the lawn panels two inches below existing grade while building up surrounding berms by four inches to make a total of six inches of water storage capacity on all lawn panels. The bordering berms are covered with shrubs, ground covers, or turf, in order to stabilize them and to prevent foot traffic over them where it might compromise the effectiveness of the retention system.

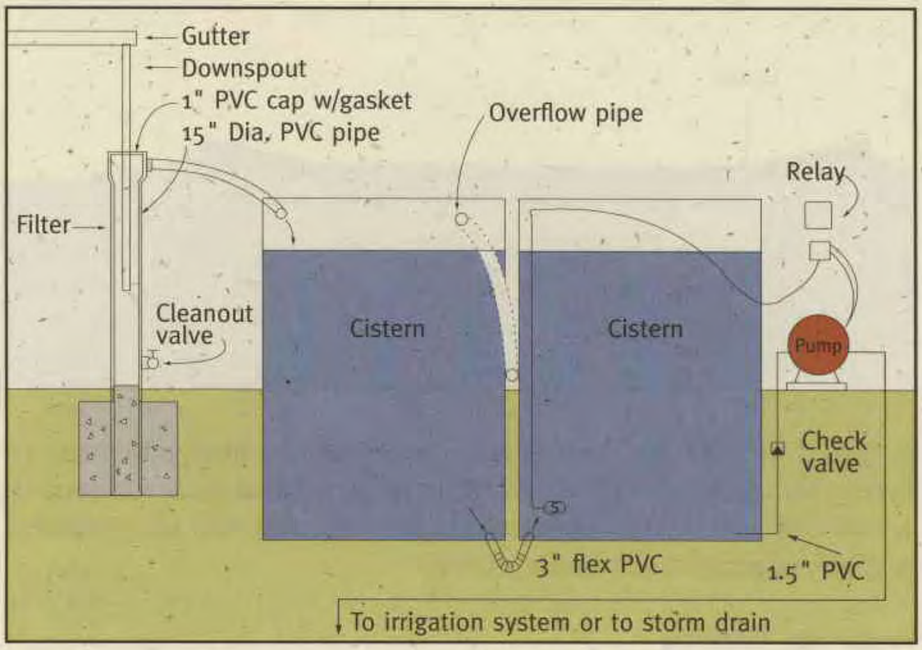
Rear yard of the demonstration site as it looks today. Grass panel holds, then absorbs, nearly 4,000 gallons of water. Two cistern units are visible at the far side of the yard. The cylindrical roof wash unit can be seen to the immediate left of the cistern. Roof water drains from the downspout into the roof wash unit, where impurities settle out. Clean water is decanted into cistern from the pipe connecting the top of roof wash unit to the top left corner of the cistern.

Cistern Collection System

Two 1,800 gallon cistern collects rain water from the southeast quadrant of the roof during the wet season and then gradually uses this stored water during the dry season to irrigate the lawn and gardens. A roof wash unit collects the "first flush" water (when the first fall rains occur) and sequesters it long enough so that gravity can settle out the summer-long build-up of atmospheric dust and bird feces. The precipitate is then drained into the adjacent lawn panel while the clean water decants into the cistern. The double cistern at the demonstration site is made of Polypropylene, a plastic that is plentiful in Los Angeles' waste stream and is recycled locally by ARCO. The unit holds 3,600 gallons of water. The water is pumped out by an electric pump on a timer system to irrigate the yard.

The cistern can also act as a flood control device. When a series of catastrophic storms occurs, cisterns can be drained and filled to

BMP A, cistern collection system.

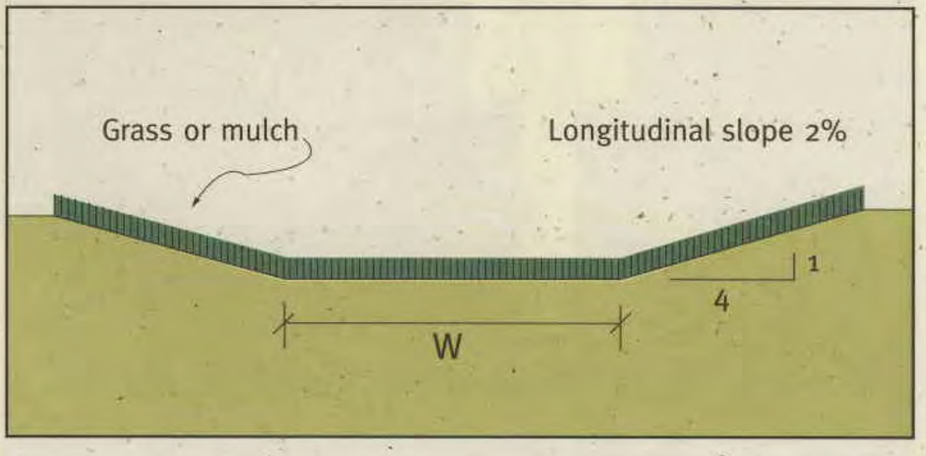


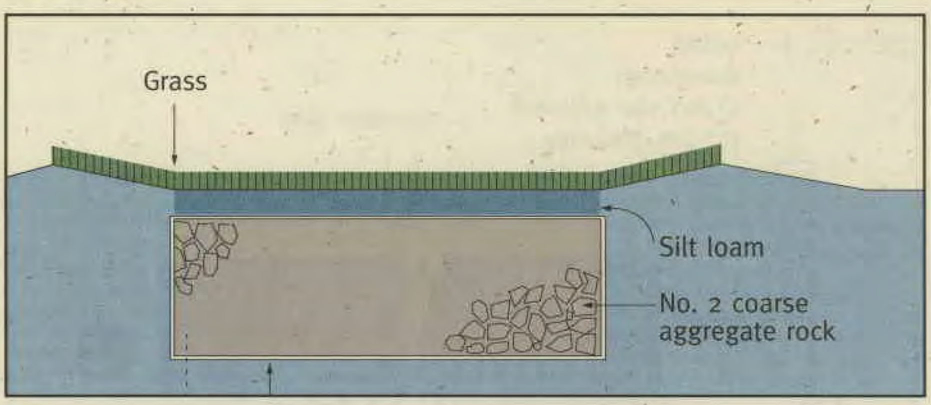
regulate the flow of water into the flood control system. If implemented on a larger scale, thousands of cisterns around the Los Angeles basin can be equipped with remote control switches that will enable flood control authorities to use them as a "networked reservoir." This will create a highly effective water conservation, pollution prevention and flood control system that is able to store or release water as needed.

Vegetated/Mulched Swale

A swale is a low-lying or depressed stretch of land. Swales are used at the demonstration site to create an attractive and functional space that also performs a vital function in waste reduction. The mulched swale is composed of recycled greenwaste from the property. It is

BMP B, vegetated/mulched swale.



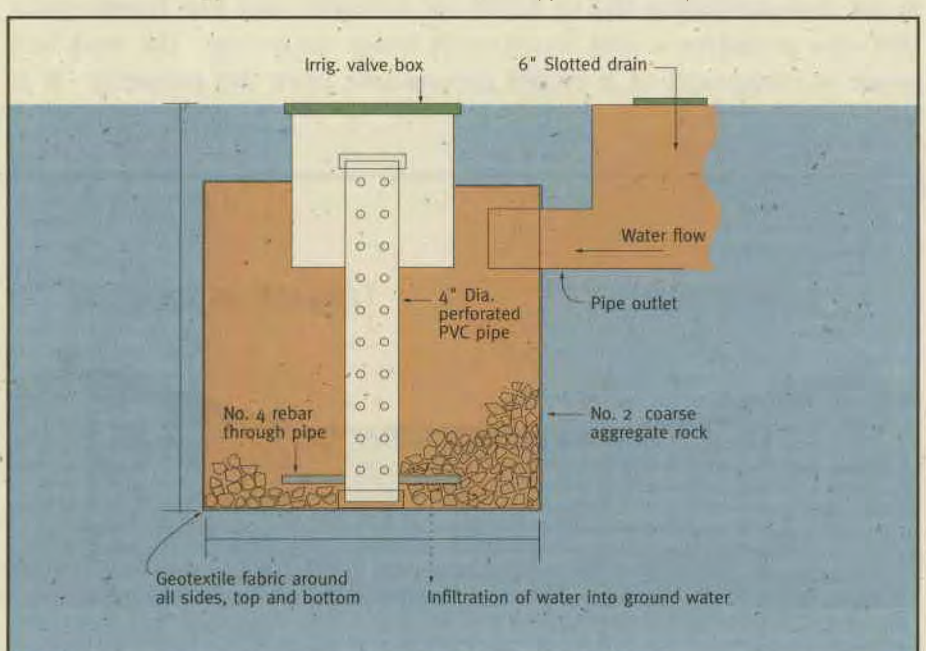


BMP C, retention grading.

designed to slow the flow of stormwater and to filter pollutants so that water can be absorbed into the earth to remove toxic substances. A swale can be used in any residential setting and may be composed of grass, vegetation or organic mulch.

Retention Grading

The front and back yard retention grading is a "sunken garden" that holds rain water until it can be absorbed into the ground. This type of grading works best in highly permeable soils (Los Angeles type 2 and 3). At the demonstration site, the runoff from the front roof panels is directed into a six-inch depression in the front lawn, while the south-east roof quadrant and half of the garage roof drains to the back yard. These mini-retention structures are capable of handling a flash flood that could occur during a 100-year storm event. During a more intense storm, excess rain water would flow into the existing storm drain system. The depressed area can also be placed over coarse aggregate rock to achieve a higher infiltration rate.



BMP D, driveway drywell.

Driveway Dry Well

This drywell system serves the dual purpose of retaining and cleansing rain water, giving the water within it time to percolate into the ground rather than carrying motor oil and other pollutants into the City storm drain system to be discharged into our beaches and bays. Rain water flowing down the driveway runs through a grate (see D) into a box containing sand and crushed rock that captures pollutants.

Front yard after T.R.E.E.S. retrofit. The front yard does not look dramatically different, but it holds, and then absorbs, nearly 4,000 gallons of stormwater.

DEMONSTRATION SITE CONSTRUCTION

The charrette site plans were adapted for construction and then implemented by the landscape design and construction firm of **Robert Cornell and Associates.** *Additionally, landscaper* **Karen Bragg** *assisted in the construction and provides the ongoing site maintenance.*

TEAM MEMBERS

Leo Marmol, Architect
Team Facilitator
Tom Richman, Landscape Architect
Leslie Ryan, Landscape Architect
Gail Boyd, Engineer
Sharon Lockhart, Environmental Counselor

Landscape Architecture Graduate Students:
Ramsey Badawi
Bonnie Dell Angelo
Ellen Hu

SUMMARY

More land is covered by single family homes than by any other type of land use in the Los Angeles Basin. Any program aimed at using individual sites to help alleviate environmental problems must include new strategies for the single family home and its outdoor property. The relatively small size of the typical single-family home site makes it especially challenging to retrofit. Of the five sites studied, the preliminary cost/benefit assessment suggests that the single family home will be the most economically challenging. A street-by-street approach has the potential to overcome some of these challenges, especially where the residential street and lane could be used to mitigate site impacts more economically than the private residential yard. Such an exploration is beyond the scope of this project but should be considered in the near future. This notwithstanding, the demonstration site effectively proves that small sites can be constructed to hold water, reduce energy costs, prevent water pollution, and cut the consumption of potable water. If all new housing were built to do the same, the cost per household would be much lower than it is to retrofit existing homes. As the city matures and single family homes are rebuilt, the devices included at the Hall residence could be routinely required as aspects of any new construction (in the same way that fire protection sprinkler systems are now required for new single-family homes in many jurisdictions).

BENEFIT ANALYSIS

The following benefit analysis provides a cost value per year; per thirty years; and a total value over thirty years for remediation of the entire property. This information was provided by the charrette team in 1997 dollars.

Issue	Performance Target	Amount Changed	Value / year	Value / 30 years
Water for irrigation	From 73/day to 15	80% reduction	$219.00	$6,570.00
Water for domestic consumption	From 181 gals./ day to108	45% reduction	$297.00	$8,910.00
Flood management	Holds 3" of water		$250.00	$7,500.00
Water pollution	Bio-remediate all first flush discharge	100%	$65.25	$1,959.50
Air pollution	5 strategically placed trees 40% canopy 1644 sq.ft. coverage	66% canopy increase	$582.00	$17.460.00
Green waste	Recycle all green waste; start with 1.3 tons	100% reduction	$81.00	$2,430.00
	Total value of all performance improvements =			$44,829.50
	Estimated cost of site improvements =			*$55,000.00

*These estimates were generated by the charrette team based on a design that was substantially different than the design eventually built. TreePeople will be using actual figures to calculate the cost/benefit ratio of the actual project. The above ratio of cost to benefit does, however, suggest that cost-effectively retrofitting small single-family home sites may be far more challenging than retrofitting larger commercial, institutional, multi- family housing, and industrial sites.

Multi-Family Housing Site:

Harbor Vista Apartments, Los Angeles, CA

"The underlying strategy of the design proposals is to reduce the amount of domestic water imported to the site; to reuse imported water on the site; and to allow the rain water that falls naturally on the site to flow back to the regional watershed system."

PROTOTYPE

This is a typical multi-family residential site, with very high gray-water discharge rates (1,500 gallons per day) and very high stormwater runoff rates (95 to 100%).

SITE PROFILE

The Harbor Vista Apartments are located at 410-450 Wilmington Boulevard, in the Wilmington district of Los Angeles, within two blocks of the busy Port of Los Angeles. The surrounding residential neighborhood, built during the 1950s and 1960s, is a mix of single-family homes and two-story apartment buildings. The 20-acre Dana Strand Village public housing development is located to the east, directly across Wilmington Boulevard. The neighborhood is well served by public schools and parks. Bus stops and a small retail district are located nearby. Currently, the site is being considered for redevelopment as a family-oriented housing community. Global Green USA used this site as one of its study sites for its Los Angeles Affordable Housing Charrette held April 18 and 19, 1997. Under the proposed plan, all of the existing wood-frame structures would be remodeled to provide a total of 132 two-, three-, and four-bedroom units, with improved community services and facilities for families with children. Coordinating with the Global Green effort allowed this team to focus on site related issues, assuring that the pressing social and housing issues were also being addressed simultaneously.

The 3.4-acre Harbor Vista Apartment site occupies one city block and was developed as rental apartments in 1987. A total of 119 one-bedroom units and 64 two-bedroom units are housed in five two- and three-story buildings. The vacancy rate in the Harbor Vista Apartments is nearly 80%, and the site suffers from severe physical neglect. The few units that remain occupied are over-crowded and require basic maintenance and repair. Nearly 95% of the site not occupied by buildings is paved for parking or shared courtyard space.

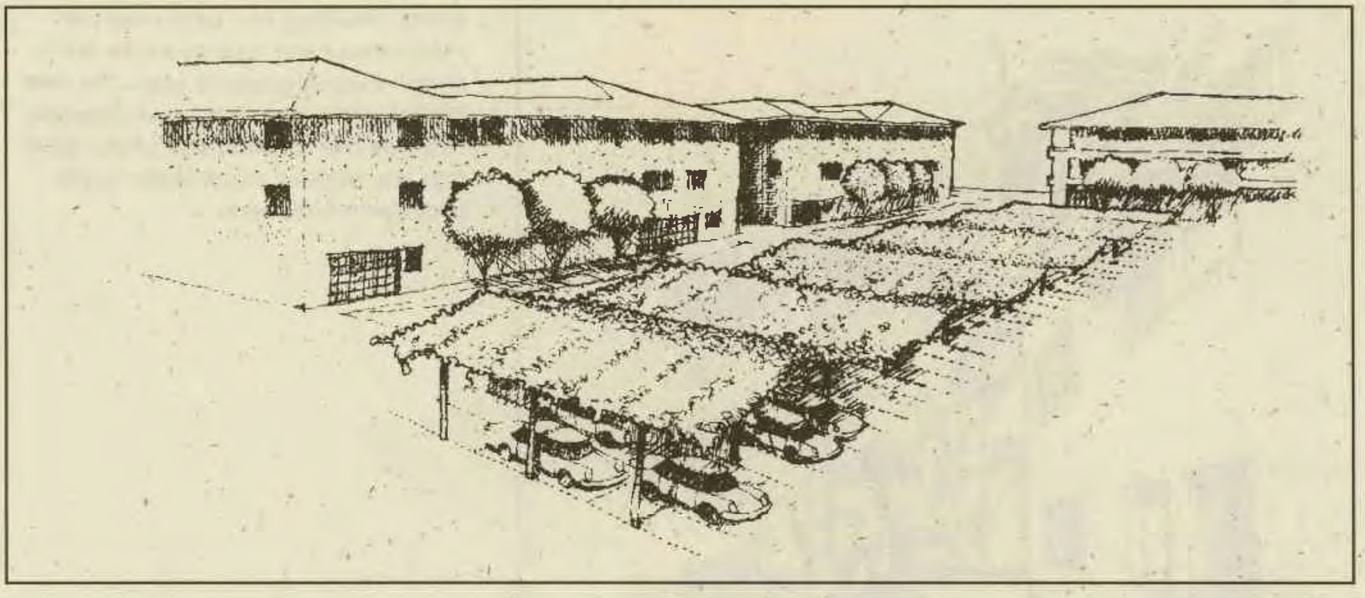
SITE DESIGN PROPOSALS

Large buildings, high on-site parking requirements, and low rise/high density development produced a site that is covered with impervious pavement and roof surfaces. There are very few green areas on the site and none of these remnant green areas are useful for outdoor play or other activities. The underlying strategy of the team's design proposal is to reduce the amount of domestic water imported to the site, to re-use imported water on the site, and to allow the rain water that falls naturally on the site to flow back into the subsoil. The design proposals work with the existing buildings and basic organization of the site plan, and they propose the following construction and management measures:

Reduce Paved Areas and Increase Plant Cover

First, the parking area was reorganized to reduce some unnecessary pavement, mostly by repainting the parking stall stripes in order to create smaller (8.5' x 18') parking stalls, and by adding stacked bays (one car parked in front of another—appropriate where these two stalls are assigned to the same household) along the west edge of the property. Some paved area was eliminated in each courtyard and along a walkway between the parking area and the courtyard buildings. Trees, shrubs, and filter beds are proposed for these new openings in the pavement.

On this property, shade trees have been sacrificed to increase the number of cars that can be accommodated within the site. Using space gained by reducing the parking stall dimensions, the design team was able to add shade trees at the edge of the large parking area. In order to balance the need for shade with the design requirements for the subsurface infiltration basin located below the pavement, the design team proposed that a lightweight overhead trellis be installed over the center bays of the parking area. The trellis would support fast-growing vines that require limited amounts of growing medium. The vines would shade and cool the cars and pavement and filter out some airborne pollution. Posts for the trellis are strategically located at the corners of parking stalls to avoid potential damage to the trellis, vines, or vehicles. Vines are planted in two small islands of growing medium at the north and south edges of the infiltration basin area. These islands also help to organize vehicle movement within the parking area.



A simple structure made of steel posts and cable provides support for vines. The vines shade the parking area and create a more attractive atmosphere in the parking lot.

In the courtyards and along the periphery of the property, trees, shrubs, and lawn areas work to filter runoff and to provide shade and shelter. Trees are strategically located to shade the hot east-, south-, and west-facing walls, windows, and roofs of the residences.

In addition to the water quality and flood control objectives described above, the design strategies in this proposal also address some important community livability issues. Reducing pavement and planting trees, shrubs, and vines helps to create a more humane environment and provides an opportunity to reorganize the site for the purpose of creating more useful outdoor spaces. Remodeling the site to provide grass or other landscape areas at the periphery of the property provides an opportunity to create more attractive and neighborly streets, yards, and alleys, while increasing safety and security through strategic planting, fencing, and lighting

Graywater Irrigation

Graywater irrigation can be achieved by diverting residential graywater from the building's drain system and using it as a water-supply source in the landscape irrigation system. In multi-family housing, laundry rooms alone can supply a constant and abundant source of water for irrigation purposes.

The graywater irrigation system used in this plan captures relatively clean water draining from the washing machines of the complex into closed tanks. These tanks hold an average of four days worth of graywater. An overflow drain returns any excess water to the building sewer drain system. A small electric pump, powered by a photovoltaic cell mounted on the south-facing roof of the apartment building, pumps the graywater to the landscaped areas using standard irrigation equipment. Because abundant graywater is available year-round at this site, there is no need to design a secondary system or to attempt to har-

A new retaining wall with vines provides privacy and security at the Wilmington Avenue property line. The new landscaped area serves a dual purpose: to shade the hot west side of the buildings and to clean storm water in the underlying filter beds.

vest stormwater for irrigation purposes. Irrigation lines are located below the surface and are operated with a standard remote electric valve system in order to limit human contact with the irrigation water.

Graywater is stored in this system for very short periods of time. It contains mostly organic detergents, which can be broken down by soils. Phosphates, often a major ingredient in laundry-room waste water, provide nutrients to plants.

With an estimated 530 residents at the Harbor Vista Apartments, laundry alone produces more graywater than the small landscape areas could use if it were to be recycled for on-site irrigation. The remodeling project will allow access to interior plumbing for the re-routing of graywater, providing an excellent opportunity to install a graywater irrigation system.

Operation and maintenance of the system involves the following:

(1) Monitor and clean the storage tank's inflow filter;

(2) monitor landscape areas for indications of salt build-up, then irrigate with city water for two to three days to leach out such build-up; and

(3) leaching bi-annually with municipal water to prevent salt build-up.

Filter Beds

A combined grass filter strip and organic filter bed removes solids and oils from the first-flush runoff at the beginning of each rain event. By pre-treating runoff, the downstream watersheds are protected from contamination and the subsurface infiltration basin is protected from clogging due to build-up of silt and other particulates.

The sand filter medium is a peat-sand mixture that has the ability to filter out both solids and dissolved contaminants. A perforated pipe wrapped with filter fabric is placed at the bottom of the sand filter medium. The pipe then channels treated water to the nearby subsurface infiltration basin. Given space limitations, many filter beds on retrofit sites will not have enough storage capacity to treat all storms. In these instances, a standard storm drain inlet may be installed to handle excess flow, leaving behind solids and most floating constituents.

The mulch filter medium is a leaf compost and peat mixture that has the ability to retain metals, oil, grease, and dissolved phosphorus. The mulch filter medium can be easily accessed and replaced with new material, as required. The material can be produced on-site, using the green waste produced by normal landscape maintenance activities.

Operation and maintenance of the filter bed system involves the following:

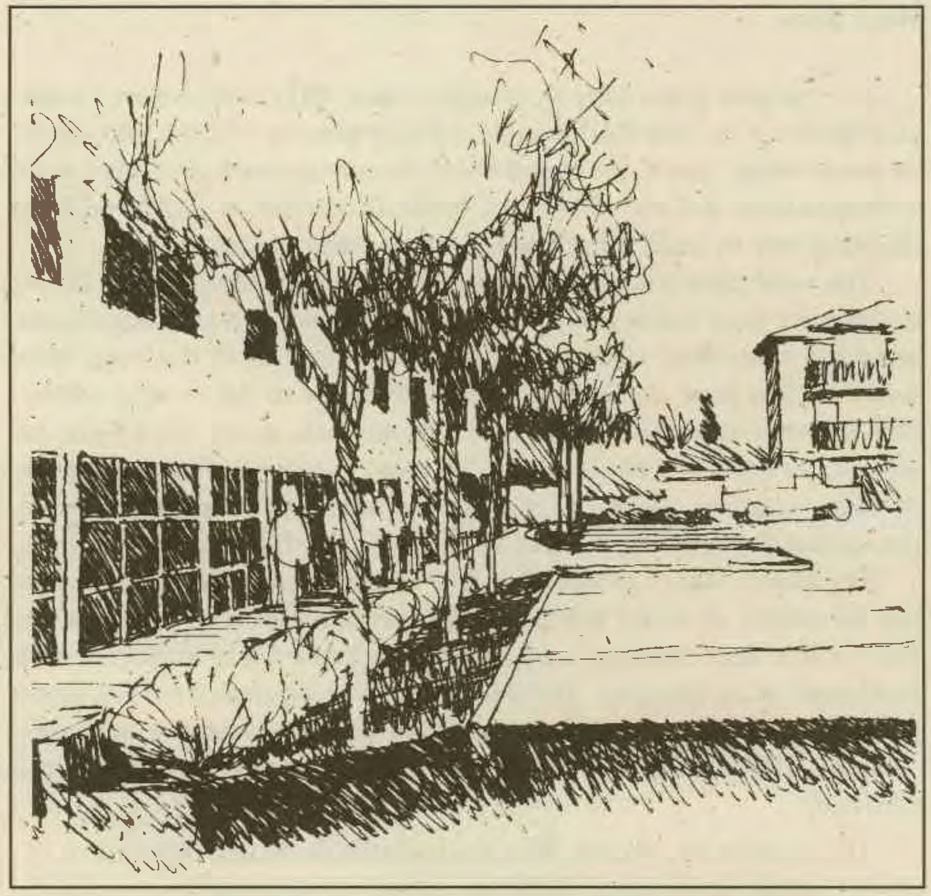
(1) monitor the mulch filter medium for declining infiltration rates (when water infiltrates slowly or becomes permanently ponded, the mulch filter medium must be replaced with new material, the normal replacement rate being twice every four to six years);

(2) maintain the grass filter strip with irrigation and mowing; and

(3) keep drain inlets free of debris.

Subsurface Infiltration Basin

The filter-treated runoff flows or is channelled into the subsurface infiltration basin beneath the parking area. From there, any remaining water infiltrates into the existing subsoil just like stormwater on an undeveloped or unpaved site. The 3-foot deep crushed stone infiltration basin in this location stores the equivalent of 4 inches of site runoff. The dual filter system (surface and subsurface) reduces or eliminates this site's contribution to the region's stormwater and water pollution problems by treating water on-site and returning it to the underlying soil. The underlying clay loam subsoil on this site carries an assumed infiltration rate of 0.5 inches per hour. Given the holding capacity of the infiltration basin, this would allow it to empty into the underlying sub-soil within thirty hours of a major storm. The basin can be further vented to storm drains through an operable valve. This would assure available capacity when a major storm is predicted.



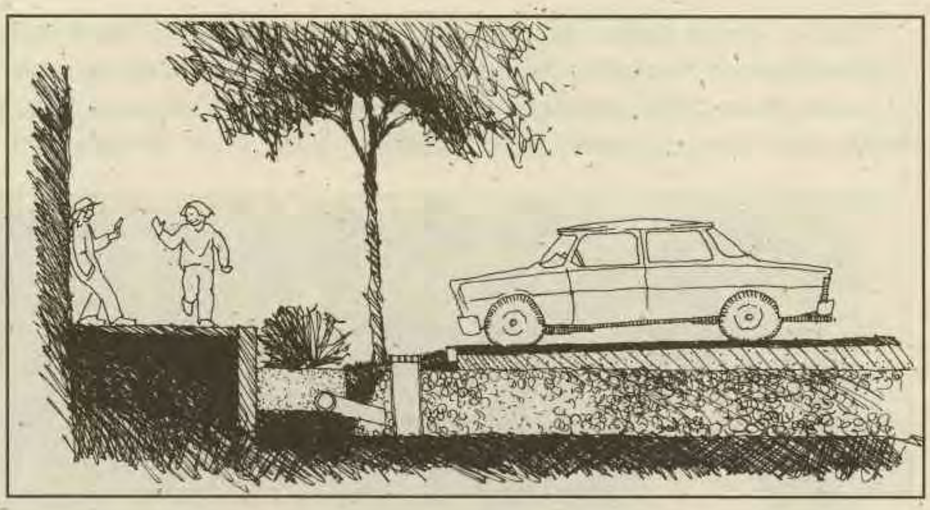
A mulch and grass filter bed separates the parking area from the buildings and provides a shaded green edge.

A crushed stone material is used to fill the 3-foot deep subsurface infiltration basin. This stone is clean, local, crushed angular quarry material with a 40% water-holding capacity. During dry periods, the stone material at the bottom of the basin is aerated by the natural movement of air through inlets and pipes that work to break down any organic deposits and to regenerate the underlying soil's infiltration capacity.

The existing asphalt in the parking area would be removed to install the infiltration basin and replaced with an impervious pavement. Impervious pavement is preferred over pervious pavement in this application so that storm water can be directed to the filter beds for cleaning before it enters the subsurface infiltration basins.

Several considerations apply to the design and installation of subsurface infiltration basins. Existing underground utilities could raise installation costs and reduce the amount of the site's available water-holding capacity. Groundwater within five to six feet of the surface on this site is a constraint as it could lead to reduced infiltration basin volume, migration, and groundwater mounding, as well as problems concerning the overall dependability of the infiltration system. Lateral seepage into existing adjacent structures can be prevented with additional construction and expense. The potential seismic and structural behavior of the water-filled storage area should be investigated on a project-by-project basis.

The filter bed and the subsurface infiltration basin work together to treat and hold stormwater runoff from the large parking area. The filter beds allow space for sidewalks, trees and shrubs near the buildings. The plants contribute to the treatment of stormwater and the reduction of energy-use for air cooling, while providing a more attractive atmosphere for residents and neighbors.



The operation and maintenance of the subsurface infiltration basin includes the following: (1) annual inspection for clogging by flushing the inlets and pipes; and (2) vacuuming or flushing the pipes clean, as required.

Green Trellis Over Pavement

Like a tree, a vine on a trellis shades the pavement, reduces ambient air temperature, humanizes the feel of the paved area, and intercepts airborne particulates that would become runoff contaminants if they reached the ground. Vines have some additional benefits over shade trees in parking areas:

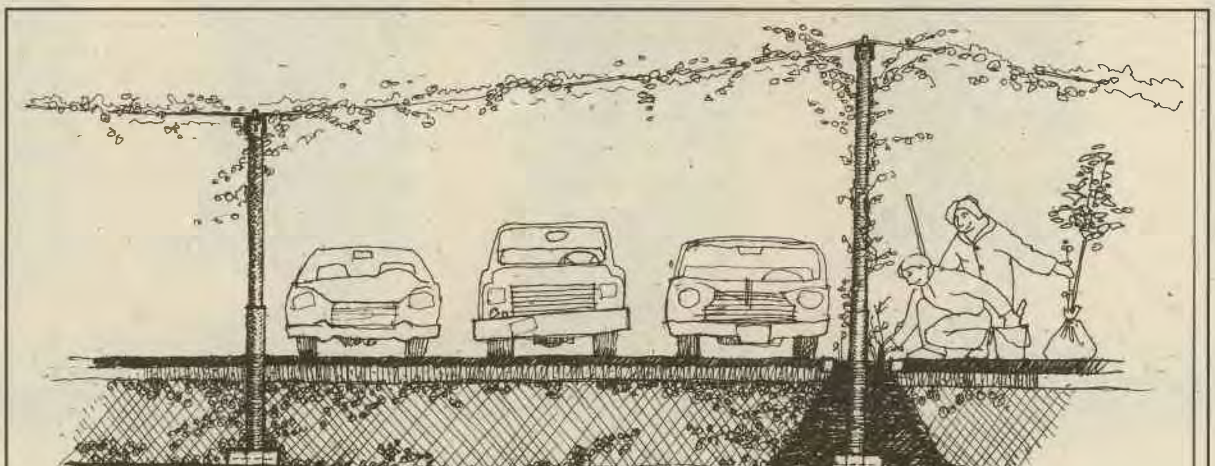
(1) they require little or no rooting soil;

(2) they grow very quickly;

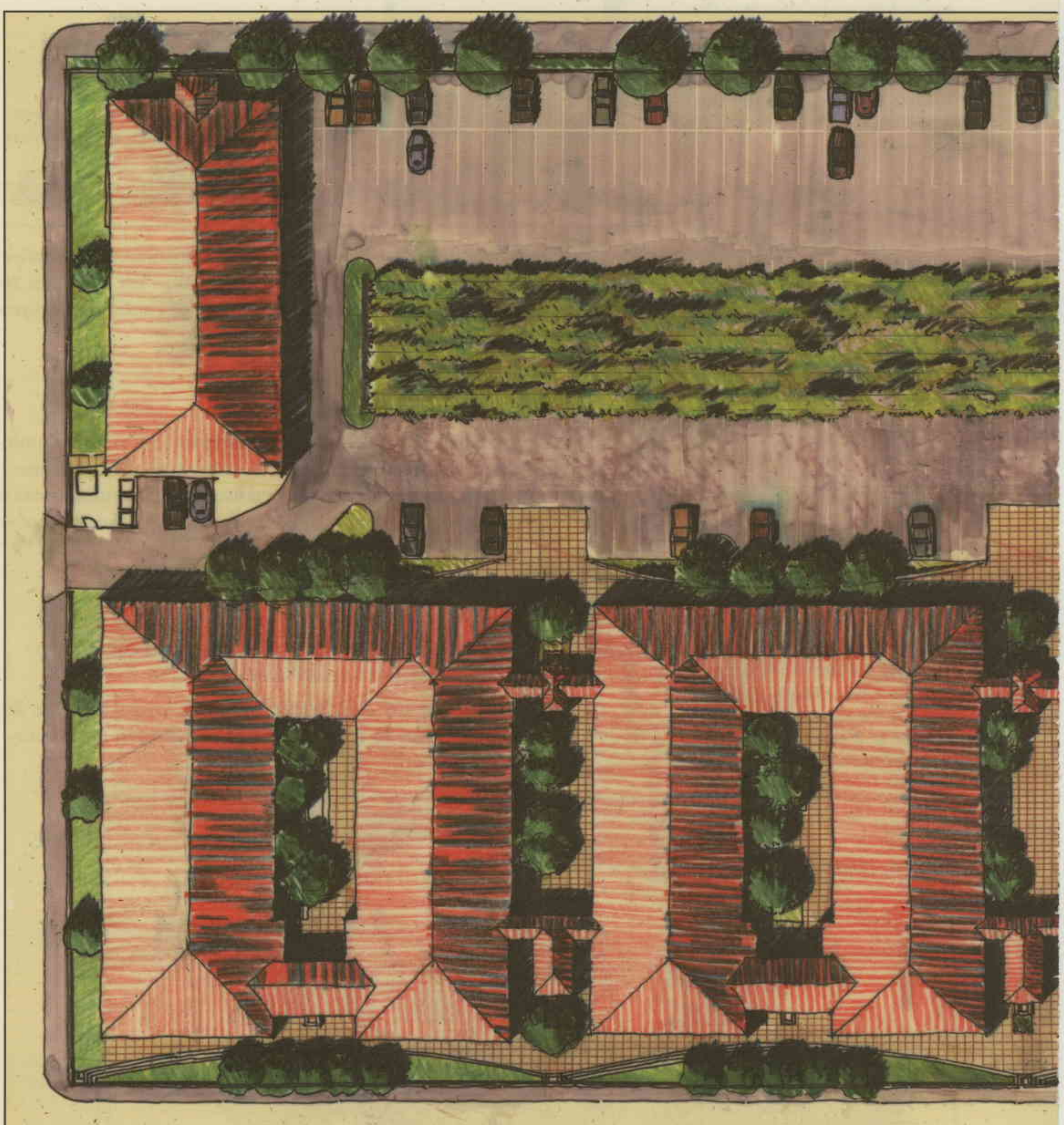
(3) their stems are narrower than tree trunks and can be supported on strong metal posts; and

(4) since they shade the cars evenly and at all hours, they are the most effective way to reduce gas fumes escaping from overheated gas tanks.

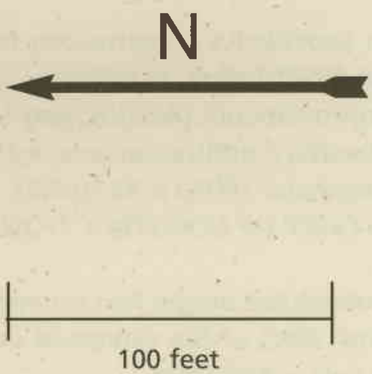
(Image below) The green trellis is economical and easy to build. A steel sleeve is set on a small footing below ground. The trellis poles slide into the sleeve. After the cables are placed between the poles, fast-growing vines are planted at the base of the poles in a bed of planting soil.



The proposed trellis shown in this plan is a pole and vinyl-clad cable with posts located at the corners of parking stalls or at the ends of parking bays. This structure is probably the strongest, most light-weight and least expensive type available. Many other designs and



The design team's site plan illustrates how the parking area can be restructured to provide space for trees, shrubs, filter beds, and a shading structure with vines. The perimeter of the property includes proposals for new vine-covered walls, areas for retention of stormwater and gray water, and strategically placed trees to provide shade and beauty. In this plan, the courtyard is planted with trees and reorganized to provide attractive seating and easily supervised play areas.



materials could serve the same purpose, given a variety of budgets and design considerations.

Maintenance requirements include the following:

1) repaint metal posts, if required; and

(2) irrigate and fertilize vines.

SUMMARY

The Harbor Vista team dramatically reduced the amount of domestic water imported to the site by re-using graywater for irrigation. The installation of low-flow shower heads and low-flush toilets, included as part of the renovation of the apartments, will further reduce the demand for imported domestic water. All rain water that falls on the site is treated within the boundary of the site in a subsurface infiltration basin located under the large parking area. Stormwater runoff channelled to the infiltration basin passes through several stages of filtering in order to prevent future clogging of the infiltration basin. Trees are strategically planted to reduce energy use and to cool the interior spaces of the apartments. Ambient air temperatures are reduced in the parking area by vines suspended on the overhead trellis and by shade trees planted at the perimeter of the parking area.

CONSTRUCTION BUDGET

The charrette team provided a construction budget for the proposed work, rounded in 1997 dollars, as follows:

All proposed site improvements, planting, graywater irrigation system, filter beds, and subsurface infiltration area = $500,000.

Construction contingencies (30%) = $150,000.

TOTAL ESTIMATED COST OF CONSTRUCTION:$750,000.

Note: Additional professional design fees for engineering and landscape architecture (allow 20%) of the estimated construction cost = $150,000. Total project cost = $900,000.

TEAM MEMBERS

Bill Wenk,
Landscape Architect
Team Facilitator
John Connell, Architect
Ira Artz, Engineer
Tom Larson, Horticulturalist
& Arborist

Landscape Architecture Graduate Students:
Craig Hooker
Brad Harris
Jason Lee

BENEFIT ANALYSIS

The following benefit analysis provides a cost value per year; per thirty years; and a total value over thirty years for remediation of the entire property. This information was provided by the charrette team in 1997 dollars.

Issue	Amount Changed	Value / year	Value / 30 years
Irrigation water use	80% reduction From 75 gal/day/dwelling unit to 15 gal/day/dwelling unit.[25]	$28,700	$861,000
Domestic water use	40% reduction From 181 gal/day/dwelling unit to 109 gal/day/dwelling unit	$34,700	$1,041,000
Flood management	30% reduction (By holding 0.84 acre feet on-site during a 133-yr. flood emergency)[26]	$3,320	$33,200
Water pollution	Capture and treat 100% of first-flush rain	$1,760	$52,800
Air pollution	Tree canopy increased from 7.5% to 29% (35 trees @ 16' canopy diameter)	$3,530	$105,900
Green waste	100% reduction All green waste recycled on-site	$10,640[27]	$319,200
Total Value of all remediation for 3.37 acre site over a thirty-year period =			$2,413,100

25. This figure is based on LAWP figures for average amount of water consumed per dwelling unit for irrigation. The actual amount of water used on this site for irrigation is unknown.
26. This charrette team exceeded the 3" minimum performance threshold for flood control by over 300%.
27. This figure based on average green waste per dwelling unit across the region. The actual amount of green waste from this site was unknown.

Public Site:

Crenshaw High School, Los Angeles, CA

PROTOTYPE

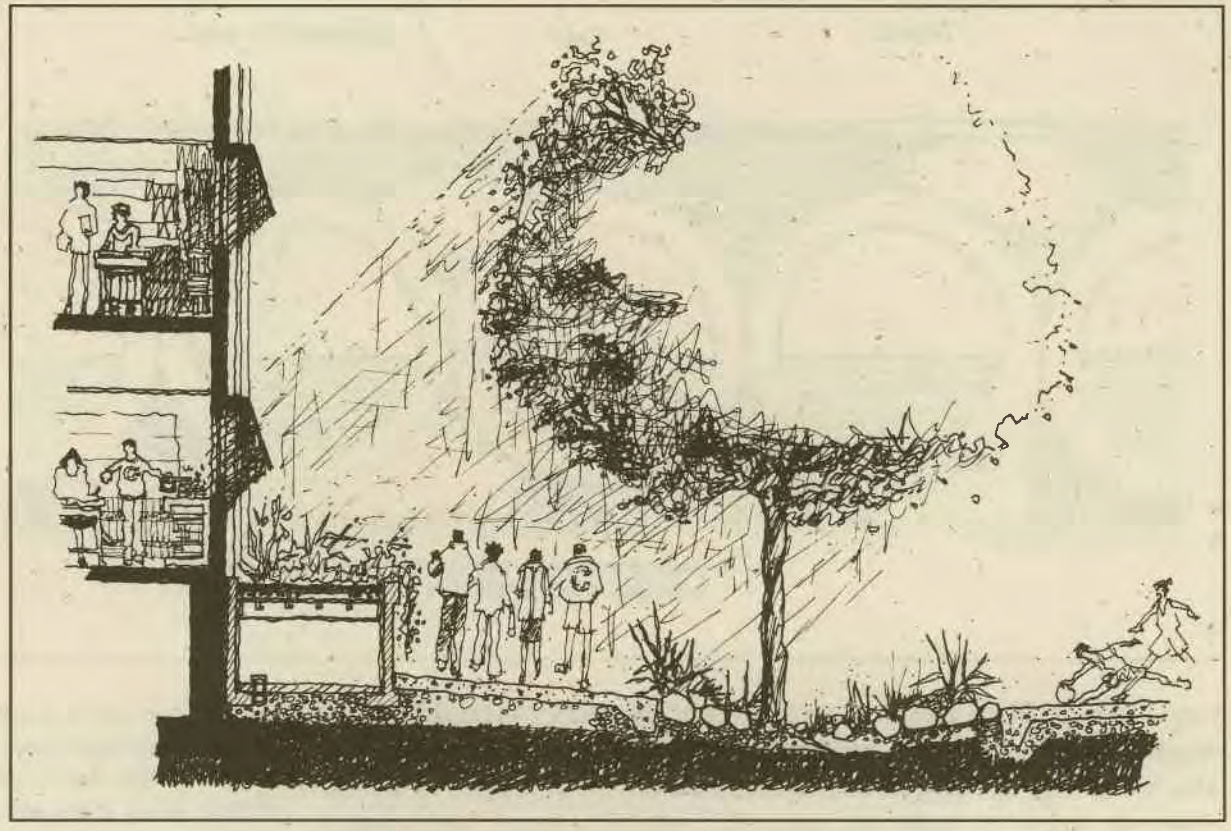
This is a typical public school site with typically high graywater discharge rates, large amounts of roof and impervious paved areas, large recreation fields that require irrigation, and soils with moderately slow percolation rates.

SITE PROFILE

Crenshaw High School is located at 5010 11th Avenue in the Crenshaw District of southwest Los Angeles, a middle-income area consisting of single-family homes built in the 1930s. The nearby commercial district on Crenshaw Boulevard is home to many small neighborhood businesses. Leimert Park, another adjacent commercial area, has been developed as a local arts and entertainment district, with coffee houses, small restaurants, and music venues.

The school currently has a student body of 2,700. Over 80% of the students are African American and 18% are Latin American. Crenshaw High School houses one of only two programs in the Los Angeles Unified School District for gifted students. The school is also known for its award-winning athletic programs and its internationally recognized choir. The highly successful and nationally acknowledged 'Food from the Hood' college scholarship program began at Crenshaw High School. The program teaches students how to run a business "from

The 25-acre Crenshaw High School site has enough capacity to slow and retain stormwater from the school property and approximately 25 acres of surrounding paved city streets.



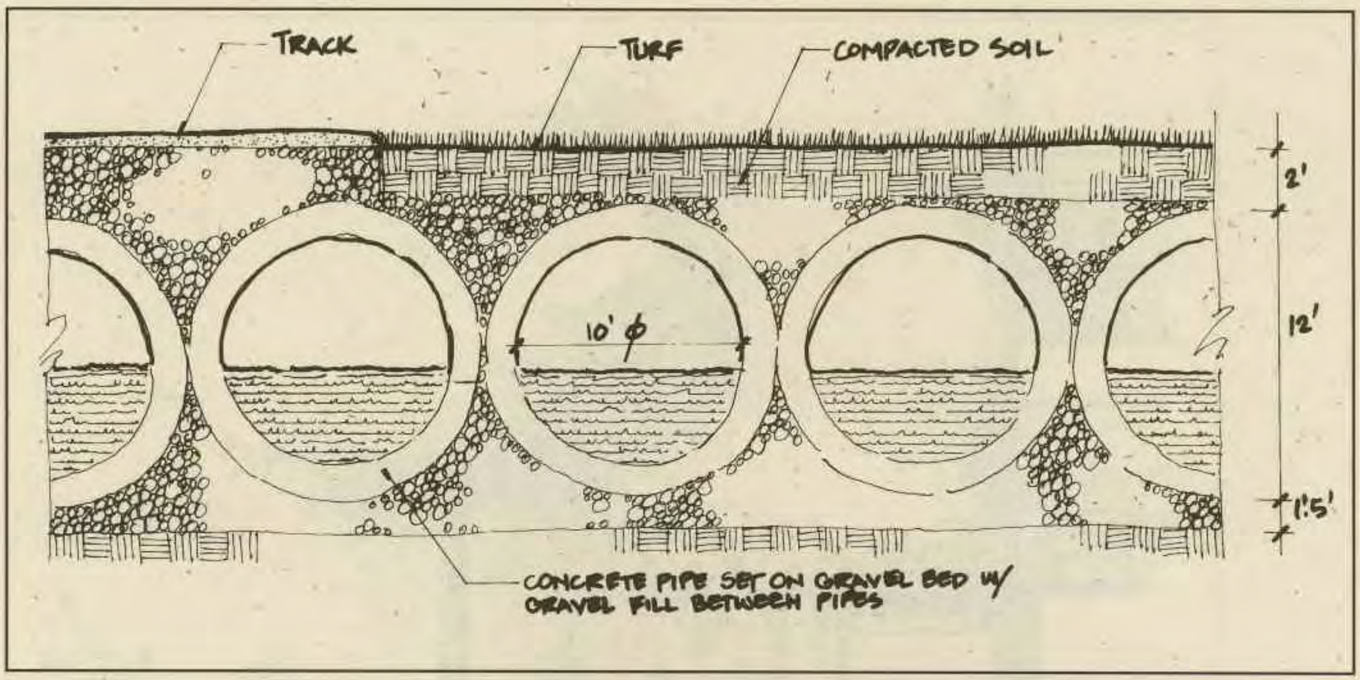
The planters located against the building walls also work as cisterns that store stormwater from the building roofs. This water can be used later for irrigating the adjoining athletic fields. The vegetated swale pictured below the shade tree provides a cool and attractive green edge between paved walkways and ball courts or parking areas. The swales also work to slow and clean stormwater as it flows off of the adjoining paved areas.

the ground up," with the proceeds from the 0.25-acre organic herb and vegetable garden being sold for profit or donated to neighborhood families.

The 25-acre site includes five separate buildings, all less than 30 years old. The remainder of the site is dedicated to athletic fields and parking. The underlying soils are of the Chino association. These soils are over 60 inches deep, are somewhat poorly drained, and have moderately slow permeability. The seasonal high water table can be within 3 to 5 feet of the surface.

SITE DESIGN PROPOSALS

Site design and remediation proposals for this site easily exceed the performance objectives set out in the TREES project (refer to the introduction section of this document). For example, there is enough land at the Crenshaw High School site to detain or slow stormwater for rains of up to 10 inches. In fact, the site has enough capacity to filter the first-flush rain (0.25 inches) that falls on it as well as on an additional 25 acres of surrounding paved streets. Stormwater falling on the site is cleaned in a variety of ways: by porous parking areas, by soil and shade trees, and by lengthy vegetated swales (discussed below). The underlying strategy of the design proposals is to reduce the amount of domestic water that is imported to the site; to re-use imported water on the site for irrigation; and—in an attractive, useful, and educational



Pre-cast concrete pipes, shown here in cross-section, are proposed to be installed beneath the school's athletic fields. These storage basins, or cisterns, can store stormwater and grey water (from the gymnasium showers) during the warm season to be used for irrigation water.

way—to hold, filter, and re-use stormwater that falls on the site and on nearby streets. All of the buildings and their uses remain unchanged. The following specific remediation measures are proposed by the charrette team in order to meet the environmental performance objectives of the TREES project. These measures can be applied to similar school sites throughout the region or they can be applied to future sites.

Roof Cisterns and Planters

Downspouts intercept all roof drainage and channel it into raised planters that are located on the ground along the face of the buildings. The planters are designed to filter and retain all roof water generated by the average local storm. Excess water is held inside the planters (below the planting soil) for later irrigation use. This simple above grade system is easy to install and can hold approximately 4 acre-feet per year of stormwater (20% of the total requirement for irrigation water per year).

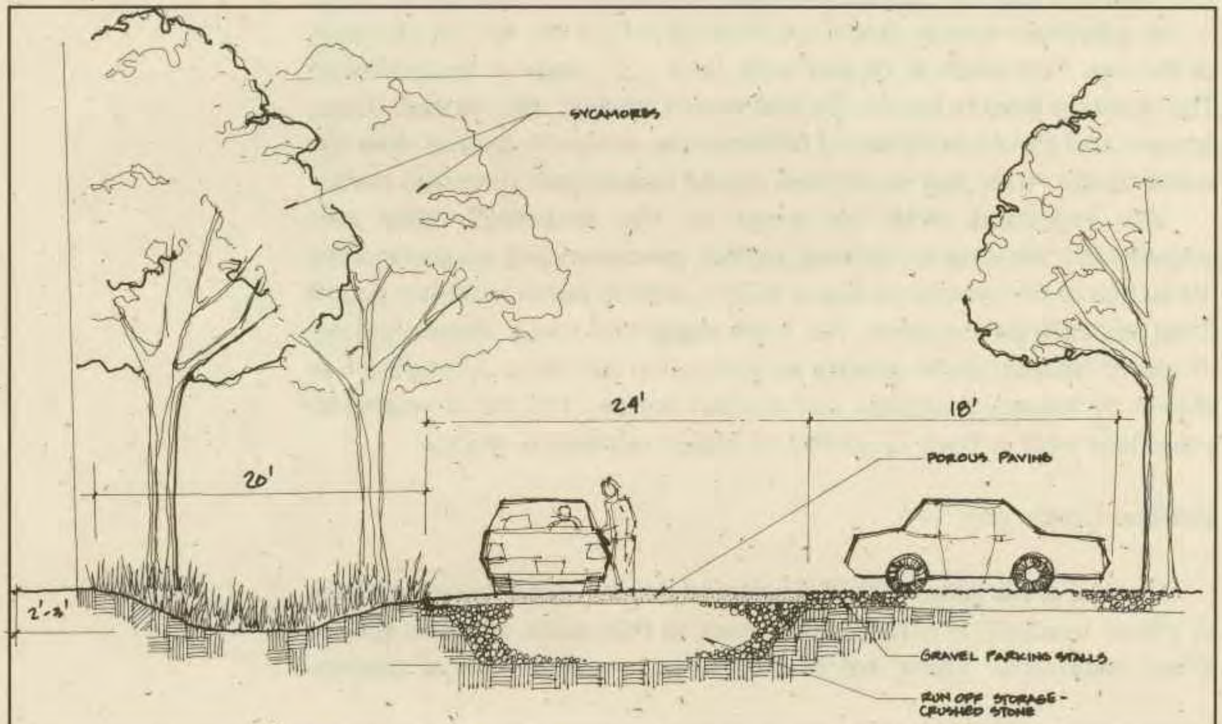
Playfield Cisterns

The design team proposed that a system of pre-cast concrete pipe storage basins, or cisterns, be located beneath the turf playfields on the Crenshaw High School site. These basins store rain water and gray-water to be used for the property's annual irrigation needs. Using local stormwater management statistics and actual annual domestic water-use figures provided by the school, the design team estimated that, using standard irrigation equipment, a combination of stormwater and recycled graywater from the gymnasium showers can be used to supply all of the 25-acre property's irrigation needs during all 12 months of the year. The team reached this conclusion after assuming that water use for showers would be decreased by 70% through the installation of low-flow shower heads which could be installed immediately. Approximately 33 acre-feet of rain water falls on the 25-acre site during an average year. Based on a water budget for the average year, the team provided playfield cisterns, with a capacity of approximately 20 acre-feet, to hold the graywater from the school for immediate re-application onto playfields (fields must be irrigated even in winter when evapotranspiration is still between 2 and 4 inches per month) and for captured stormwater that can be held for much longer periods of time. These 20 acre-feet would provide enough water to satisfy the landscape irrigation demands during the dry months.

Gym Shower Graywater System

Current domestic water use at the school is estimated to be 25 gallons per day per student. With a total of 2,700 students, the total domestic water needs are equal to 54 acre-feet per year. It is assumed that the gymnasium showers account for 50% of the domestic water use. With the installation of standard low-flow shower heads, the amount of water used in the showers would be reduced by 70%. The total amount of graywater produced by the showers and reclaimed for irrigation use is 9 acre-feet per year. Depending on the demand for irrigation water at the time of discharge, this graywater will either be used directly for irrigation or stored in the playfield cisterns for later use. Measures may be needed to prevent bacteria build-up in these

This illustration shows the basic construction of a porous parking area. The design team proposed to remove pavement from the existing parking areas and replace the hard asphalt material with crushed stone. Shade trees are shown in groves located in the crushed stone areas and along the vegetated swales.



cisterns, where water-use rates, water-storage duration, and the proportion of graywater to stormwater may vary widely.

Porous Parking Area with Shade Trees

The design team proposed converting the existing under-used parking areas into groves of large canopy trees that would delineate parking aisles and shade the surrounding area. These shade trees help to reduce ambient air temperature on the site, absorb significant amounts of carbon dioxide, and hold excess stormwater runoff. The team suggested that parking stalls slated to remain should be covered with a pervious crushed stone. The porous stone surface would allow stormwater and auto-related contaminants to be absorbed and trapped in the soils below at safe concentrations.

Vegetated Swales

Swales are shallow drainage channels that direct the flow of stormwater on the surface of the ground. Vegetated swales are planted with trees, shrubs, and grasses to help slow runoff and to filter water-borne pollution. A vegetated swale slows the flow of rain water so that it can be absorbed directly into the soil, thus reducing storm impacts. Vegetated swales filter a portion of water-borne pollution before it can contaminate water downstream, leaving grease, oil, and other potential contaminants trapped in its soil and vegetation at harmless concentrations.

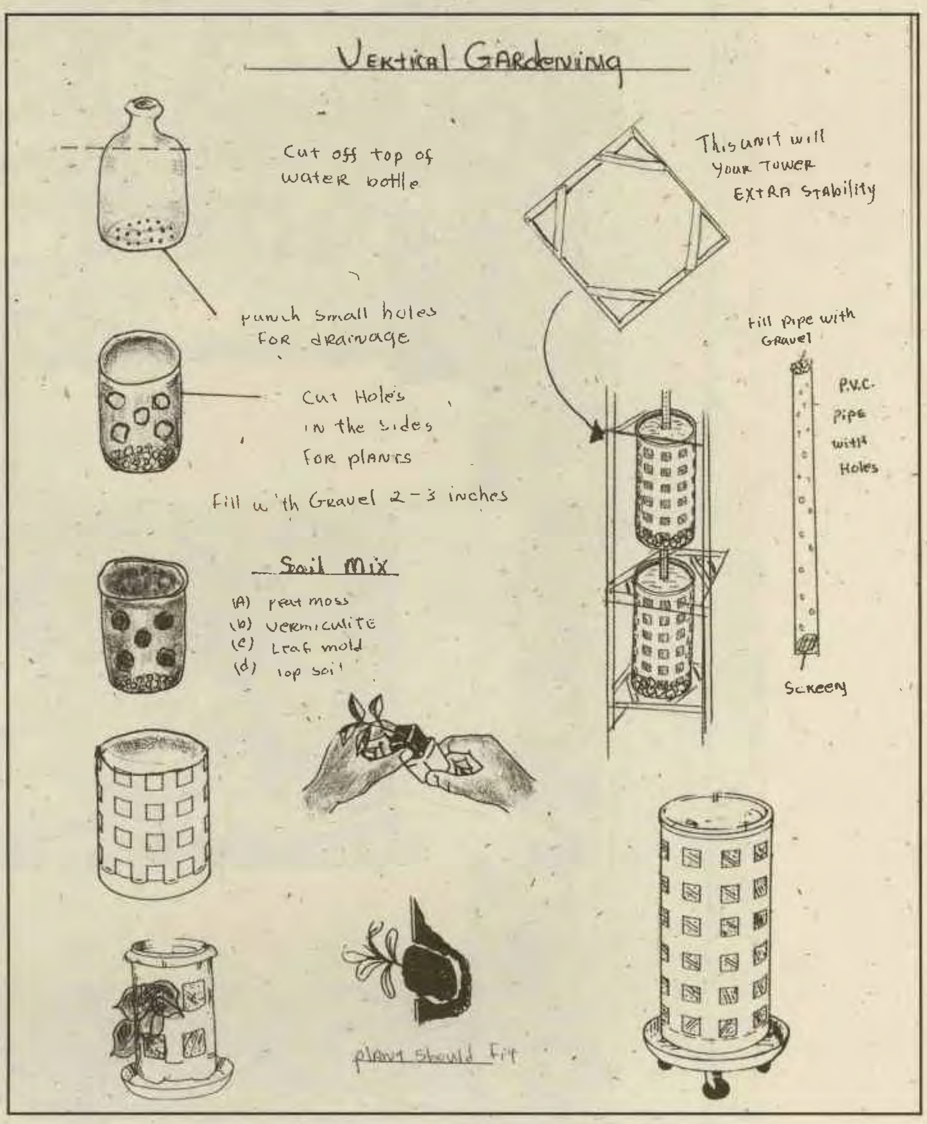
The vegetative swale by the softball field also captures and filters the first- flush rains from adjacent streets. The rain water from the softball field's terraced land area is channelled down the broad vegetative swale that cuts through the paved basketball area. This swale brings the water to the playfield cisterns under the football field at the lowest elevation of the site. This swale is 20 feet wide with a 2% slope at its centerline. The drainage path is lined with 100-pound washed river stones. Trees, grasses, and shrubs are planted between the stones to further slow the water in the swale and to increase on-site stormwater retention rates.

The vegetated swale proposed for the basketball court area requires the removal of existing asphalt pavement and approximately 30 inches of excavation so that it will be able to move and filter runoff from adjacent paved areas. The team suggested that a diverse palette of native riparian plant species be planted in the swale, including California Sycamore, wiregrass, and various sedges. The swale would be underlain with at least 12 inches of highly permeable gravel.

Vertical Gardening

Vertical gardening techniques can be used to grow large numbers of plants in small or narrow areas such as balconies, window sills, or along walkways. There are several ways to make vertical gardens

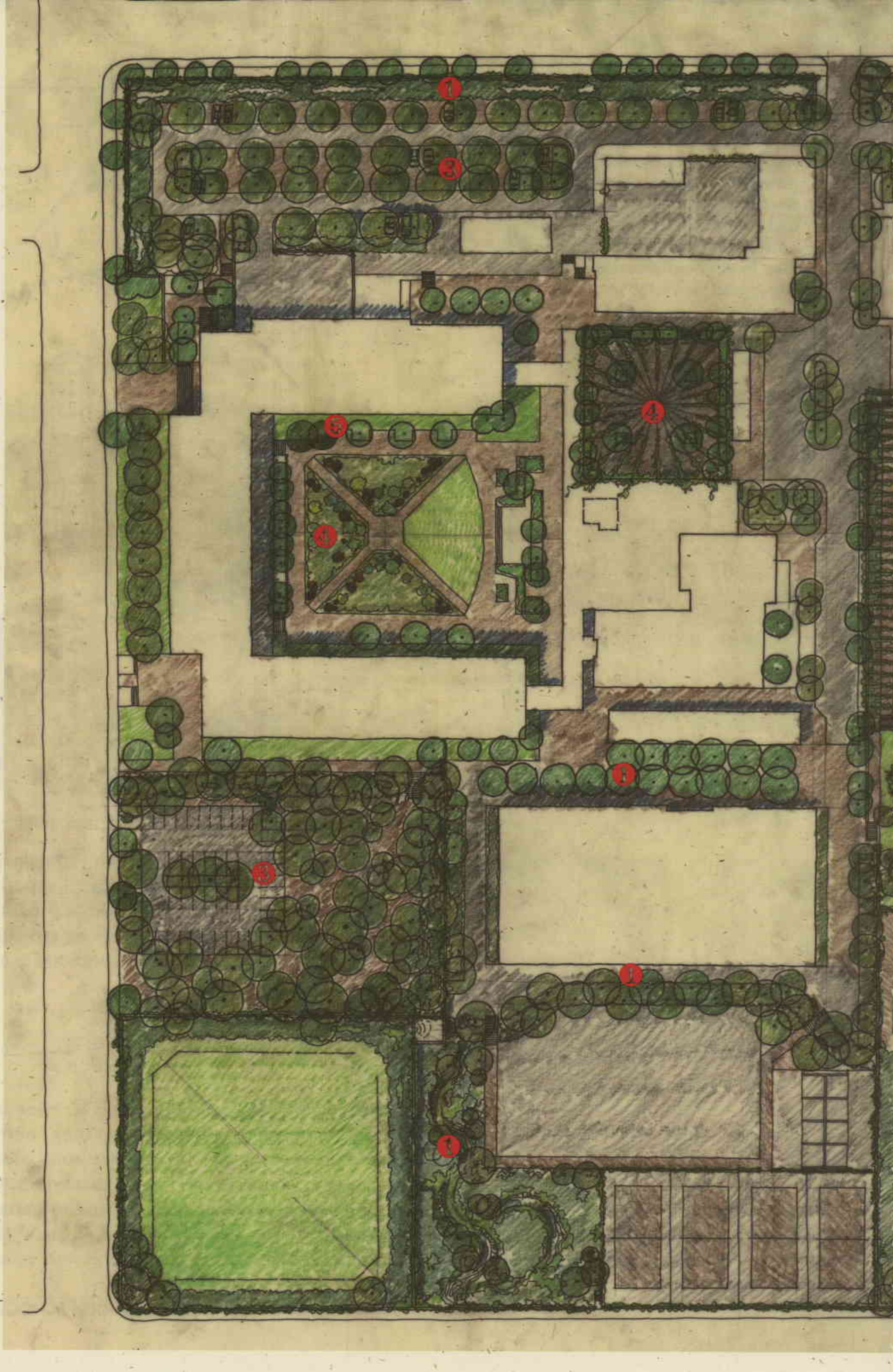
Vertical Gardening is one of many techniques that the design team suggested to be used as part of the school's popular neighborhood gardening program - "Food from the Hood". This illustration shows how 2 gallon water bottles or other plastic containers can be re-used to grow flowers and vegetables in small spaces.

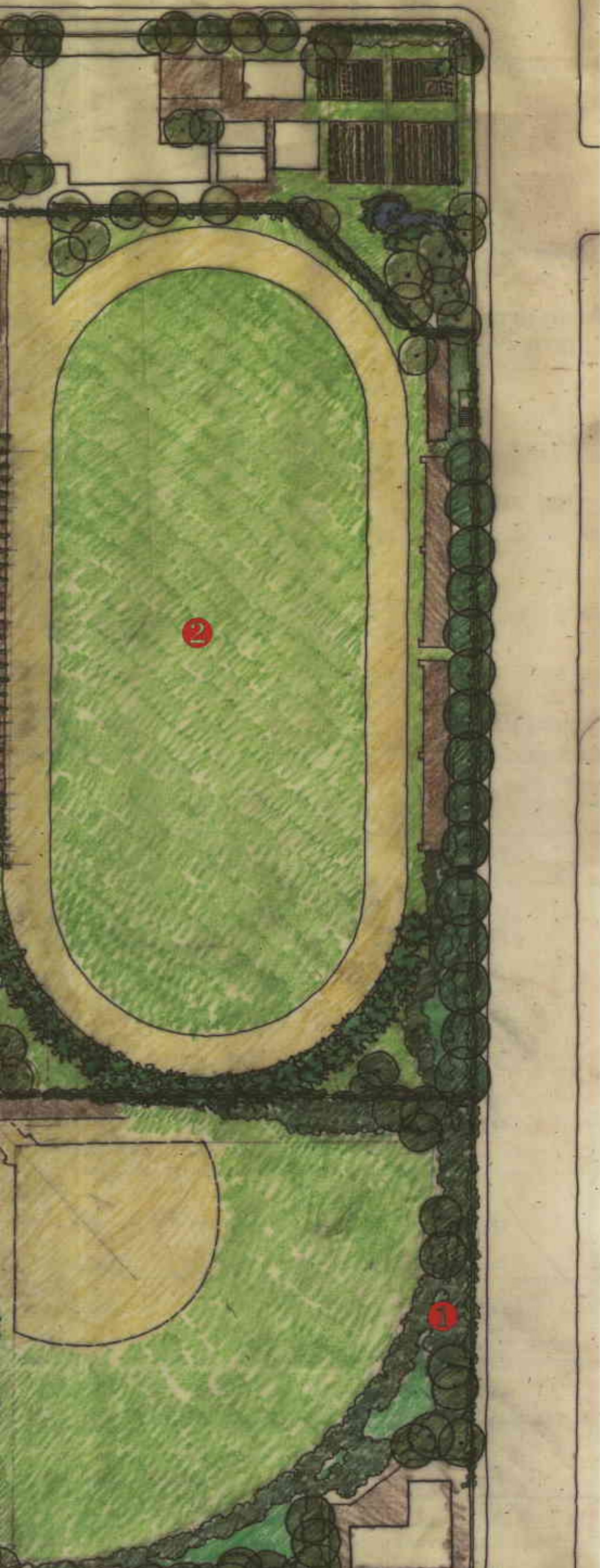


using recycled water bottles or other plastic containers. Lattice fences, balcony dividers, or simple string and net supports are other types of vertical garden structures that can help to produce food and flowers in small spaces. This is an example of one type of gardening that could become part of an expanded neighborhood gardening program at the school.

SUMMARY

School sites are located throughout our region. Presently they use more than their share of water and energy, and they contribute more than their share to the problems of flooding and solid waste disposal. This can easily change. The large open areas that typically characterize these sites provide ample opportunity for on-site water re-use and stormwater bio-remediation. In fact, as the Crenshaw High School charrette team demonstrated, we can probably use school sites to





The design team's illustrative site plan shows how the school site looks after installation of vegetated swales (1), playfield cisterns (2), and groves of shade trees planted in porous parking areas (3). In addition, spaces for outdoor classrooms and gathering spaces are shown with shade structures and drought-tolerant plantings (4). Cisterns are installed astride buildings to harvest rainwater from roofs for later use to irrigate gardens and fields (5).

improve the water quality of storm runoff from surrounding streets for little or no cost.

CONSTRUCTION BUDGET

The charette team provided a preliminary construction budget for the proposed work, rounded in 1997 dollars, as follows:

All proposed site improvements, including parking, planting, gray-water irrigation system, vegetated swales, and cisterns = $1,200,000'

Construction Contingencies (30%) = $360,000.

TOTAL ESTIMATED COST OF CONSTRUCTION: $1,600,000.

Note: Additional professional design fees for engineering and landscape architecture (allow 20% of total construction budget) = $320,000.

TEAM MEMBERS

Colin Franklin
Landscape Architect, Architect & Ecological Planner
Team Facilitator

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Landscape Architect

Hoi Luc, Architect

Kate Diamond, Architect

Michael Drennan, Engineer

Bernadette Cozart,
Horticulturalist

Landscape Architecture Graduate Students:
Chris Padick
Jerry Taylor
Miranda Maupin

BENEFIT ANALYSIS

The following benefit analysis provides a cost value per year, per thirty years, and a total value over thirty years for remediation of the entire property. This information is provided in 1997 dollars.

Issue	Amount Changed	Value / year	Value / 30 years
Irrigation water use	100% reduction (from 108 acre-feet/year to 0)	$353,300	$10,600,000
Domestic water use	40% reduction (from 54 acre-feet/year to 32 acre-feet/year)	$70,000	$2,100,000
Flood management	100% reduction (from 21 acre-feet to 0 during a 133-year flood emergency)[28]	$88,250	$2,647,500
Water pollution	200% reduction (All average annual rainfall is treated on-site)[29]	$26,600	$798,000
Air pollution	300 shade trees and vines on trellises	$1,058	$468,000
Green waste	100% reduction	$7,000	$210,000
Total value of all remediation measures over a thirty-year period =			$16,823,500

28. This charette team exceeded the 3" minimum performance threshold for flood control by over 300%.
29. This 200% reduction is a consequence of cleaning water from surrounding streets as well as school property.

Commercial Site:

Jiffy Lube and Convenience Commercial Area at Pico Boulevard and 24th Street, Santa Monica, CA

A view of the convenience shopping area and parking lot at 24th Street and Pico Boulevard in Santa Monica. The Jiffy Lube is located on the adjoining property.

PROTOTYPE

This is a typical commercial site, with one-story buildings and paved parking areas facing a main arterial street. Over 90% of the site area is pavement and roof surface.

SITE PROFILE

The commercial site is located on Pico Boulevard, a major east-west arterial. The project area includes two separate parcels and extends the full width of the block between 24th Street and Cloverfield Boulevard in Santa Monica, a middle- to upper-income city in Los Angeles County. The site includes a convenience commercial building with three small businesses and, on the adjacent parcel, a Jiffy Lube automotive oil-changing service. Commercial buildings line Pico Boulevard, but the neighborhood around this heavily developed commercial area consists of well-maintained, single-family homes and several schools. The underlying soils on this site are of the Hanford association and are over 60 inches deep, well drained, and have moderately rapid subsoil permeability.

In total, the charrette site is 24,133 square feet, or 0.55 acres. The Jiffy Lube parcel is 14,758 square feet with the building covering 24%

of the site area and the parking lot covering 64%. A landscaped boulevard accounts for 12% of the Jiffy Lube parcel area. The convenience commercial parcel consists of approximately 9,375 square feet. The buildings cover 37% of the parcel, the parking lot has twenty-two stalls and covers 53%, while sidewalks and other paved areas (such as the rear driveway for deliveries and trash collection) cover 3%, and landscaping accounts for 7% of the total parcel area. An alley separates the convenience commercial property and the Jiffy Lube from the neighboring residences.

In summary, 61% of the site is covered in pavement, 29% is covered by buildings, and 10% is planted with traditional landscape materials.

SITE DESIGN PROPOSALS

Taking advantage of the permeable subsoils on this site, the underlying strategy of the design and management proposals is as follows: to make the site surfaces more permeable in order to facilitate water infiltration and to enhance flood control; to reduce the requirement for irrigation water by installing drought-tolerant plants; to capture, store, and re-use the rain water that falls on the site as irrigation water; to capture and remove pollutants from the stormwater runoff; to reduce energy consumption by decreasing the need for air-conditioning; and to maximize the use of trees and plant cover for aesthetic purposes, energy conservation, and to help reduce air and water pollution.

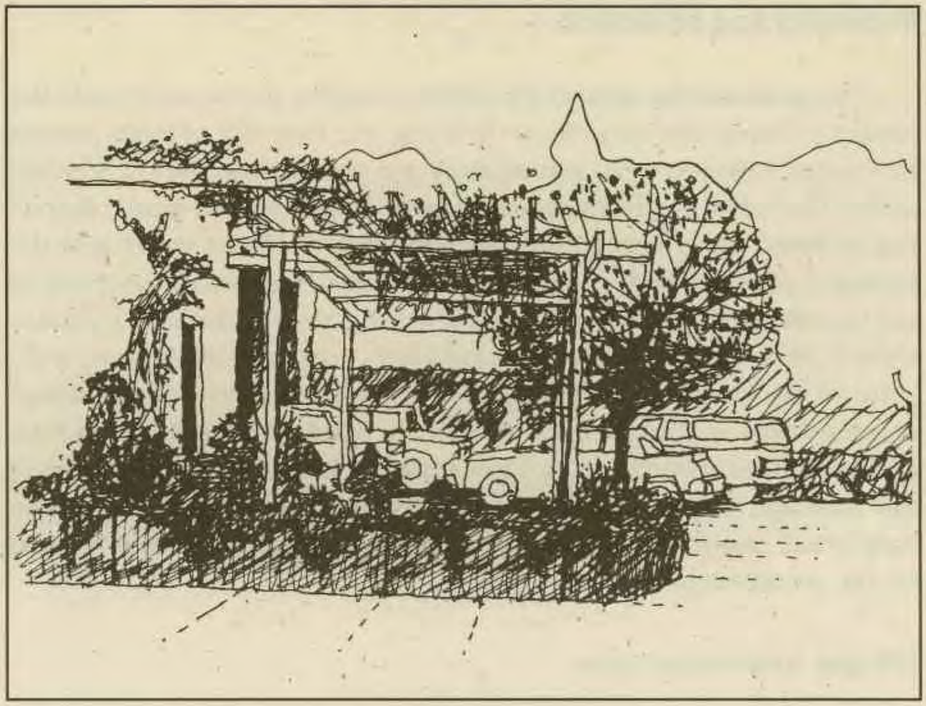
Increasing Shade

The commercial site design proposes a total of fifteen new shade trees for the site. These large trees are strategically located to shade buildings and pavement. Creeping fig vines are trained to grow on existing masonry walls and up the sides of the proposed stormwater storage tanks. The vine-covered walls help to cool the building interiors. The team provides arbors and trellises for the building walls as well as for above the patio areas near the entrances to the Jiffy Lube and the commercial building. The increased shade for parked cars reduces the amount of volatile organic compounds emitted by petroleum products in gasoline and in plastics around overheated vehicles. Increased tree cover and vegetation also helps to create a more inviting and comfortable environment for patrons.

Underground Cisterns

There are two existing underground storage tanks located at the Jiffy Lube site. The tanks have a total capacity of 15,000 gallons. They are presently used to intercept possible petroleum-based chemical

This sketch shows how some existing pavement areas can be modified to provide shade for cars and customers. Shade trees are proposed along public sidewalks and parking areas. An overhead trellis with vines provides protection from the sun and creates a protected space for customers who are waiting for their cars to be serviced. New vines are also shown covering existing concrete-block walls.



spills. These tanks could easily be adapted so that the rain water they normally capture could later be used for site irrigation. When full, these tanks overflow into the existing municipal storm drainage system. On the hundreds of other similarly equipped car-oriented commercial sites located in the Los Angeles River watershed, tanks like these could be adapted to release stored rain water in the event of a flood warning. With the release of the water already stored in the tank, additional storage space would be freed up to intercept 15,000 gallons of stormwater per site, on average, during a flood emergency.

Roof Water Cisterns

At the Jiffy Lube, a portion of the roof runoff will be diverted into an existing raised planter located in the alley. It will be converted to catch and temporarily retain 800 cubic feet of rain water. Roof runoff from the convenience commercial building will be directed through modified down-spouts into large concrete holding tanks located at the 24th Street entrance to the parking lot and in front of the building. The tanks are made of used concrete pipes salvaged through the Cal-Max Program and are designed to hold over 100% of projected flood period roof runoff. This water will be stored and used for drip irrigation during the dry season.

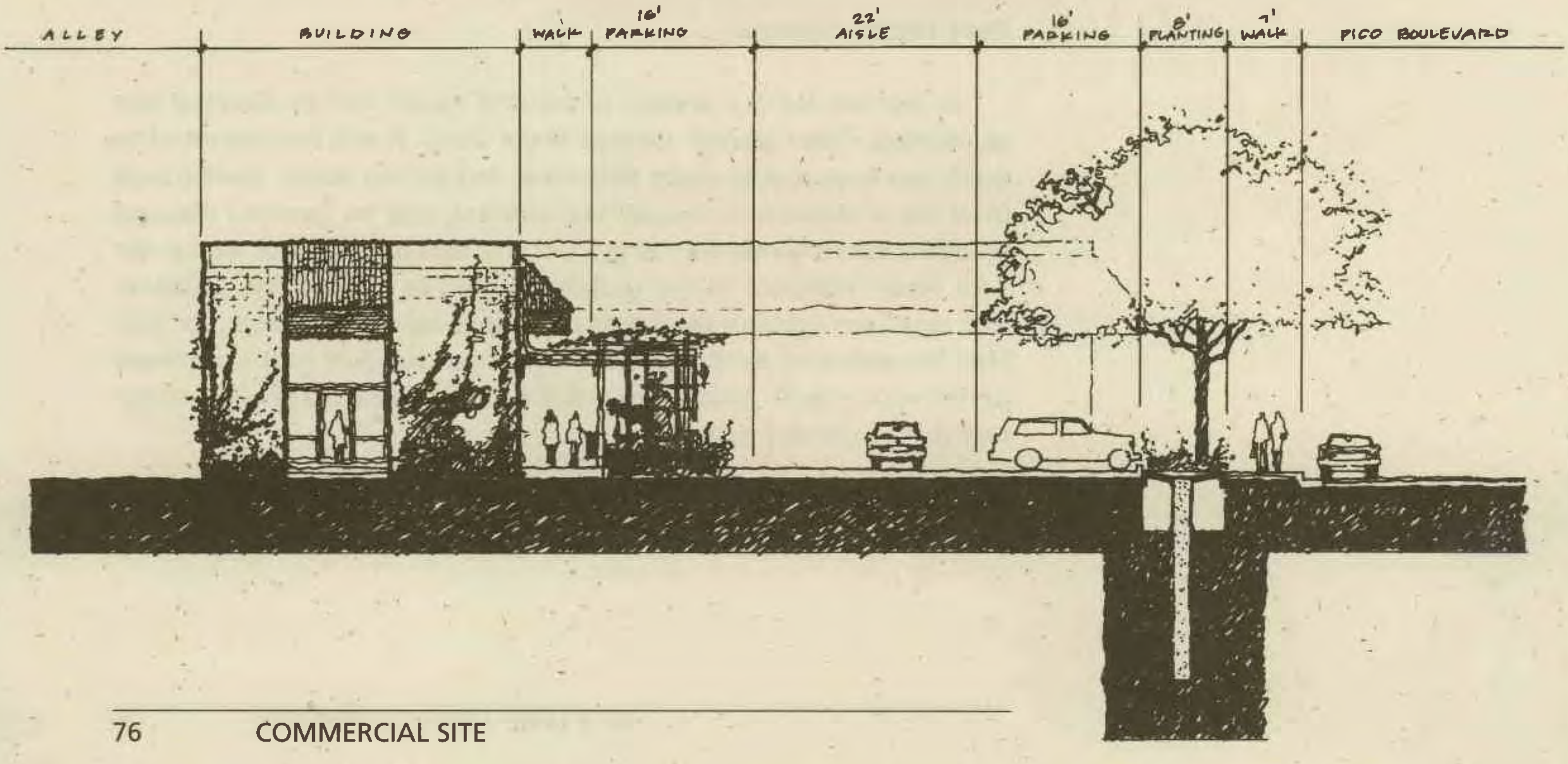
Regrading and Infiltration

The grades in the enlarged planted areas that are located inside the property line at the city sidewalk along the frontage of both parcels have been lowered to accept stormwater runoff from the site's paved areas. The team proposes drainage flow deflectors and minor regrading of paved areas, where necessary, in order to direct water into the enlarged planting beds. On the convenience commercial portion of the site, the team provides a constructed dry stream bed in the planter areas to slow surface drainage and to allow water to soak into the rootzone of the plants and into deep drainage chimneys.. The drainage chimneys are vertical pipe stands that are filled with fast-draining rock and sand filter material. The filter material is installed at the inlet of the drainage chimneys and is inoculated with bio-remedial agents to help break down petroleum by-products and other pollutants carried by the stormwater.

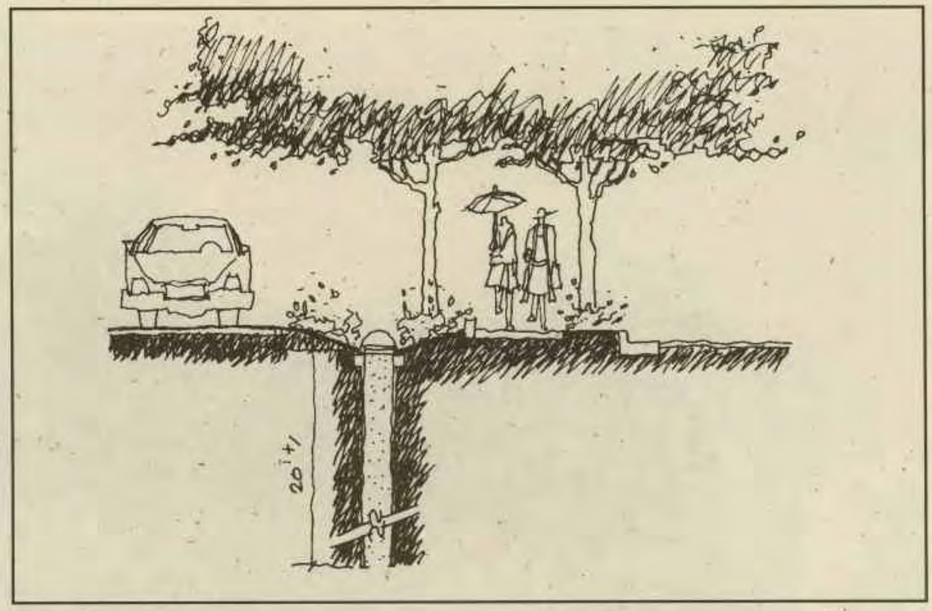
Off-Site Infiltration Zone

The team included a permeable paved area at the south edge of 24th Street, directly under an existing parking space. This infiltration zone consists of four subsurface drainage chimneys covered with a permeable paved area. The permeable paved area filters the first-flush rain water and prevents it from clogging the chimneys. In the event of a flood, this system serves as an overflow for the recessed planters at the site property line. The infiltration zone will also accept stormwater from the street. This drainage structure can easily be built into other city streets, where soil conditions permit.

This detailed cross-section illustrates the design team's proposals for roof water cisterns, enlarged planting areas and subsurface drainage chimneys. The roof water cisterns are shown close to the building and are contained within a vine-covered trellis structure. The trellis also holds the drain pipe that extends outside of the building wall, from the roof, over the walkway and into the cistern, providing a shading structure and a conduit for a 6" drain pipe. The enlarged planting area is located inside the property-line and next to the existing city sidewalk. This area provides space for shade trees, low drought-tolerant plants and a drainage chimney. The drainage chimney is designed to return storm drainage into the existing sub-soils.



This illustration shows a closer view of the proposed green strip that runs along the city streets. Drought-tolerant plants and large trees located in the green strips provide low maintenance shade and beauty.



Green Roofs

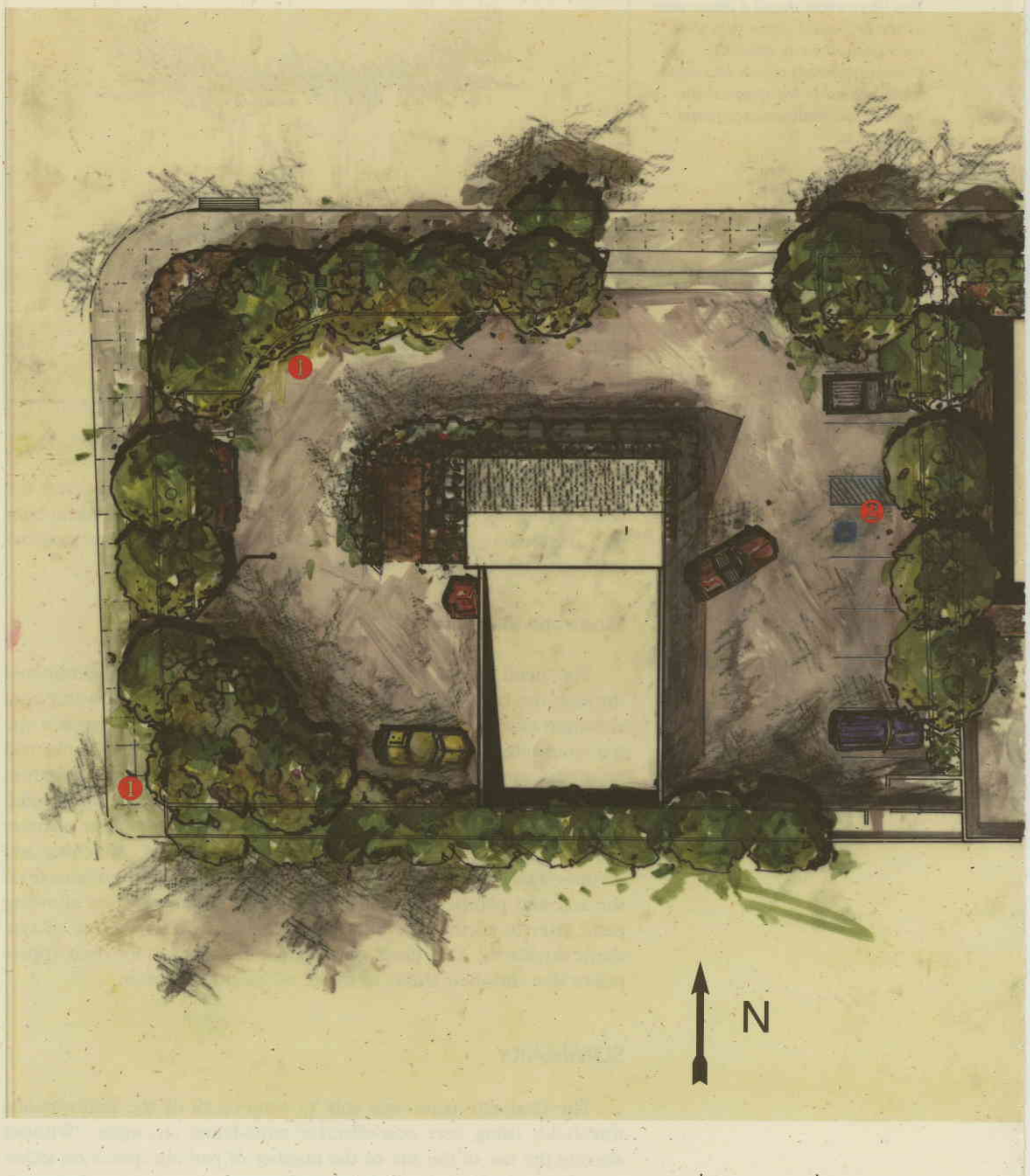
The roof and sheathing has been removed from the area over the patio outside the meat market. This simple renovation will admit light into the building, improve air circulation, provide a place to grow vines, and create a more pleasant outdoor space for tables.

Landscape Management

The need to import water for irrigation has been eliminated through the installation of storm-water storage tanks and water conservation measures. Through the use of an efficient drip irrigation system controlled by a rain sensor, the water from the storage tanks will be used for irrigating the plant beds during the dry season. Irrigation requirements on the site will be reduced through the use of drought-tolerant plants arranged by hydrazone in swaled catchment planters that will directly receive available stormwater runoff. Mulching and increased tree shade will greatly reduce evapo-transpiration rates from the soil and plants. Nutrients will be kept on the site by allowing plant litter to accumulate in the beds, rather than by the use of synthetic fertilizers. Also, plant varieties will be selected for their appropriate size and their ability to thrive without fertilization.

SUMMARY

The charrette team was able to achieve all of the performance thresholds using very cost-effective remodeling strategies. Without altering the use of the site or the number of parking spaces on either parcel, paved areas were reduced and stormwater was stored, re-used,


N
20 feet

The design team's illustrative site plan shows the location of the various BMPs. They include increasing shade (1), underground cisterns (2), roof water cisterns (3), infiltration chimneys (4), off-site infiltration zone (5), and green roofs (6).

and returned to the subsoil. The team proposed cleaning stormwater with such simple and cost-effective management practices as, re-using green waste as mulch for plant beds in order to hold irrigation water in the soil for longer periods of time. In addition, placing simple shading structures and vines on the existing buildings is very cost-effective and helps to create cooler and more attractive auto-oriented businesses.

TEAM MEMBERS

Greg McPherson, Landscape Architect & Forester *Team Facilitator*
Owen Dell, Landscape Architect
Jack Irish, Landscape Architect & Architect
Alan Cavacas, Engineer

Landscape Architecture Graduate Students:
Brad Emarine
Laura Welts
Ints Luters
Ken Walden

CONSTRUCTION BUDGET

The charette team provided a construction budget for the proposed work, rounded in 1997 dollars, as follows:

All proposed site improvements, planting, stormwater irrigation system, filter beds, subsurface infiltration areas = $70,000.

Construction Contingencies (30%) = $20,000.

TOTAL ESTIMATED COST OF CONSTRUCTION: $90,000.

Note: Professional design fees for engineering and landscape architecture will be required (allow 20%) = $20,000.

BENEFIT ANALYSIS

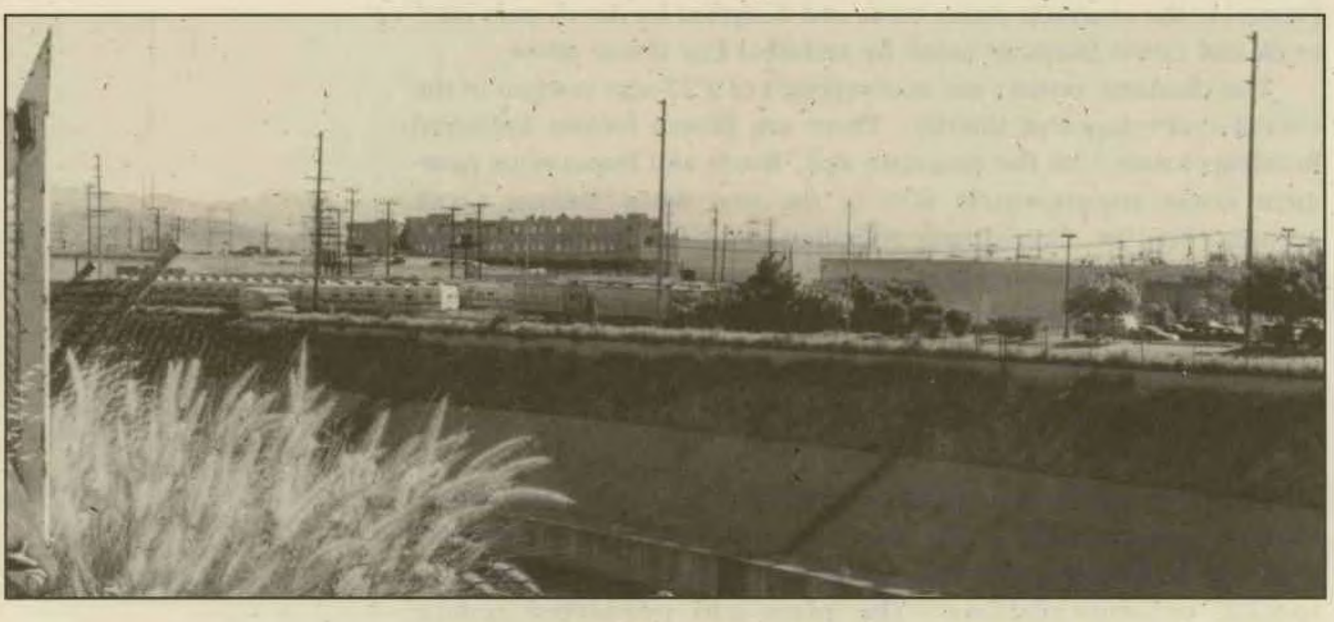
The following benefit analysis provides a cost value per year; per 30 years; and a total value over thirty years for remediation of the entire property. This information was provided by the charrette team in 1997 dollars.

Issue	Amount Changed	Value / year	Value / 30 years
Irrigation water use	100% reduction From 653 gal./day to 0	$2,383	$71,490
Domestic water use	20% reduction From 969 gal/day to 775 gal/day	$708	$21,240
Flood management	100% reduction From 0.4 acre-feet to 0 (during 133-year flood emergency)[30]	$1,800	$18,000
Water pollution	Capture and treat 503 cu. ft. of on-site water and 322 cu. ft. of off-site water	$270	$8,100
Air pollution	Strategic shade from trees and vines	$1,269	$38,070
Green waste	100% reduction All green waste recycled on-site	$324	$9,720
	Total value of all remediation for 0.54 acre site over a thirty-year period	=	$166,620

30. This charrette team exceeded the 3" minimum performance threshold for flood control by over 300%.

Industrial Site:

Conjunctive Points, Culver City & Los Angeles, CA



The design team's plans and prototypes reduce stormwater run-off and heat gain, repair damaged plant and wildlife communities, and enhance the local urban community.

PROTOTYPE

This is a typical light industrial area that is currently being redeveloped as a technology and arts district. The existing site has a 95 to 100% stormwater runoff rate and very high heat gain due to extensive paved and roofed areas (98.5% of the total site area)

SITE PROFILE

The Conjunctive Points site is located at the intersection of Jefferson Boulevard and National Boulevard. The site sits at the juncture of Culver City, a thriving middle-class community, and south-central Los Angeles, an under-served area. The site location is convenient to the 10 and 405 freeways, downtown, Hollywood, Century City, Santa Monica, LA Airport, and the South Bay. A bikeway extends from the beach to the site, and a greenway is being constructed along an abandoned railway located at its edge. Ballona Creek, a major flood control channel draining approximately 70,000 acres into Santa Monica Bay, runs through the west edge of the site.

The Conjunctive Points project will rebuild this under-used industrial area so as to unite the arts, science, and entertainment industries in a visionary mixed-use community of innovative work-space, theaters, exhibit spaces, restaurants, and parks. The existing buildings range in age (1920s to 1990s) and size. Presently, a total of 360,000 square feet of building space has been redeveloped for private use. Several thousand more square feet are currently on the drawing board. An example of the type of future development that can be expected in the district is the award-winning new business center located in the charrette project area and designed for developers Frederick and Laurie Samitaur Smith by architect Eric Owen Moss.

The charrette project site is comprised of a 27-acre portion of the overall redevelopment district. There are fifteen former industrial buildings located on the charrette site. Roofs and impervious pavement cover approximately 80% of the site, while Ballona Creek accounts for 19%. Green space is limited to around 1% of the project area, although a small city park and school are located directly to the northwest of the charrette site.

SITE DESIGN PROPOSALS

Since this site is in the midst of dramatic change, aspects of which are quite unpredictable at this time, the design team opted to provide generally applicable plans and prototypes, rather than detailed site-specific recommendations. The plans and prototypes reduce stormwater runoff and heat gain, repair damaged plant and wildlife communities, and enhance the local urban community. The plan works with the existing buildings but also anticipates major changes to the site, as is illustrated in the Conjunctive Points master plan.

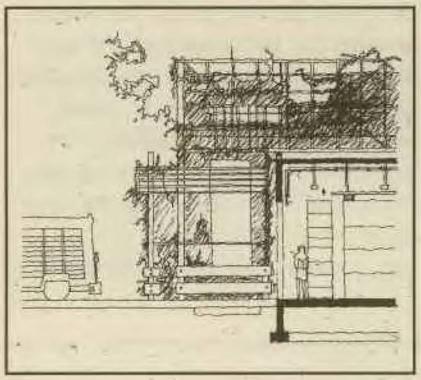
The charrette plan is based on the existing site and building locations with reference to the current Conjunctive Points masterplan for the Culver City site. Minor modifications to the proposed density and site organization include the addition of approximately 90,000 square feet of warehouse, light manufacturing, and residential uses along Corbett Street. The following specific recommendations could be applied to other industrial sites in the Los Angeles-area as well as to the Conjunctive Points site.

Green Planning

The charrette team made several overall planning and redevelopment proposals:

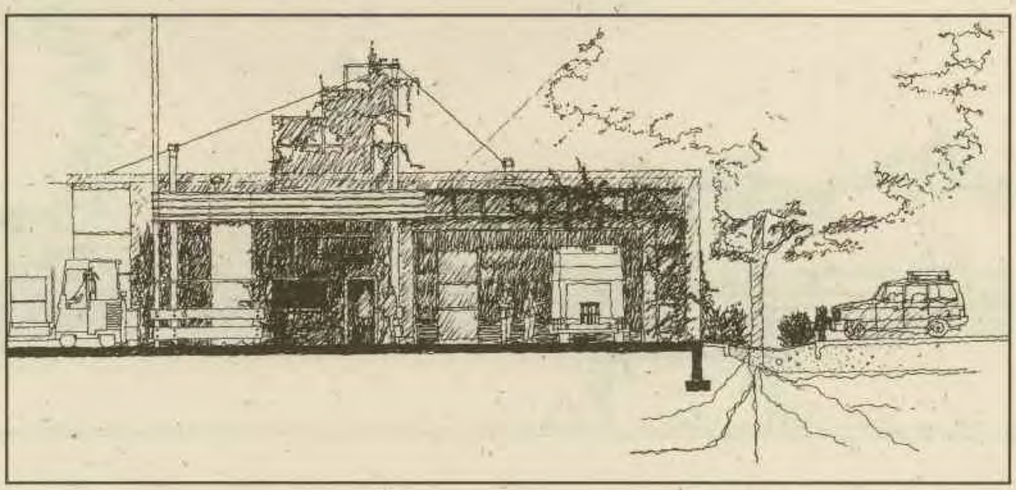
- Assuming that the developer's desire to drastically reduce automobile dependence at this site is achieved, a much higher percentage of the land presently dedicated to car storage will be available for permeable surfaces (e.g. vegetated areas, permeable pavements for pedestrians and occasional emergency vehicle use, ponds and wetlands, and parks and open spaces). Service and emergency access will need to be carefully planned in order to avoid the piecemeal development of paved access areas, which would result in the eventual addition of unnecessary paved areas over time.

- Each new or renovated building could include planters on building roofs, walls, and balconies. These planters will use and absorb rain water.
- New pedestrian paths should be carefully planned, using information about pedestrian use patterns to determine the most efficient locations for future paved walkways. This will help to limit unnecessary pavement.
- Whenever it is possible, the development of adjacent parcels should be coordinated. This would create opportunities for shared storage areas for stormwater collection and re-use, shared composting and other maintenance practices, shared resources and amenities, and 24-hour access to community facilities.
- The existing railroad right-of-way could be used as a green pedestrian spine to connect the different activities on the site. Architectural elements already proposed there could easily be adapted to perform in an ecologically sound manner.
- Many outdoor elements on this site should be designed to reveal and explain its ecological function



Cistern Walls

The design team located storage tanks for holding roof drainage adjacent to building exteriors. Above grade tanks such as these are less expensive to install and repair than are below grade tanks. The tanks, or cisterns, could either be installed immediately or phased in along with future renovations to existing mechanical and plumbing systems. The tanks may be located along the south or west building face to provide some shade, although care must be taken not to pre-



These drawings illustrate how cistern walls might look against an existing one-storey concrete block warehouse building. In these sketches the cisterns and buildings are also shaded with vine-covered trellis structures and shade trees.

vent access to daylight or to render interior spaces less livable due to obstructed views. The team suggested that tanks like these are capable of collecting and re-using 100% of the stormwater that is now drained off existing flat roof areas. The water may be suitable for site irrigation or, after some treatment, for domestic use (depending on the quality of the rain water).

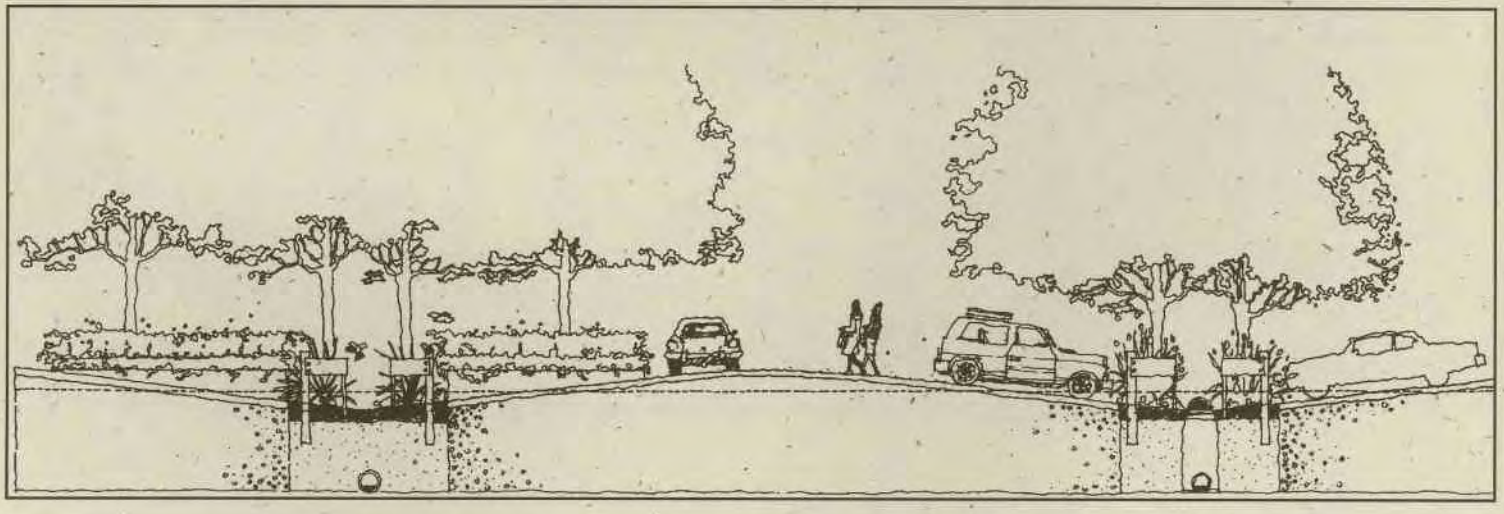
Green Screens

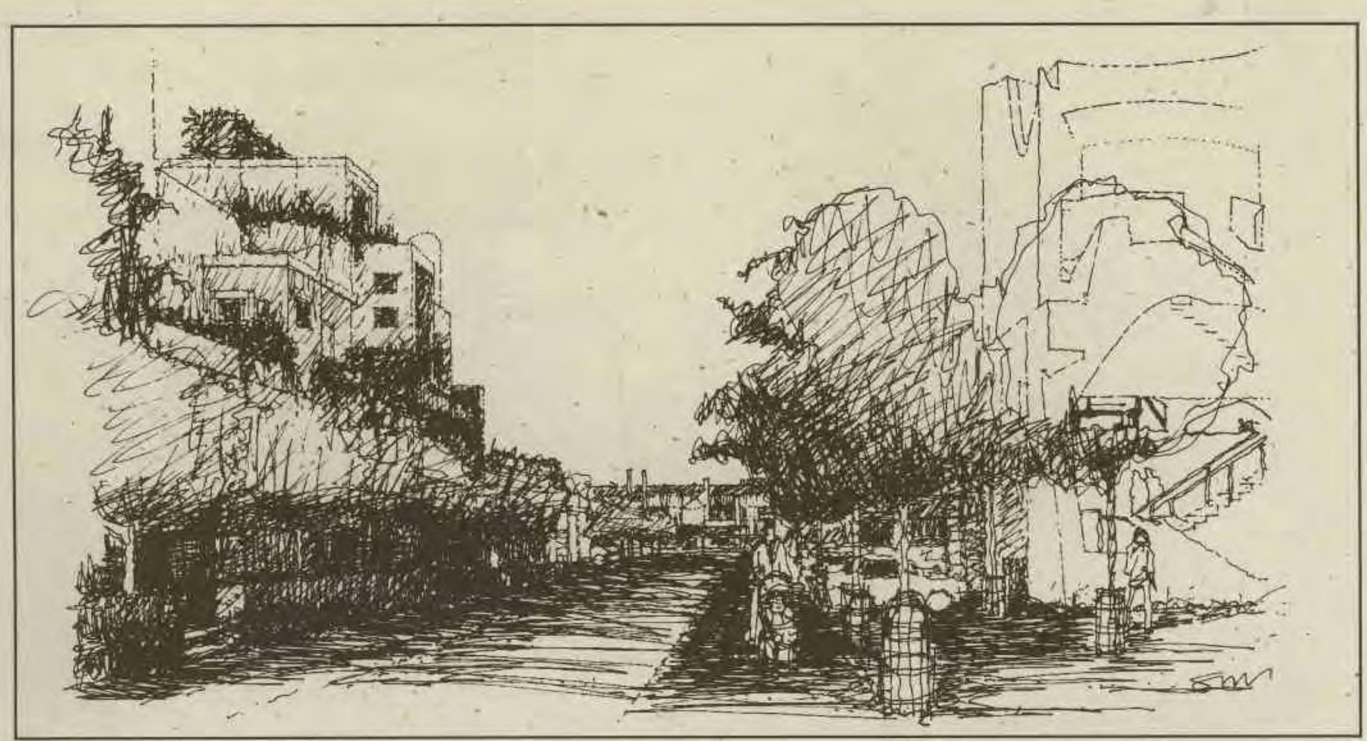
The team proposed installing green screens, or narrow strips of trees or vines on trellises that are fixed to building walls and roofs, to provide shade and to reduce heat gain around the building. Stormwater runoff from surrounding streets and paved sidewalks can be channelled directly into narrow planting areas alongside the building walls where the green screens are rooted. A secondary mechanical irrigation system of soaker hoses monitored by rain sensors will irrigate these areas during dry periods.

Green Creeks

The team proposed to modify the existing flood-control channel on the site in order to increase flood control capacity and to provide a recreation space close to water. They suggested that, if this approach were to be followed throughout the region, then flood storage capacity would be significantly increased and recreational access to freshwater amenities would be found closer to neighborhoods. In some instances, it may be possible to create wildlife areas that are contiguous with the city's existing and future green corridors. The goal of these types of "green link" projects is to establish a new urban landscape that will provide a clean and more balanced environment for both people and animals.

This cross-section view shows the layout of a standard paved parking lot with 12' wide islands located between parking bays. The islands extend the full-length of the parking bay and include a bio-filtration system, drought-tolerant plants, and shade trees. In addition, the conventionally paved parking area is graded to provide long channels that are designed to detain stormwater during a flood event.





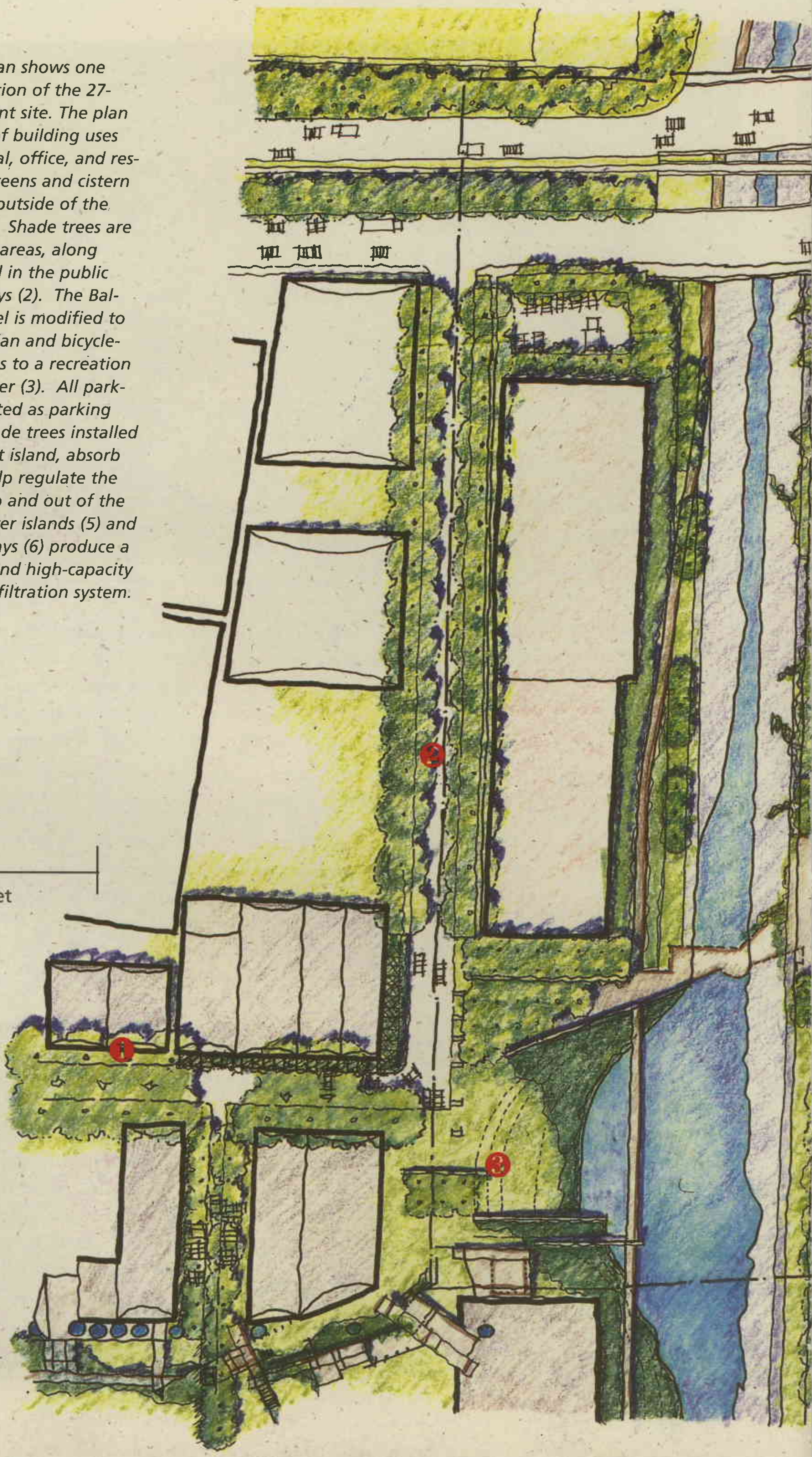
This view on Corbett Street looking toward Ballona Creek illustrates a mixture of land uses and activities. Permeable pavements such as crushed stone allow shade trees to be planted close to automobiles and pedestrians. A bicycle and pedestrian crossing over Ballona Creek is proposed at the end of Corbett Street.

A range of options was explored by the charrette team. These options included making breaks in the existing concrete channel to allow for regraded vegetated areas; removing pavement and utilities around existing channels; and partially reconstructing parts of the site, using permeable materials such as gabion walls and vegetated areas.

Parking Orchard

This team retained many of the existing parking areas but improved their ecological function. In some areas, traditional asphalt paved parking bays were proposed. These lots were graded to direct stormwater to rows of landscaped islands located between the bays. These landscaped islands act as filter areas that clean the first-flush water from storms occurring early in the rainy season, before the pollution laden water can migrate to the subsoils beneath the parking areas. Shade and/or fruit trees are also planted in the islands to shade vehicles and to provide food. The paved parking areas would be graded so that the centerline of each isle would be substantially higher than the centerline of each green filter island. This would allow for the parking bays to be partially flooded to hold large amounts of water during a flood emergency while not restricting vehicular access. In other areas, the team proposed gravel surfaced parking areas rather then asphalt. Gravel lots are far more permeable than asphalt and are also less expensive to install. These gravel lots would be shaded by trees planted in an orchard-like grid pattern.

This illustrative plan shows one possible organization of the 27-acre redevelopment site. The plan shows a mixture of building uses including industrial, office, and residential. Green screens and cistern walls are located outside of the building walls (1). Shade trees are shown in parking areas, along building walls and in the public street right-of-ways (2). The Ballona Creek channel is modified to provide a pedestrian and bicycle-crossing and access to a recreation area near the water (3). All parking areas are treated as parking orchards, with shade trees installed to reduce the heat island, absorb carbon, and to help regulate the flow of water into and out of the site (4). Green filter islands (5) and flood retention bays (6) produce a highly economic and high-capacity flood retention/infiltration system.



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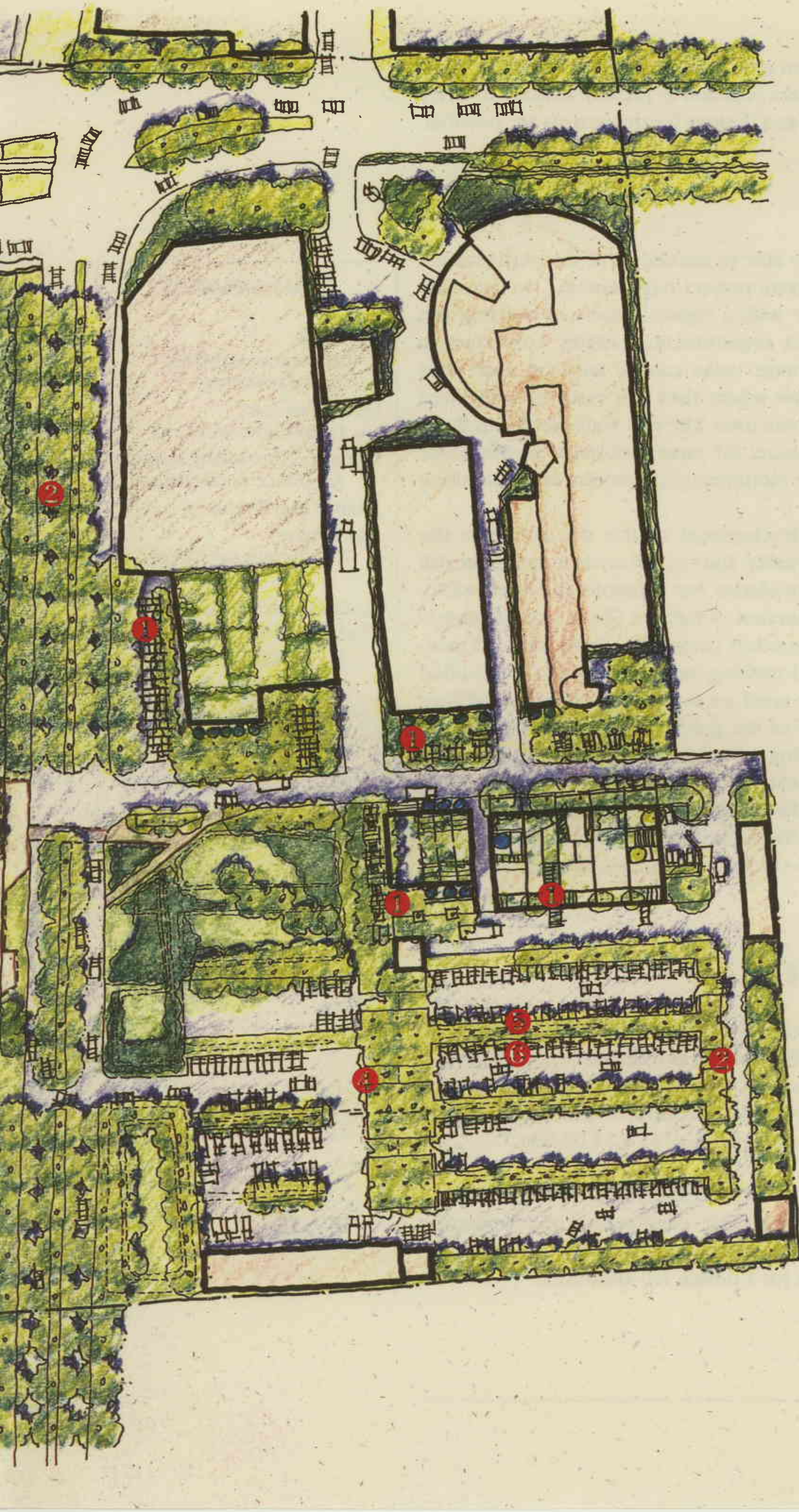

1
2
1
1
1
1
5
6
2
4

Salvaged steel pipe (with an inert non-toxic finish) could be used for bollards to control where cars park and to prevent damage to trees. Many other recycled materials and designs for tree guards are possible.

SUMMARY

The design team was easily able to exceed all of the performance thresholds set out in the charrette project requirements. In fact, they could have developed the site with a higher density of building use and still have met the project requirements. Highly cost-effective above ground stormwater storage tanks can be used on such sites where there is ample space and where they can easily be integrated with existing architecture and site uses. The rain water stored in these tanks is appropriate for irrigation; for most industrial purposes; for flushing toilets; and, with some monitoring and treatment, for drinking and hand-washing.

The challenge for the redevelopment of this site concerns the potential to affect the water quality and overall environmental health of the region outside of its boundaries. For example, the opportunity to affect the environmental function of Ballona Creek was integrated into the design team's rather modest proposals. The proposed treatment of the large, open, paved parking area could easily be modified to suit other parking areas in retail areas or at other industrial sites throughout the region. Many of the green screen proposals can be adapted to fit almost any building—from a single-family residence to a large warehouse. These simple structures, designed to shade building exterior walls, could provide the inspiration for the transformation of Los Angeles and its neighbors. Thus this region—known by the world as the land of the parking lot—could, in the future, become known as the land of the garden.

TEAM MEMBERS

John Lyle,
Landscape Architect
Team Facilitator

Susan Van Atta,
Landscape Architect

Christine Theodoropolous,
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Jacob Lipa, Engineer

Mia Lehrer
Landscape Architect

Landscape Architecture Graduate Students:

Eileen Takata
Erik Peterson
Ken Holden
Jerry Schneider

Architecture Graduate Student:

Jennifer Zurich

CONSTRUCTION BUDGET

The charrette team provided a rough construction budget for the proposed work, rounded in 1997 dollars, as follows:

All proposed site improvements, including parking, planting, graywater irrigation system, filter beds, subsurface infiltration area = $3,000,000.Construction Contingencies (30%) = $1,00,000.

TOTAL ESTIMATED COST OF CONSTRUCTION: $4,000,000.

Note: Professional Design Fees for engineering and landscape architecture will be required. The plans are very conceptual and cannot be used to develop a basis for a design fee allowance.

BENEFIT ANALYSIS

The following benefit analysis provides a cost value per year; per thirty years; and a total value over thirty years for remediation of the entire property. This information was provided by the charrette team in 1997 dollars

Issue	Amount Changed	Value / year	Value / 30 years
Irrigation water use	Presently, there is no irrigation on this site	$0	$0
Domestic water use	40% reduction (from 90 gal./day to 54 gal./day/employee)	$56,400	$1,692,000
Flood management	Flood discharge reduced 30% (Hold 6.75 acre-feet on-site during flood emergency)	$27,000	$270,000
Water pollution	Capture and treat 100% of first flush on-site.	$14,100	$423,000
Air pollution	Trees and green screen shading (equal to 140 strategically placed trees)	$131,600	$3,948,000
Green waste	Presently, the site has no green. Green waste from new trees and vines will be 100% recycled on the site.	$0	$0
	Total value of all remediation over thirty-year period	=	$6,333,000

CONCLUSION

The plans you have just seen make a convincing case. They answer our original question—does it make sense to treat every site in our region as a mini watershed—with a collective and emphatic "Yes!". They illustrate how, in so doing, the benefit to our region may be far greater than the cost. We believe that these plans successfully demonstrate not only that the apparently separate issues of water use, air pollution, solid waste management, energy use, water pollution, and flooding are, in fact, all connected, but that they are all connected at each individual site. We believe that these plans also suggest that improving the environmental performance of individual sites, and thus of our region as a whole, will require unusual levels of cross-jurisdictional and cross-disciplinary cooperation and coordination between those people and institutions who are responsible for the different pieces of the environmental puzzle.

We hope we have illustrated, for the benefit of our citizens and all interested parties and groups, what a city comprised of more sustainable sites would look like. We think that such a city would not only protect our shared environment, but would also lift our spirits. The capacity to inspire is sorely lacking in our region; yet inspiration is precisely what we need. We feel that these designs provide tantalizing glimpses into how a more sustainable city could also be a city we would enjoy more, and in which we could take pride.

But of course this book is just one small piece of a much larger puzzle. Much more work is still needed. First, it almost goes without saying that proposals such as these are only effective if they are broadly applied. For instance, more than half of our region's sites would need to meet the performance thresholds suggested for flood-control in order to obviate expansion of our flood control infrastructure. As part of this widespread implementation strategy, many of our building codes, zoning regulations, and engineering standards would need to be revised. These regulatory mechanisms—which most often are designed to ship environmental problems off sites to be "fixed" by central authorities (if at all)—must be changed so that we deal with as many problems as we can right on sites. But before taking this unprecedented step, the systems, strategies, and devices for accomplishing this improved performance must be tested, adjusted, and improved.

We are proud to have a demonstration site for doing exactly that for a typical 50 foot x 150 foot residential lot. However, other demonstration projects are also needed. Projects are needed for school sites, industrial sites, multi-family sites, small-scale commercial sites, large-scale commercial sites, and residential streets.

It is also very clear that since sites only cover slightly over half of the land in our region, with the rest being covered mostly by roads, that a second project that focuses on the design of streets is needed. We are confident that our roads and rights-of-way could be built or retrofitted to ensure dramatic increases in environmental performance.

Finally, citizens, home-owners, builders, and government officials need to be supplied with educational tools. These tools must clearly explain how environmental devices and systems should be built and maintained. Virtually no educational tools appropriate to the Los Angeles region exist at this time, and they are desperately needed. This planbook advances a very different way of thinking about how we build our sites and, thus, our cities. Minds will not be changed overnight. But they *will* change when they are fully informed.

We now have a chance to provide a whole new generation of schoolchildren with this new way of thinking

This change has already begun. With nearly 200 million dollars from the "Proposition BB" rehabilitation bond now available, over 400 schools are slated for campus redesign and repaving. Consequently we now have a chance to provide a whole new generation of schoolchildren with this new way of thinking.

We can use this redevelopment initiative to teach students how their campuses function as urban forest watersheds. We hope that students will then use their new knowledge to discover any problems stemming from how the water on their campus watershed is handled, and will suggest strategies for solving them. Students will be able to use BMPs, like the ones identified in this book, to suggest how to retrofit their campuses. Their ideas will be used by landscape architects who will formalize their design ideas into real construction plans.

Once the heavy construction is complete the students will return, facilitated by TreePeople staff and trained volunteers, to plant new trees and greenery on their campus. In most cases, we will be replacing pavement with greenery and the students will thus begin the long-term process of caring for the land as "campus watershed managers."

Education and understanding are the key to this new way of thinking. Fortunately, the arguments in support of more sustainable sites become stronger every day. The costs of separately managing environmental problems at the "end-of-the-pipe" is clearly too high. Many people in various fields are beginning to re-examine the most basic assumptions of their disciplines because, clearly, something is not working. It seems that the more concrete we pour and the more money we spend, the more problems we create.

Most people now agree that concrete is part of the problem, not part of the solution. Clearly the solution lies in large numbers of people taking small steps, working with, rather than against the forces of nature.

Glossary

133-year storm

The storm intensity used by the Army Corps of Engineers for calculating flood likelihood. Presumably a storm of this intensity occurs once every 133 years on average.

aeration

A process whereby air voids are introduced into soil for improved fertility and water holding capability.

bio-remediate

Bio-remediation uses biological processes to repair pollution damage. For example, a grass swale can bio-remediate much of the pollution caused by automobile use by holding heavy metals in the soil at harmless concentrations as well as by the action of soil bacteria, which gradually breaks down hydrocarbon waste such as crankcase oil.

bollard

A sturdy element, usually a post, placed in such a way as to prevent automobiles from entering an area.

catchment planter

A planting bed that has been specially designed to hold and absorb storm flows from adjacent areas, usually from parking lots.

cistern

Any tank or recess used to capture and store rain water for later use.

drainage chimney

Holes drilled into the ground sufficiently deep to allow rain water to quickly flow back into the ground. Also known as a dry well.

drainage flow deflector

A ridge and/or a depression in a flat paved surface for the purpose of re-directing sheet flow into a channel, thus changing the destination of storm water.

dry flow

The continuous flow in a storm drain system that occurs even during extended periods without rain.

evapotranspiration

The loss of water from the soil both by evaporation and by transpiration from the plants growing thereon.

filter medium

Any item or substance that is used for filtering impurities. In many of the designs included in this planbook, soil, sand, and mulch were used as a filter medium.

first-flush rain

In the Los Angeles area, many months can pass between one rain storm and the next. During this time, pollution and grime build up on all of the city's outdoor surfaces, and in particular, on its streets. When the next rain storm finally comes, it washes the accumulated grime and pollution off of the streets and into the underground storm drain system. This is the "first flush rain." As you might expect, it carries a very large amount of suspended and dissolved pollutants.

gabion wall

A sloping wall used mostly to line streams made of rock filled wire cages.

grass filter strips

A grassy edge or swale which filters storm water in the root layer before percolating the water into the soil below or discharging the water overland.

graywater

Water drained from household sinks, washers, tubs, and showers - that is, all water not coming from toilets. This water carries relatively few suspended or dissolved solids. Consequently, it can often be used for such purposes as landscape irrigation.

green filter islands

A grassy or planted landscaped island, usually in a parking lot, that filters storm water in the root layer before percolating the water into the soil below or discharging the water overland.

green link

Green links connect various locations via generously planted "park- like" linear corridors.

groundwater

Groundwater is water that saturates the soil at some distance below the surface. The level of groundwater or "water table" varies from soil to soil and from season to season. In rare instances, and on particular sites, the groundwater table comes up to the surface. This results in standing water on the surface of the ground. More often, the groundwater table is located many feet below the surface.

groundwater mounding

In certain instances, where stormwater is returned to the soil in one location at a faster rate than in adjacent locations, groundwater mounding can occur. This means that the water table (where the soil is saturated) can be higher under a recharge basin than in adjacent locations. Occasionally this can create problems. Often it is benign.

growing medium

Any substance used for planting. This is almost always soil. Sometimes soil will be substantially amended with additives, fertilizers, and organic material. Substantially amended soil is commonly referred to as growing medium.

heat gain

Heat can slowly build up in an object over time. This is called heat gain. In a building, heat gain is most often the consequence of many hours of sunshine striking and warming the exterior walls and roof.

heat island effect

Many urban areas lack shade trees. In these areas the sun strikes pavement and rooftops, heating them to very high temperatures. These surfaces re-radiate heat back into the air, raising air temperatures by five or more degrees. Urban areas that contain dense tree canopy avoid the heat island effect because trees absorb virtually all of the sun's energy without radiating heat back into the air.

high crowns

Virtually all roads and parking areas have some kind of crown, or high point, to insure that water flows off promptly. Usually this high point is a ridge along the center line of the road or parking bay. This ridge is ordinarily only a few inches higher than the edges. "High crown" suggests a condition where this crown is made artificially higher to allow the road or bay to hold more water than it otherwise could.

holding pond

A depression where rain water is directed and held temporarily. Holding ponds function to slow the rate at which water is discharged from a site to the rate more typical of undeveloped natural sites.

humus layer

The top layer of soil where there is the most organic activity, fibrous root material, and recycling detritus from the plants above.

hybrid cistern system

A container for holding rain water, both as a resource for later use and to help alleviate downstream flooding during time of flood threat.

infiltration zone

An area patricularly well suited and/or altered for directing storm water back into the soil.

impervious pavement

No water can penetrate through an impervious pavement. Almost all asphalt and concrete pavement is impervious.

percolation rate

The rate at which water can filter into the soil. Some soil types, such as sand, have a very high percolation rate; other soils types, such as clay, have a very slow percolation rate.

permeable pavement

Permeable pavement is honey-combed with voids, or air-pockets. These voids allow water to migrate down through the pavement into the soil below.

potable water

Water that is fit to drink.

recharge areas

Certain zones in the landscape can accept water back into the soil at higher than average rates. Such areas are often referred to as recharge areas.

residential density

The number of family units to be found on an average acre of land in a residential area is referred to as its density. These densities range from low (1-2 units per acre) to high (40 + units per acre).

riparian retention and treatment area

A retention or recharge area where plants native to rivers or lakes are installed to consume and clean the water therein.

run off

Stormwater that flows off of one surface or site onto another.

shade trees

Trees large enough to shade a two-story building. In some climates, shade trees lose their leaves in the winter. Some evergreen trees are suitable shade trees, but they may shade the house or street during the winter when people would prefer to have the light and warmth of the sun.

sheet flow

Sheet flow is storm water that flows in even sheets across a flat surface, such as a parking lot.

soaker hose

Soaker hoses are water conserving means of watering shrub beds especially. These hoses contain small perforations that allow water to flow gradually and continually onto the soil. They work particularly well with cisterns as they operate well with the low water preasures typically delivered by cisterns.

stormwater

Stormwater refers to all rain water that hits the surface of the ground. Stormwater either percolates back into the soil or flows on the surface to the nearest storm drain inlet, stream, or other wetland area.

subsoil

The soil layer below the "topsoil" layer.

subsurface

Below the surface of the ground.

swale

A V-shaped depression in the land, usually lined with grass, designed as a channel for moving storm water from one place to another.

trellis

A small structure, usually made of wood, wire, or metal, designed to support plants such as twining vines.

watershed

A region or area bound peripherally by a water parting or ridge and draining ultimately to a particular watercourse or body of water. Most sites are now mini-watersheds, with the property line constituting the "ridge" and the storm drain system located in the street constituting the "watercourse" to which it discharges.

Appendix A
Organization Profiles

TreePeople is a nonprofit environmental volunteer organization that has served the Los Angeles area for over 25 years. TreePeople's mission is to inspire the people of Los Angeles to take personal responsibility for their environment, training and supporting them as they plant and care for trees and improve the neighborhoods in which they live, work and play.

Staff and volunteers work in partnership with schools, neighborhoods, community groups, businesses and forest and park services bringing people and trees together to build stronger communities and improve the quality of the environment. Best known for planting over 1.5 million trees in Los Angeles and surrounding mountains, and for developing and running the largest environmental education program in the country, TreePeople is at the forefront of the urban forestry movement, offering sustainable solutions to urban ecosystem problems.

TreePeople, 12601 Mulholland Drive, Beverly Hills, CA 90201; (818) 753-4618, Fax (818) 753-4625; Web site: www.treepeople.org/trees/

Moriarty Condon was established by Stacy Moriarty and Patrick Condon in 1986. The firm provides a full range of services in landscape research, planning and construction design for projects throughout North America. Their clients include government, non-profit agencies, neighbourhoods, institutions, individuals and private development corporations. They have also developed an international reputation for sustainable design, with particular emphasis on "ecological infrastructure," a system of parcels, streets and public spaces that can reduce construction costs while eliminating site-generated pollution. Current projects include the design and construction of a 200-acre college campus, planning and design for a 1,400 unit hillside community, site design guidelines for school districts, a public garden in downtown Minneapolis, and residential and institutional developments in British Columbia. Planning studies include work in British Columbia, California, Massachusetts, Minnesota, and the New York metropolitan region.

Moriarty/Condon, Suite 102, 1661 West Second Avenue, Vancouver, Canada, V6J 1H3, (604) 737 6987, FAX (604) 730 0056, E-mail MCLALtd@aol.com

PS Enterprises (PSE) is a strategic communications, public relations and policy development firm located in Santa Monica, California. Founded in 1989 by Tom Soto, the firm specializes in environmental legislation, media and community relations, conference coordination, communicating with hard-to-reach audiences, and environmental policy research and development. PSE's experience working on legislation and public policy allows the firm to conduct strategically planned outreach campaigns on behalf of a variety of clients. PSE is registered as a Minority Business Enterprise (MBE) with state, county, and local agencies.

PS Enterprises, 3350 Ocean Park Boulevard, Suite 205, Santa Monica, CA 90405 (310) 392-6195, Fax (310) 399-6971 Web site: www.psenterprises.com.

Jones & Stokes Associates, Inc. Associates is a multi-disciplinary firm providing a wide range of services in environmental planning and natural resource management. The firm's expertise includes wildlife and habitat management and restoration; terrestrial and wetland biology; water resource and wastewater management; aquatic ecology and fisheries; environmental law and regulation; mitigation monitoring; cultural resources analysis; municipal and open-space planning; transportation, air quality, noise, and energy analyses; and geographic information system (GIS) services.

Clients throughout the Western United States include federal, state, and local governments; special districts; private organizations; nonprofit organizations; engineering and law firms. Headquartered in Sacramento, CA. Offices in Bellevue, WA; San Jose, Bakersfield and Irvine, CA; and Phoenix, AZ

Jones & Stokes Associates, Inc., 2600 V Street, Sacramento, CA 95818, (916) 737-3000; Fax (916) 737-3030. Web site: www.jsanet.co

Appendix B:
Charrette Participants

Ira Artz is a civil engineer with over 20 years of experience in water resource planning, engineering and management projects. He is currently with the firm of Simons, Li & Associates in Costa Mesa, California where he combines the disciplines of hydraulics, environmental science and regulatory management in the analysis of flood control projects. Previous work experience includes 10 years with the Army Corps of Engineers. Mr. Artz has written on topics such as the availability of water for solar power plant cooling and the use of sewage sludge to rehabilitate impacted land in Southern California.
Simons, Li & Associates, 3150 Bristol St., Ste. 500, Costa Mesa, CA 92626,
(714) 513-1280, FAX (714) 513-1278.

Gail Boyd is an engineer and senior consultant with URS Greiner, Woodward-Clyde in Portland, Oregon. Mr. Boyd has developed state-of-the-art methods for stormwater and watershed management and is working on cutting-edge projects in the Pacific Northwest and California. He has been a policy advisor to the US EPA for over 20 years and served as manager of the agency's Nationwide Urban Runoff Program. He is a nationally recognized expert in evaluating and controlling water quality problems resulting from nonpoint source pollutants. He has managed controversial environmental impact studies including the Los Angeles to San Diego "bullet train," US Navy supersonic flight areas and bombing ranges, nuclear power facilities and major municipal "waste-to-energy" facilities. Mr. Boyd conducts workshops and planning sessions for municipal and industrial clients throughout the western states.
URS Greiner, Woodward-Clyde, 111 S.W. Columbia, Ste. 990, Portland, OR 97201,
(503) 222-7200, FAX (503) 222-4292.

Alan Cavacus is an engineer with Woodward-Clyde Consultants in Santa Ana, California. He has over 19 years of experience in the environmental consulting practice. Clients include the EPA Office of Water and several private and municipal entities. He has extensive experience in flood plain and flood frequency analysis, urban hydrology and hydraulics and the evaluation of stormwater management techniques. Mr. Cavacus was the principal designer of a low environmental impact residential development in Maryland, which used a design approach involving planted areas integrated into drainage and grading designs to provide water control without the use of large and expensive structural measures. Recent projects have focussed on water quality in the areas of assessment, performance goal development, and management practices.
Woodward-Clyde Consultants, 2020 East First St., Ste. 400, Santa Ana, CA 92705,
(714) 835-6886, FAX (714) 667-7147.

Patrick Condon is a member of the University of British Columbia Landscape Architecture Faculty. He currently holds the UBC James Taylor Chair in Landscapes and Liveable Environments. In that capacity he has organized a series of international design charrettes for urban sustainability. From 1981 to 1983 he was the Director of Community Development for the City of Westfield, Massachusetts and from 1984-1991 he taught landscape architecture at the University

of Minnesota. He has won awards for his teaching and research and has published and lectured widely on sustainable urban design and landscape design theory. He is a partner in the design and planning firm of Moriarty/Condon Ltd.
Moriarty/Condon Landscape Architects & Planners Ltd., 1661 West 2nd Ave., Ste. 102, Vancouver, BC V6J 1H3 (604) 737-6987, FAX (604) 730-0056.

John Connell is an architect and owner of the 2Morrow Studies @ Fox in Warren, Vermont, a firm that designs and builds art, environments and educational situations that promote higher awareness of human behavior within the natural environment. Recent projects include kinetic sculpture from recycled materials for Ben & Jerry's theme park and the design and construction of a biological waste treatment greenhouse for four single family homes. Mr. Connell founded the Yestermorrow Design/Build School to teach the design of energy-conserving, environmentally-sound homes. He is the author of Homing Instinct and has spoken and taught at a number of colleges and universities.
2Morrow Studies @ Fox, 313 Brook Road, Warren, VT 05674, (802) 496-5546, FAX (802) 496-6280.

Bernadette Cozart is Executive Director of the Greening of Harlem Coalition and is a gardener for the Department of Parks and Recreation of New York City. Transforming public spaces—including abandoned buildings, vacant lots, and tree pits—is the focus of the coalition. These sites become ecologically sound, viable spaces for community interaction and industry, such as growing organic produce for salsas, jellies, etc. Ms. Cozart's background is in horticulture with an emphasis on botany.
300 Riverside Dr., Apt. 10-H, New York, NY 10025, (212) 254-2870.

Owen Dell is a nationally recognized licensed landscape architect and contractor. He is the owner of County Landscape & Design in Santa Barbara, California, specializing in sustainable landscape design and construction. Mr. Dell teaches and lectures around the country on sustainable landscaping, fire safety and other topics. He is the author of *How to Open and Operate a Home-Based Landscaping Business* and is a regular contributor to *Sunset Magazine* and other publications. Mr. Dell is president of Small Wilderness Area Preserves, Inc. and is a member of the board of directors of The Sustainability Project. He has received numerous awards for his work and community activism.
County Landscape & Design, 234 Mesa Lane, Santa Barbara, CA 93107, (805) 962-3253, FAX (805) 962-6603.

Kate Diamond is the nationally recognized and award-winning proprietor of Siegel Diamond Architecture. Her projects include the LAX Air Traffic Control Tower, the award-winning design for the new Universal City Metro Red Line Subway Station, the University of California, Irvine Student Services Addition and the New Jefferson Elementary School (both published in Architecture). Ms. Diamond was the first woman president of the Los Angeles Chapter of the American Institute of Architects. She has presented lectures all over the U.S. on topics such as: "Reinventing the California Dream—Coming to Terms with Density," "The Art of Architecture in the Social Ecology," and "Transportation Facility Design as an Act of Placemaking."
Siegel Diamond Architects, 605 West Olympic Blvd., #820, Los Angeles, CA 90015, (213) 627-7170, FAX (213) 627-7069.

Michael Drennan is a principal engineer with the environmental engineering firm of Montgomery Watson where he is responsible for directing their practice in the field of watershed management. He has led stormwater management pro-

grams for both municipal and industrial clients and is currently assisting a number of watershed groups to define and accomplish their mission. Recognizing that many of today's barriers to improving the aquatic environment are institutional as well as technical in nature, he has focused much of his recent attention on resolving conflicts that could preclude sound technical solutions. He is currently serving as Vice President of the Los Angeles/San Gabriel Rivers Watershed Council whose mission is to facilitate a comprehensive, multi-purpose, stakeholder-driven, consensus process to protect, restore and enhance the watershed ecosystem.
Montgomery Watson, 301 North Lake Avenue, Suite 600, Pasadena, CA 91101, (626) 568-6049, FAX (626) 568-6101.

Bruce Ferguson is Professor of Landscape Architecture and Director of the Master of Landscape Architecture program at the University of Georgia. He is a landscape architect who has specialized in environmental management of urban watersheds for twenty years. His book, Stormwater Infiltration, is the standard professional reference in its field. He conducts stormwater management continuing-education courses for designers and lectures at universities throughout the US. Consulting projects include conservation of irrigation water on the lawn of the White House and site design guidelines to protect run-off quality in the states of California, Florida, Georgia and New York.
School of Environmental Design, University of Georgia, Caldwell Hall, Athens, GA 30602-1845, (706) 542-4704, FAX (706) 542-4485.

Colin Franklin is an architect, landscape architect and ecological planner. Since 1975, he has been principal at Andropogon Associates, Ltd. in Philadelphia, Pennsylvania. He has a career-long involvement in the design of new towns and is active in the movement to develop sustainable communities both nationally and internationally. Mr. Franklin is an advisor to the World Bank, creating environmental design strategies for land development and management. He has worked in Iran, Sri Lanka, West Pakistan and the South Pacific. Currently, he is working on a major new city in the Middle East and is a participant in the 'Green Building' program, a sustainable design initiative in Bozeman, Montana. He has lectured and published articles on the historic values and planning guidelines that preserve community and park landscapes.
Andropogon Associates, Ltd., 374 Shurs Lane, Philadelphia, PA 19128, (215) 487-0700, FAX (215) 483-7520.

Paul Hawken is a businessman, environmentalist and author. He serves as Chairman of The Natural Step, a non-profit educational foundation whose purpose is to develop and share a common framework comprised of easily understood, scientifically-based principles that can serve as a compass to guide society toward a sustainable future. Mr. Hawken is the author of several books published in over 50 countries, including the best-selling *Ecology of Commerce* (1993). His book, *Growing a Business*, became the basis for a PBS series which Mr. Hawken hosted and produced. The program explored socially responsive companies and is shown on television in over 115 countries. His latest book, *Natural Capitalism: The Next Industrial Revolution,* written with Amory and Hunter Lovins, is scheduled to be released in September of 1999.
South 40 Pier, No. 20; Sausalito, CA 94965, (415) 332-5124, FAX (415) 332-7933.

Kristina Hill is Associate Professor at the Department of Urban Studies and Planning at MIT. She is a recipient of the Fulbright Scholarship for her study of the ecological impacts of agricultural development in southern Sweden using computerized mapping and assessment techniques, and the American Society of

Landscape Architects Merit Award. Her current research interests include spatial patterns of land use and their impacts on environmental sustainability and the use of Geographic Information Systems (GIS) to trace ecologically-significant changes in land-use during regional development.
Dept. of Urban Studies and Planning, Massachusetts Institute of Technology, Bldg. 10-485, 77 Mass. Ave., Cambridge, MA 02139, (617) 253-7305.

Robert Kennedy is the Chief Forester for the City of Los Angeles Street Tree Division, managing the largest, most diverse urban forest in the world. He is a certified arborist, landscape contractor and pest control advisor. He also has a private landscape contracting and maintenance business. Mr. Kennedy has written articles for the Journal of Arboriculture and has lectured on urban forest issues and proper arboricultural practices throughout Southern California. He has served on many important city committees including Stormwater Management, Recycling and Planning, Greenway and Open Space and Community Forest Advisory. He has also worked to educate high school students and young adults about the urban forest, teaching classes in environmental issues and fundamentals of plant and nursery management.
Street Tree Division, City of Los Angeles, 200 North Main St., City Hall East, Room 1550, Los Angeles, CA 90012, (213) 485-5675, FAX (213) 237-0158.

Thomas A. Larson is president of Integrated Urban Forestry, a division of Evans and Associates. He has over 25 years of experience in the landscape and nursery business. Mr. Larson leads project teams, assigns personnel, and performs field reconnaissance. He is also responsible for a large part of IUF's business development. Mr. Larson has also served as Park Supervisor for the Kern County Special District of Parks & Recreation, as President of Urban Forestry Consultants, as General Manager for SeaTree Nurseries, and as Vice President of Sales & Marketing for Keeline-Wilcox Nurseries. He was a member of the Cost-Benefit Model team for the T.R.E.E.S. Project with Jones & Stokes Associates.
Integrated Urban Forestry, 23382 Mill Creek Dr., Ste. 225, Laguna Hills, CA 92653, (949) 837-5692, FAX (949) 588-5058.

Mia Lehrer is the founder/president of Mia Lehrer + Associates, a landscape architecture and urban design firm in downtown Los Angeles. She has been involved in the planning and design of landscapes whose scale has varied from the coast of El Salvador to residential gardens. She is currently working on the design of Bosque Los Pericos, the largest public park in the city of San Salvador, as well as the renovation of Barnsdall Park in Los Angeles and a series of urban open spaces in Berlin, Germany.
Mia Lehrer + Associates, 800 No. Alameda St., Los Angeles, CA 90012, (213) 892-0009, FAX (213) 892-0008.

Jacob Lipa is a civil engineer and the principal of Psomas & Associates. He has over 21 years experience with all phases of the design and management of civil engineering projects with emphasis upon analysis of hydrological and flooding issues. He manages the design team for wetlands design, storm drain facilities and planning for Playa Vista, Los Angeles, a 1,000-acre master-planned mixed-use facility. He has conducted numerous flood plain studies and design of flood control systems. He has extensive experience in the design and modeling of water quality aspects both from urban runoff and from construction and dredging activities.
Psomas & Associates, 3420 Ocean Park Blvd., Santa Monica, CA 90405, (310) 450-1217, FAX (310) 452-7411.

Andy Lipkis founded and has been president of TreePeople for twenty-five years. TreePeople is a guiding light for the rapidly-growing citizen forestry movement in this country. Mr. Lipkis' creative programs include airlifting bare root trees to Africa, inspiring the planting of one million trees in LA before the 1984 Summer Olympics, numerous disaster relief efforts during flood and fire, and many versions of training designed to increase the number of citizens involved in urban tree planting and care. Mr. Lipkis and his wife and colleague, Katie Lipkis, were named to the UN Environment Programme's Global 500 Roll of Honour and also hold American Forests' Lifetime Achievement Award.
TreePeople, 12601 Mullholland Dr., Beverly Hills, CA 90210, (818) 753-4600, FAX (818) 753-4625.

Sharon Lockhart is an attorney specializing in Environmental Law. She is a private consultant on biological and policy issues related to proposed developments which would either impact wetlands or endangered species. She provides input for project design, develops wetland and habitat restoration plans, prepares biological baseline information and impact assessments and prepares permit applications. Formerly, she was a biologist for the US Fish and Wildlife Service.
7943 East Santa Cruz Avenue, Orange, CA 92869, (714) 289-1817, FAX (714) 289-1907.

Hoi Luc is an architect for the City of Los Angeles. He is responsible for all aspects of design projects from concept to construction. He has worked for the city for seven years and his projects include the Wilshire Area Police Station, the South Central Constituents Service Center, the Temporary 77th Street Police Station, and the Tillman Water Reclamation Plant Warehouse. Mr. Luc has worked as an architect for 10 years and has designed buildings for both commercial and industrial clients.
Architectural Division, Bureau of Engineering, City of Los Angeles, 600 South Spring St., Los Angeles, CA 90014, (213) 847-5281.

John Lyle passed away in July of 1998. We were truly fortunate to have had the benefit of his expertise during the Charrette phase of the T.R.E.E.S. Project. Mr. Lyle had been a Professor in the Department of Landscape Architecture at California State Polytechnic University in Pomona where he initiated the Master of Landscape Architecture program. His design interests included ecological bases for design and planning and design applications of regenerative systems. He designed water conservation plans for several California cities and created a Landscape Management Plan for endangered species recovery for the US Navy. His private practice clients included Appalachian Ministries Educational Resource Center and Oberlin College. His articles were published in the *Los Angeles Times, Landscape Architecture*, and *Nikkei Design.* He lectured throughout the US and in Brazil and Greece.

Leo Marmol and Ron Radziner are founding partners of Marmol & Radziner, a Santa Monica, California architecture and construction firm that has designed projects for public agencies, non-profit organizations and private clients. Recent projects include First Flight Child Care Center for Los Angeles International Airport which serves 1000 infants and preschool children and a design for the Sheenway School and Cultural Center, which includes elderly housing, a school, clinic and child care center. The firm completed the award-winning restoration of the Neutra-designed Kauffmann House in Palm Springs and is designing a sustainable house in Colorado, which will utilize environmental technology and non-toxic building materials. The firm's work has appeared in *Architectural Record*, *Progressive Architecture,* the *New York Times* and other publications.
Marmol & Radziner, Architecture & Construction AIA, 2902 Nebraska Avenue, Santa Monica, CA 90404, (310) 264-1814, FAX (310) 264-1817.

Greg McPherson is a Research Forester and Project Leader for the Pacific Southwest Research Station's Western Center for Urban Forest Research and Education. His research focuses on the measurement and modeling of urban forest benefits and costs, with particular emphasis on energy, carbon and water use. Dr. McPherson served as lead scientist on the Chicago Urban Forest Climate Project from 1991-94. He was also instrumental in the Sacramento Urban Forest Eco-Systems Study. Both projects analyze the link between the urban forest and the environmental and economic benefits it provides. The data is used by cities throughout the US.
USDA Forest Service, Pacific Southwest Research Station, Western Center for Urban Forest Research and Education, Department of Environmental Horticulture, University of California, Davis, CA 95616-8587, (916) 752-5897, FAX (916) 752-6634.

Jeff Olson is a Professor of Landscape Architecture at CalPoly Pomona, where he began teaching in 1974. His areas of interest are primarily related to ecologically-based land planning and design and to methods of visual analysis. He is the author of a computer database for native and cultivated plants in California. His professional experience includes private practice in California, Alberta and British Columbia. He has taught at the University of Arizona and has lectured in Canada, Mexico and Italy.
CalPoly Pomona, Department of Landscape Architecture, Pomona, CA 91768, (909) 869-2685, FAX (909) 869-4460.

Tom Richman is principal of Tom Richman & Associates (TR & A), an urban design/ landscape architecture firm in Palo Alto, California. The firm is bringing its focus on self-renewing landscapes to public streetscapes, campus design and the renovation of commercial districts. The firm has won multiple national ASLA awards for projects such as an urban forestry and traffic calming plan for a Bay Area neighborhood. TR & A created *Start at the Source-Residential Site Planning & Design Guidance Manual for Stormwater Quality Protection* for the Bay Area Stormwater Management Agencies Association. The design techniques in the document are presented to municipal planners, engineers, public works officials and developers in workshops led by the firm.
Tom Richman and Associates, Urban Design and Landscape Architecture, 654 Gilman St., Palo Alto, CA 94301, (650) 462-8880; FAX (650) 325-1018.

Bill Roley, an applied ecologist and designer, is the director of the Permaculture Institute of Southern California and a Professor of Integrated Systems at California Polytechnic University. He consults with city and county governments on watershed management, wastewater nutrient cycling, greenwaste management, and vermacomposting. Dr. Roley's international work involves teaching design and installation skills using regenerative and sustainable landscape techniques. Specific projects include creating a productive landscape for an orphanage in Tijuana and an ecotourist biopreserve in the Yucatan. His work creating a research and demonstration site for Ecology Farms in Paris, California is an example of full-circle solutions for urban management. Dr. Roley is on design teams in Vietnam, Hong Kong, Mexico, and Brazil, where he is helping to develop regenerative strategies for sustainable infrastructure management.
1027 Summit Way, Laguna Beach, CA 02751. (949) 494-5843, FAX (949) 494-0129.

Leslie Ryan has a private practice in landscape architecture, community and environmental planning and public art based in Oakland, California. Some current projects include the conceptual design for an urban plaza and roof terrace gardens for the San Diego New Main Library, and renovation of a Waldorf charter

school to reflect the environmental philosophy of founder Rudolph Steiner. Ms. Ryan completed a one-year fellowship and residency at the American Academy in Rome, focusing on historical places of healing and restoration. Her award-winning designs have appeared in *Landscape Architecture* and *Time*. Her public artwork has been installed in San Diego and Rome.
3326 Birdsall Avenue, Oakland, CA 94619, (510) 532-5666, FAX (510) 532-5666.

Larry Smith is an urban forest planner with the Davey Resource Group. Mr. Smith has been involved with community-based projects as well as all aspects of the Green Industry for the past 14 years. He is the Chair of the Los Angeles Community Forest Advisory Committee and Project Director for the City of Los Angeles Street Tree Inventory Management System project. He developed and managed theUrban Forest Ecosystem Partnership Summit in Los Angeles. As a team member of the Los Angeles River Computer Design Charrette, he examined alternative design solutions that addressed the environmental quality objectives of the Los Angeles River Master Plan.
6824 Aldea Ave., Van Nuys, CA 91406, (818) 705-8122, FAX (818) 705-1913.

Christine Theodoropoulos is an associate professor in the Department of Architecture at California State Polytechnic University in Pomona. She teaches courses in architectural design and structures. She is a registered civil engineer and architect. Her research interests include the development of teaching materials and methods in the practice, theory and history of structural technology in architecture with particular emphasis on seismic design. She is the director of the Neutra VDL Research House in Los Angeles.
2351 Edgewater Terrace, Los Angeles, CA 90039, (909) 869-2690, FAX (909) 869-2683.

Susan Van Atta is principal of Van Atta Associates, a landscape architecture firm based in Santa Barbara, California. In addition to designing landscapes, she specializes in natural resource analysis and restoration as well as historical restoration. She is a founding member of The Sustainability Project Board of Directors of the Santa Barbara Chapter of the AIA and a member of the Innovative Building Review Committee of the County of Santa Barbara. Some of her awards include the Santa Barbara Beautiful Design Award, plus awards for Art in Public Places in San Luis Obispo and Inspiration Point in Newport Beach. She has been a guest lecturer at CalPoly San Luis Obispo, the University of California and other institutions.
Van Atta & Associates, 235 Palm Ave., Santa Barbara, CA 93101, (805) 730-7444, FAX (805) 730-7446.

Jeff Wallace is an independent contractor responsible for designing, managing, and programming the Cost-Benefits Model for the T.R.E.E.S. Project. Mr. Wallace was one of the early members of Silicon Graphics Computer Systems, and uses his fifteen years of technical and project management experience to provide innovative, easy-to-use computer-based tools for analysis and simulation of environmental systems. He has a BS in Computer Science, an MBA and MFA in film.
99 East Middlefield Rd., Suite 32, Mountain View, CA 94043, VOICE/FAX (650) 961-9319.

Peter Warshall is a biologist, anthropologist and writer. He runs his own consulting firm and serves as editor-in-chief of *Whole Earth Review*. His training and experience includes natural history, natural resource management (especially watersheds, wastewater, and wildlife), conservation biology, biodiversity assessments and conflict resolution. He has served as a consultant to the United

Nations, US AID, the Apache people of Arizona and major transnationals such as Chlorox and SAS Airlines. He designed one of the first zero-discharge constructed wetland sewage systems. His articles have appeared in the *San Francisco Chronicle, Orion, River Voices, SPIN* and *Animal Kingdom.*
Whole Earth Review, 1408 Mission Ave., San Rafael, CA 94901, (415) 256-2800, FAX (415) 256-2808.

Bill Wenk is president of Wenk Associates Inc., a planning and landscape architecture firm based in Denver, Colorado. He is a member of the American Society of Landscape Architects and is also a member of the Conservation Funds National Forum on Non-point Source Water Pollution. His firm's work along urban rivers and streams has been recognized nationally and internationally for its environmental responsibility, and for the integration of urban and natural systems.
Wenk & Associates, 1035 Cherokee St., Denver, CO 80204, (303) 628-0003, FAX (303) 628-0004.

Appendix C
T.R.E.E.S. RESOURCES

A library was set up at the charrette to make the following resources available to design team members.

AIR QUALITY

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Acknowledgments

In 1992, an idea came to me for how to make Los Angeles economically and environmentally sustainable in the 21st Century—using the same financial and human resources that are now being wasted through the inefficient and dis-integrated management of our urban ecosystem.

Such a far-reaching vision could never have made the journey from dream to reality without the dedication of many people who were willing to commit themselves to proving its feasibility to the local, state, and federal agencies who collectively have the resources and the responsibility to maintain the City's infrastructure.

The T.R.E.E.S. Project received extraordinary support from numerous individuals who worked together to create, evaluate, and implement landscape designs with the potential to transform Los Angeles into a more beautiful, self-sustaining, and uplifting environment for all of its residents. Because of their efforts, the T.R.E.E.S concept is now steadily gaining influence in Los Angeles and across the nation.

Enormous thanks are due to Helen and Peter Bing, Tony Thomas, and Bill Graham. They were quick to see the possibilities in the T.R.E.E.S. Project and the first to offer their assistance. It was because they backed their belief in the dream with the funding that could make it come true, that we were able to move forward and secure sponsorship and participation from a multitude of agencies.

On behalf of TreePeople's board, staff, volunteers and members, I wish to express profound gratitude to all those listed on these pages beginning with Patrick Condon who enthusiastically embraced the T.R.E.E.S. concept, helped formulate the charrette and then served as its ring-master/facilitator. Patrick then took all the raw material and formed it into this book. He's helped breathe life into this dream by staying with process and even guiding the demonstration projects. We also want to thank the design team members and other technical contributors cited throughout the book; to the countless others who added their time, skills, and goodwill to accomplishing this first phase of the T.R.E.E.S. Project; and once again, to our sponsors—without whom none of this could have taken place.

We wish to extend our deep appreciation to Mrs. Rozella Hall, who allowed her residence to serve as the premier demonstration site for some of the sustainable designs detailed in this book. Mrs. Hall's patience and good-natured support made it possible for us to accomplish extensive landscape retrofits to her property with minimal difficulty.

Mrs. Hall also accepted with warmth and grace the frequent visits of numerous agency officials, technical experts, and members of the general public who came to view the beauty, simplicity, and efficacy of these designs. Her untimely passing at the end of 1998 has deeply saddened everyone who enjoyed the special privilege of knowing her. We are grateful to her daughter, Keisha Hall, who intends to maintain the availability of the property for periodic monitoring, improvements, and scheduled tours. Warm thanks also to Bob Cornell and Associates for managing the entire landscape construction project and to Karen Bragg for continuing to maintain the site in sterling condition.

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PSE helped us get the teams together to retrofit the demonstration site and to review the Cost Benefit Analysis. They served as our liaison with various public agencies and private groups, and they helped us to reach a national audience with the publicity campaign they designed for the opening of our demonstration site. We very much appreciate their beneficial assistance. Special thanks to Rick Ruiz for contract compliance problem solving, Kate Hahn and Laurel Airica for managing and editing this manuscript. I want to extend even greater thanks to Laurel for all of her writing and editing work—she's given the project a voice.

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—Andy Lipkis

Second Nature

Adapting
LA's Landscape
for Sustainable Living

T·R·E·E·S

T.R.E.E.S.—Trans-Agency Resources for Environmental and Economic Sustainability—is creating cross-jurisdictional and cross-disciplinary connections between those people and institutions responsible for component parts of the urban ecology, especially in the areas of energy, water, waste removal, and air quality systems. This book enumerates and demonstrates the diverse benefits to be derived from such a unified, cost-effective approach to managing our environmental challenges.

The architectural and landscape designs and retrofits described in this book could solve our environmental dilemmas, beautify our city, and fulfill our dream of a sustainable city in the 21st Century.

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