



Desalination Plant

Monterey, California

RESEARCH REPORT

Cal Poly Architecture and Environmental Design
Graduate Research Studio





MPWSP Desalination Plant
Monterey, California

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COLLEGE OF BUSINESS

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INTRODUCTION



01

- Executive Summary
- Explanation of Desalination Process
- Any Additional Introductory Info



The water upon which we all depend is finite. Three quarters of our planet is covered with water. Only three tenths of a percent is considered a renewable fresh water supply.¹

MPWSP Program

The Monterey Peninsula Water Supply Project (MPWSP) is a large water supply project serving many cities and communities in the central coast of California. It includes approximately 10 miles of pipelines, "slant" wells under the seabed, the potential for aquifer storage and the second largest desalination plant in the Western Hemisphere. This report presents an architectural proof of concept for the desalination plant.

The overall project for new water for Monterey Peninsula achieved a major milestone in filing its Application to California Public Utilities Commission (PUC) on April 23, 2012. This report relies on project parameters described by Richard Svindland, Vice President of Engineering for California American Water (CAW), on January 11, 2013 in his report under the PUC application.



This report will be provided to the Design/Build proposers as an addendum to the Request for Proposals for MPWSP (RFP). In all cases of any conflict between this report and the remainder of the RFP, the RFP shall prevail.

The following report is a Proof of Concept Master Plan is submitted to California American Water on August 8, 2013.

This report contains architectural renderings for the purpose of informing the Design/Build proposers of the architectural aspects of CAW's goals and planning. The Desalination Plant is primarily an engineering facility. Our architectural design is intended to house the project as well as meet the goals of CAW:

- Engineering Excellence
- Sustainable Design
- Education for All

1. Wettereau, G., M61, Desalination of Seawater, AWWA, 2011

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- Thomas Shorey

CalPoly

The Architecture Graduate Research Studio of California Polytechnic State University (CalPoly) was contacted by CAW to provide a Proof of Concept Master Plan for the Desalination Plant for the Monterey Peninsula Water Supply Project (MPWSP)

This report is the result of the research of the Architecture Graduate Research Studio at CalPoly. Please see the comprehensive Table of Contents at the front of each of two volumes. The report has two parts:

- A Design Book, containing our Proof of Concept Master Plan, from inspiration to conceptual design, including diagrams showing:
 - function and inspiration of the design
 - sustainable elements
 - educational elements.

- A Research Book, containing our research and development of our design.

It includes:

- Sustainability in large industrial projects and how it was applied to this design.
- Water and energy efficiency in the plant, its grounds, educational exhibits, and staff use.
- Materials selected on these sustainable criteria.
- Environmental quality inside the plant.
- Innovative elements in community and education.
- Scope of work considerations to support sustainable design.

We have reported to CAW, (the utility company for water for the Monterey Peninsula) and to the Governance Committee for the MPWSP. Our faculty advisor is James Doerfler, Interim Head of Architecture, assisted by Kevin Dong and Cesa: Torres.



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Executive Summary



Building Program

Our design is based on the 9.6 MGD desalination program. We have a diagram of the 6.4 MGD program layout for the treatment building, but we have not included any of the other “variable” elements of the alternate sizing in our design. Please see Section 2. General Design Criteria, page 2-5 of the RFP for further information on this element of the proposal. Sustainable designs are intended to produce durable, efficient designs with long life cycles. All the following elements are considered in light of sustainability.

Buildings

There are 2 main buildings. They are the treatment building, containing the reverse osmosis equipment, and the administration building, containing the

control room, laboratory facilities and offices. Our Master Plan shows over 20 other features of the site. The treatment building floor is lower than the administration building to conceal its bulkiness and take advantage of contours of the site. The floor of the treatment building is 15 feet below the floor of the administration building. They are about 30 feet apart.

Surrounding the treatment building is an elevated walkway. The walkway serves as pedestrian access and an educational tool. Visitors can walk around the building, see the processes, hear about desalination and enjoy the view of the Salinas River Valley farmlands and the town of Castroville.

Along the front (south) elevation of the treatment building, we have placed a mesh screen extending the entire length of the building and nearly matching its height. This screen provides a linear continuity to the front of the engineering processes behind, both the treatment building and the adjacent multimedia filter area. The main multimedia filters are exterior, the required piping protection to be provided as required for the material selected.

The administration building is described in Appendix 2 of the RFP, beginning on page 2-58. Our design shows a room layout. Efficiency of use by the staff of the project is the guiding principle of our architectural considerations. The Salinas River valley is in the view of the north facing rooms in the administration building. We have placed principal offices and assembly rooms there. This building might be able to be made even smaller than our preliminary study. It is recommended that the finishes and fittings be

high-quality industrial products.

Significant is lockers, showers and staff bathrooms. These facilities are important to the full time staff. The center of the Administration Building is highlighted with a water feature, central to our education program. It is fed by both roof water collection and the full time flow of test water taken from the treatment building. The water feature leads to the sustainable garden and the elevated walkway. The elevated walkway carries around the treatment building, providing views of the process equipment inside.

The educational program will occupy the visitor entry way, the water feature and informative signs and displays to be added by the owner. The roofs of both buildings should be designed to hold solar electrical panels to be added after construction. Please see the Energy Section of our Research Book.



Executive Summary



Multi-media Filter area

We have included a perforated metal screen surrounding the multi-media filter area. The ongoing maintenance of these large filters requires access to each filter and appropriate protection to process piping supplying the raw seawater. Visitors can view this portion of the site from the beginning of the elevated walkway.

Tanks and Ponds

Tanks and ponds have been arranged to correspond with their function in the plant. Feedwater tanks are near the filters at the beginning of the process and potable water storage, called clearwells, are located at the end of the post-treatment portion of the treatment plant.

Ponds for storage of rinse water for filters and concentrate from the R.O. process are located according to the process function. The ponds require maintenance, protection from wildlife and ultraviolet sun damage, if applicable.

Slab foundations for Equipment

Equipment, such as a substation for electrical power supply should include adequate safety protection and reasonable aesthetic consideration. We have included a perforated metal screen around the

electrical substation and the generator and clearwell pumps. We are not providing a structural design for foundations. We are coordinating CAW goals with the architectural elements of the project.

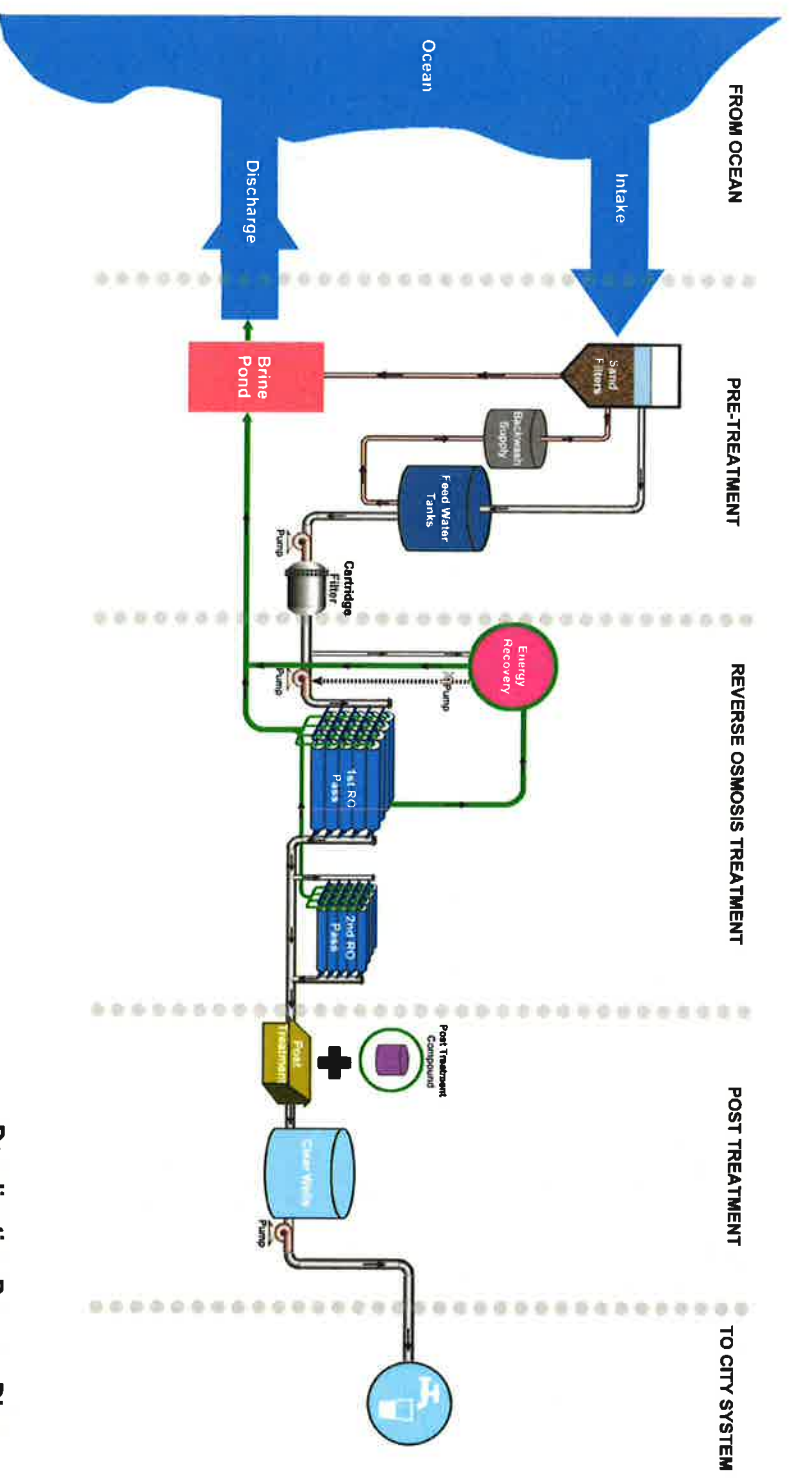
Site Features

We are showing undisturbed areas, graded areas, paved areas, tree lines and a xeriscape garden. Security gates and a perimeter security fence will be required. A fundamental sustainable concept applied to the entire design is to build as little as possible, including disturbing the site as little as possible.

Lay-down areas should be developed as close to the building footprints as possible, yet protecting the undisturbed areas of the site as much as possible. We have included two lines of larger trees and two lines of smaller trees to reduce erosion and maintain local habitat.

Paved areas should be sloped to drain to bioswales or be permeable paving. No site runoff is expected. The rear of the multi-media filter area and the rear of the treatment building should be paved with an emergency capture for spilled chemicals.

Explanation of Desalination Process Diagram



Desalination Process Diagram

Desalination Process

Desalination is a three-step process. The suspended solids are removed by elaborate filter systems, then the molecules of salt and water are separated by special membranes under high pressure, then minerals are added back in to produce drinking water.

- First Step: Filtering. Sand filters remove objects and organic debris. Cartridge filters remove tiny objects.
- Second Step: Reverse Osmosis (R.O.) The molecules of salt and water are separated.
- Third Step: Post Treatment adds back in certain minerals to make the water drinkable.

Having just reported that the process is simple, it is deceptively simple because it contains several smaller steps transforming a natural substance, raw seawater, full of organic and chemical components into a precisely configured product consumed by the public by the gallon every day. The level of efficiency achieved is directly dependent on the rigorous maintenance of the process. Clearing the filters often produces much more efficient reverse osmosis. The highest quality is never a question. The public health is on the line.



lead foundation

02



LEED FOUNDATION



02

- LEED as Model
- LEED Categories & Diagrams





INTRODUCTION

California has always been a huge advocate of the environment and in 2008 California instituted CalGreen, the first statewide green building code in the United States. Moving toward a more energy-independent future, California is also challenging the design and construction industry with our nation's first-ever net-zero energy goals: all new residential construction by 2020 and all new commercial construction by 2030.

This project conceptual design not only embraces current environmental policies set out by the State Government but supports the vision of local community members and environmental organizations to not only meet, but to exceed these current standards set out by the government. By supporting this proactive approach through the design, this project will not become outdated in a number of years but will last into the future. This approach will work versatility into the design, which will lead to cost savings when future upgrades can be made with greater ease to meet the needs of ever improving standards and technological advances.

A holistic approach has been taken in preparing this proposal to create a sustainable development that applies principles from numerous green building and operations programs, as well as standard professional architectural and engineering practices. This approach considers the value of protecting the environment directly through the facilities construction, operations and education programs while consider the funds spent on the project. Lean Design and Construction principles promote this approach of maximizing value while minimizing waste.

The majority of projects that are certified through green building programs are typical commercial and residential buildings. Therefore the principles of these programs are easiest applied to these project types. A desalination project is a specialized industry building project that is not your average building but the LEED 2009 Green Building Rating System for New Construction and Major Renovations offers a range of ideas that support environmental responsibility that can be easily applied to a facility of this type. This program has been explored in depth and its findings are outlined in the attached Appendix.

Explanation of LEED as Model

Primary LEED Categories



02

LEED

Established in 1993, U.S. Green Building Council (USGBC) recognized that the sustainable building industry needed a system to define and measure “green buildings.” This action led to the creation of an every evolving green building rating system known as Leadership in Energy and Environmental Design (LEED). LEED uses the U.S. Environmental Protection Agency’s TRACI environmental impact categories as well as the National Institute of Standards and Technology (NIST) as the base for weighting each credit that make up the rating system.

The LEED 2009 Green Building Rating System for New Construction and Major Renovations is a set of performance standards typically used to certify the design and construction of commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. This program has also been used to certify specialized buildings that have commonalities with these building types. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

The LEED program has been broken down into 7 topics, which are made up of a range of prerequisites and credits requirements. These topics include:

1. Sustainable Sites (SS) - encourage strategies that minimize the impact on ecosystems and water resources.
 2. Water Efficiency (WE) - promote smarter use of water, inside and out, to reduce potable water consumption.
 3. Energy and Atmosphere (EA) - promote better building energy performance through innovative strategies.
 4. Materials and Resources (MR) - encourage using sustainable building materials and reducing waste.
 5. Indoor Environmental Quality (IEQ) - promote better indoor air quality and access to daylight and views.
 6. Innovation in Design (ID) - address sustainable building expertise as well as design measures not covered under the five LEED credit categories above.
 7. Regional Priority (RP) - address regional environmental priorities for buildings in different geographic regions.
- All prerequisites must be completed to achieve any level of certification, while credits are option but offer weight to the level of certification that can be achieved.
- LEED 2009 for New Construction and Major Renovations certifications are awarded according to the following scale:

1. Certified 40–49 points
2. Silver 50–59 points
3. Gold 60–79 points
4. Platinum 80 points and above

110 points is the maximum score any project can score on the LEED 2009 for New Construction and Major Renovations certifications program. It is believed after completing the LEED Checklist attached as part of the Appendix that this project has the potential to receive a Gold status with relative ease and with investing in a number of additional green strategies there is potential of receiving Platinum status if the program is pursued. Of course, this status will depend upon the final design decided upon as well as the construction practices implemented.

A cost-benefit analysis that not only includes the upfront financial cost but analysis the benefits of investing in a quality building design and range of products that require less operation and maintenance, that are environmentally friendly and educate members of the public who visit the faculty are a virtual part of the analysis should be conducted. The LEED Supporting Document will aid in this analysis since the level of difficulty of achieving each credit type has been outlined.

Sustainable Features LEED-Like

Legend

● Sustainable Sites

1. Minimize Distruption to Existing Ecosystems protecting and Restoring the Habitat
2. Bike Path(1a) / Bike Racks(1b) / Storage and Showers(1c) Reduces Automobile Pollution
3. On-Site Charging Station and Electrical Powered Vehicles for Staff Reduces Automobile Pollution
4. Priority Parking for 5% Carpools and Vanpools Reduces Automobile Pollution
5. Supporting the Habitat with Native and Adaptive Vegetation that Minimizes Water Use
6. Reflective Road Surface Reducing Heat Island Effect
7. Solar Panels and Highly Reflective Roof Surface Reducing Heat Island Effect
8. Trees Shading Road Surface Reducing Heat Island Effect
9. Service Road Lighting Reducing Light Pollution
10. Lighting on Motion Sensors Reducing Light Pollution

● Water Efficiency

11. WaterSense Fixtures and Roof Rainwater Harvesting Reducing Water Use

● Energy and Environment

12. Building Design that Maximizes Energy Performance
13. Installation of Solar Panels Utilizing On-site Renewable Energy

● Material and Resources

14. Use Sustainable Building Materials and Reduce Waste

● Indoor Environmental Quality

15. Promote Better Indoor Air Quality and Access to Daylight and Views

Sustainable Features LEED-Like



02



03 sustainable site



SUSTAINABLE SITES



03

- Undisturbed Area Diagram
 - Landscape Strategies
 - Xeriscape
 - Landscape Diagram
 - Seasonal Diagrams
 - Flower Blooming Seasons
 - Landscape on Swales
 - Landscape on Slopes
 - Xeriscape Plant List
 - Roof Catchment
 - Stormwater Design:
- Permeable vs. Impermeable

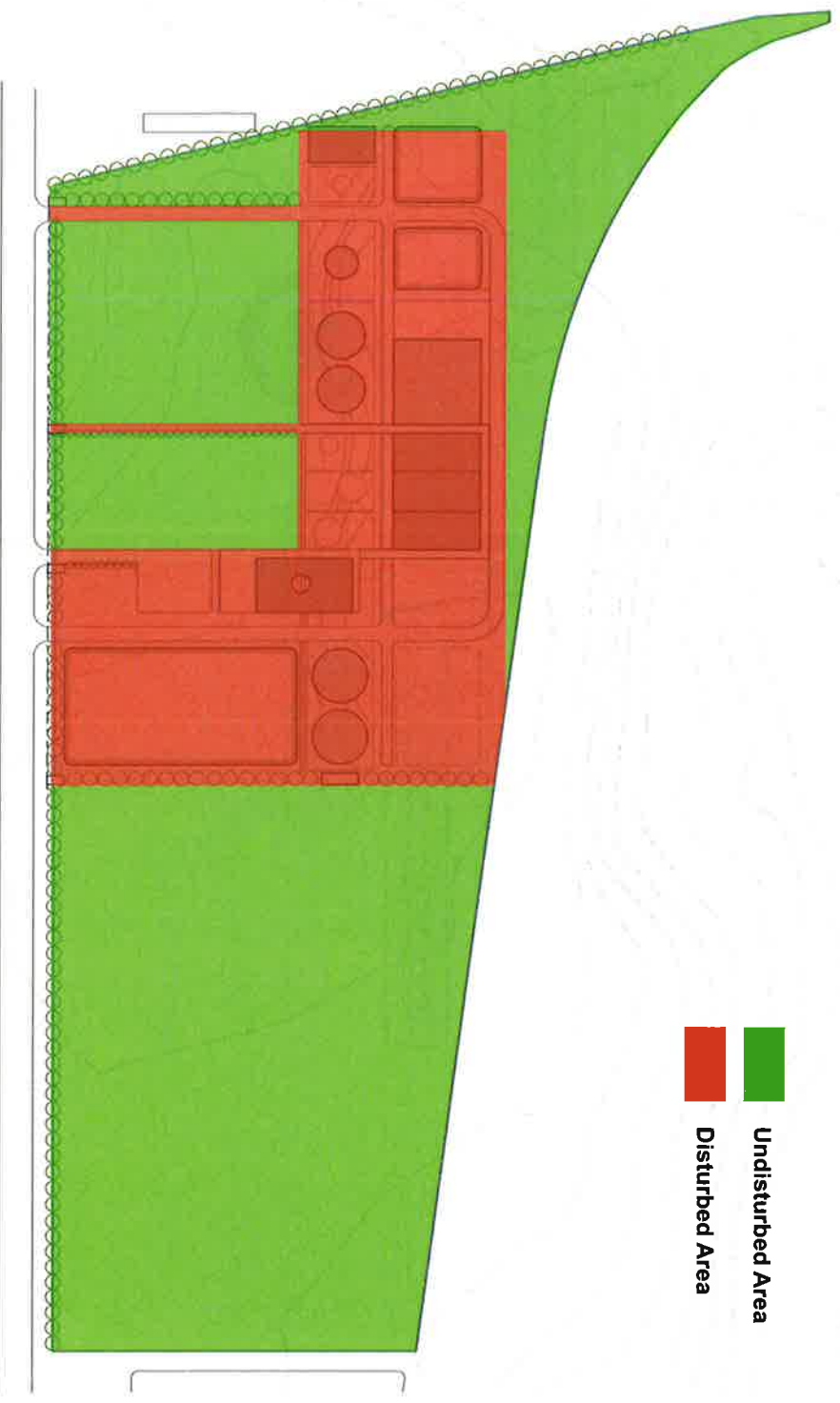


Sustainable Site Introduction

1. Minimize Distruption to Existing Ecosystems protecting and Restoring the Habitat
SS Credit 1: Site Selection
Technologies & Strategies Utilized: During the site selection process, a preference to a site that does not include sensitive elements or restrictive land types. A suitable building location and a design with a minimal footprint to minimize disruption of the environmentally sensitive areas is proposed.
SS Credit 4.4: Alternative Transportation—Parking Capacity
Technologies & Strategies Utilized – Parking lot size minimize. Provide preferred parking for carpools or vanpools for 5% of the total parking spaces.
SS Credit 5.2: Site Development—Maximize Open Space
Technologies & Strategies Utilized: Select a suitable building location and design the building footprint to minimize site disruption.
2. Bike Path (1a) / Bike Racks (1b) / Storage and Showers (1c) Reduces Automobile Pollution
SS Credit 4.2: Alternative Transportation—Bicycle Storage and Changing Rooms

- Technologies & Strategies Proposed: If the building is designed with transportation amenities such as bicycle racks and shower/changing facilities they can be utilized if the existing bike path is extended out to the project. See the attached bike route map attached to the Appendix. Incorporating changing facilities and showers into the facility can also be utilized by employees who may be conducting long shifts or night shifts.
3. On-Site Charging Station and Electrical Powered Vehicles for Staff Reduces Automobile Pollution
SS Credit 4.3: Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles
Technologies & Strategies Proposed: Provide electrical powered vehicles for staff to utilize around the site with an on-site charging station. Providing priority parking spaces for low-emitting and fuel-efficient vehicles for visitor and staff vehicles is easily achievable.
 4. Priority Parking for 5% Carpools and Vanpools reduces Automobile Pollution
SS Credit 4.4: Alternative Transportation—Parking Capacity
Technologies & Strategies Utilized – Parking lot size minimize. Provide preferred parking for carpools or vanpools for 5% of the total parking spaces.

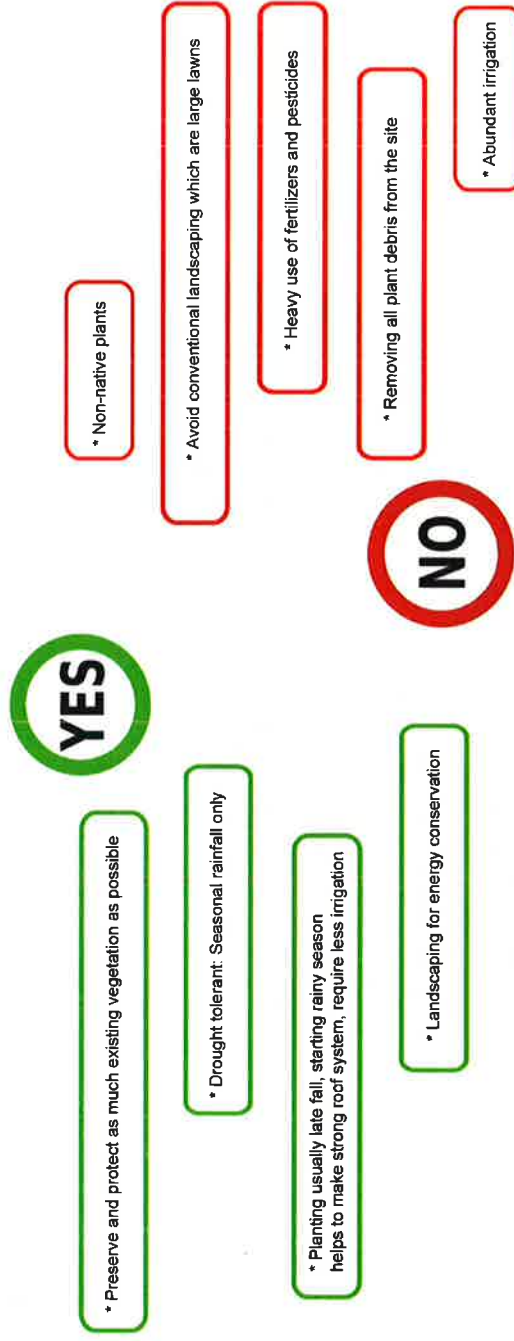
Undisturbed Area Diagram



The site lends itself to development of the western end of the site. The sustainable goal of limited development fits with cost savings in this program diagram. We have intentionally left as much of the site undeveloped as possible.

During construction, considerable effort must be used to protect the site. Temporary fencing, runoff capture, defined lay-down areas for contractors will be needed.

Landscape Strategies



The beauty and pleasant environment combine with conservation of water are the educational goals of the courtyard. The main courtyard features are xeriscape plantings, precise irrigation and careful drainage. We were sensitive to the shortage of water in the region, of course, the main reason for the project, as well as education about xeriscape gardening, cost reduction, shading, beauty

and a durable landscape design. The following pages show these elements in detail. We considered a green roof, however it seems that the benefits of preparation of the roof for solar PV has more benefits in the long run. The courtyard seems more accessible and maintainable for our goals, especially engaging the water feature adjacent to the courtyard.

What's Xeriscape Landscape

- Defined as "quality landscaping that conserves water and protects the environment."

What's People misleading about Xeriscaping?

- It is not a bare earth ZERO-escape(Xeri means "Dry" in Greek), nor is it cactus and gravel rock garden

Benefit of Xeriscape

- Reduced water bill and water conservation
- Efficient and cost effective
- Provides wildlife habitat
- Reduces fossil fuel consumption and pollution
- Presents minimal pest and disease problems
- Thrives with little fertilization
- Requires low pruning and maintenance
- Saves valuable landfill space
- Improve property value
- Provides attractive year round landscapes
- Uses beautiful sustainable plants that are well adapted for the area
- It is appropriate for the local soil and climate



03

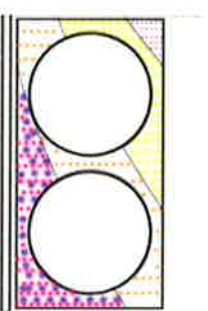
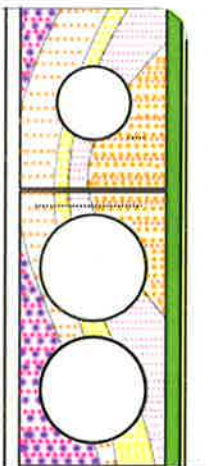
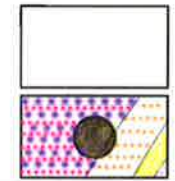


The Seven Principles of Xeriscape

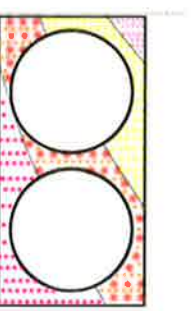
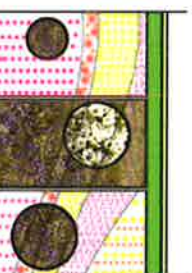
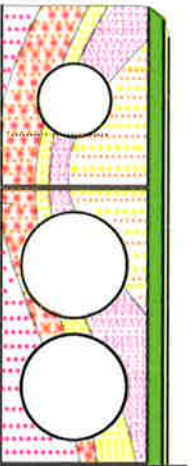
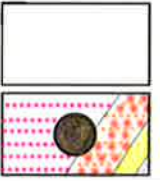
Landscape Diagram



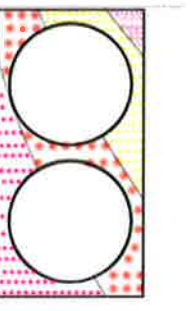
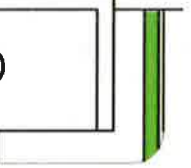
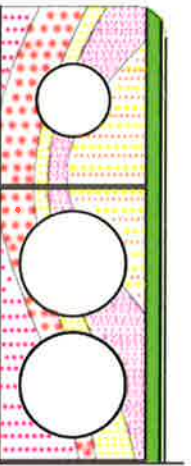
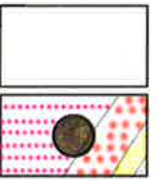
Spring



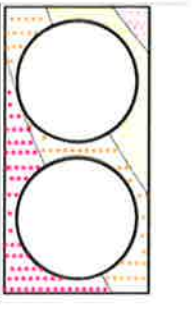
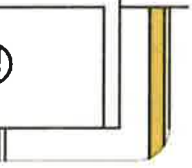
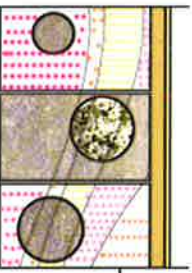
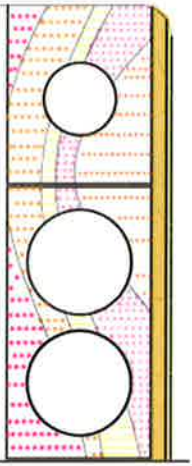
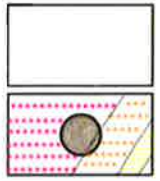
Summer



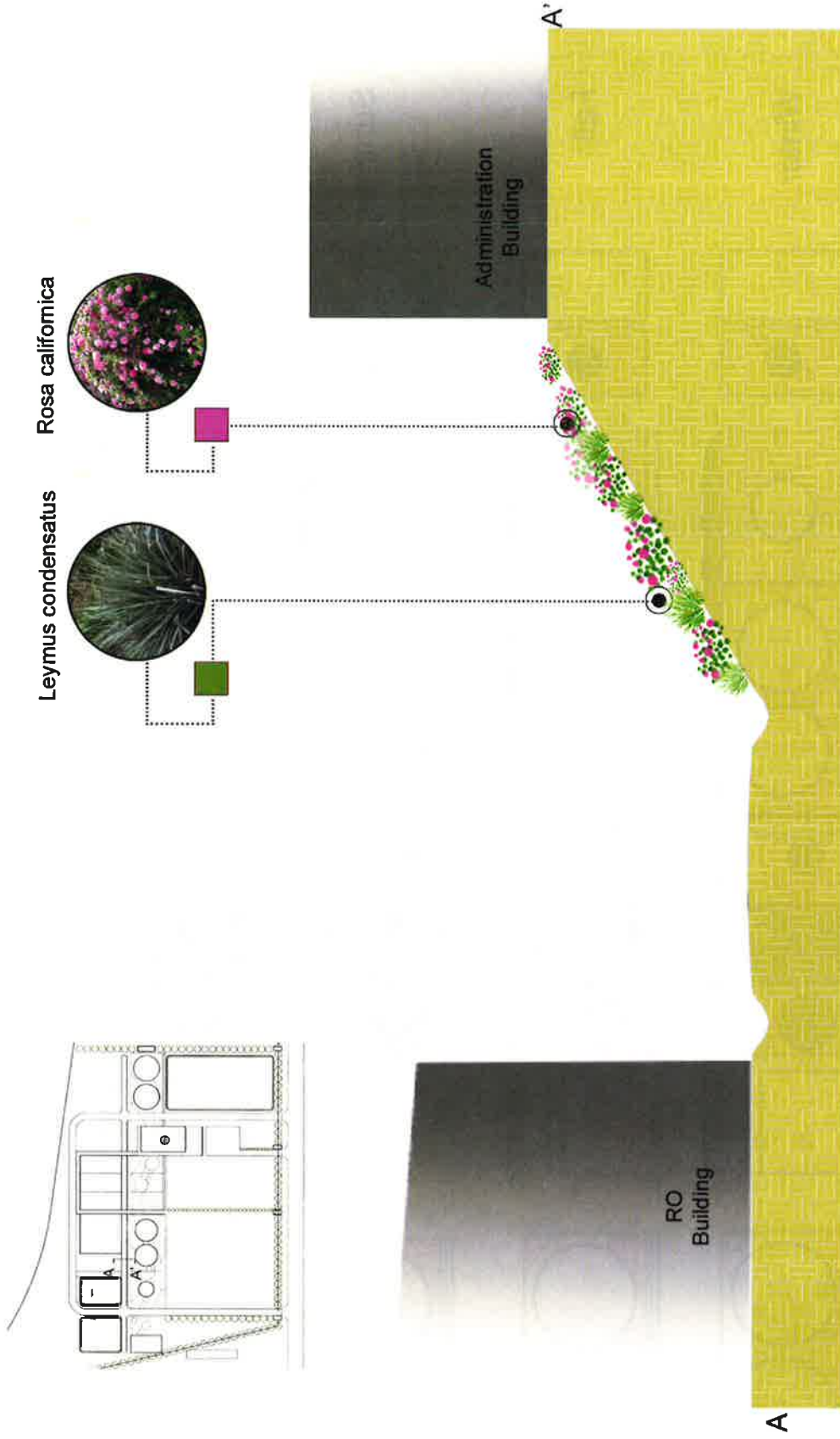
Fall



Winter



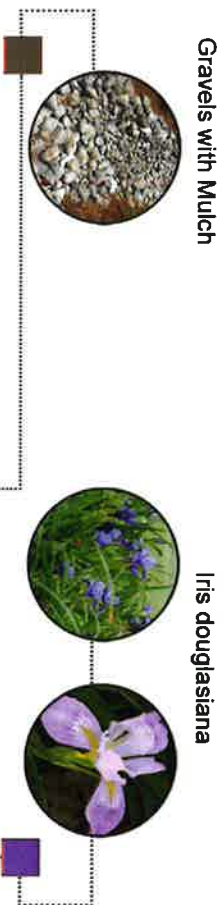
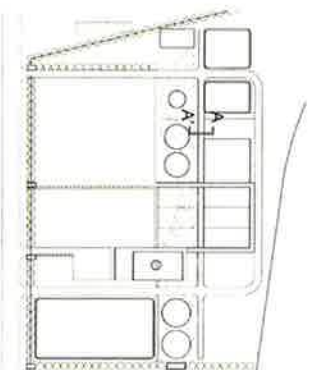
Landscape on Slopes



Avoiding water runoff is easy when working on a sand site. To accomplish this, the design approach for surface water throughout the site is to avoid collecting water into a point source. The use of roadway swales, avoidance of curbs and implement permeable

paving where appropriate will accomplish this goal on our sandy site. Note that roof water is being collected for use in the water feature.

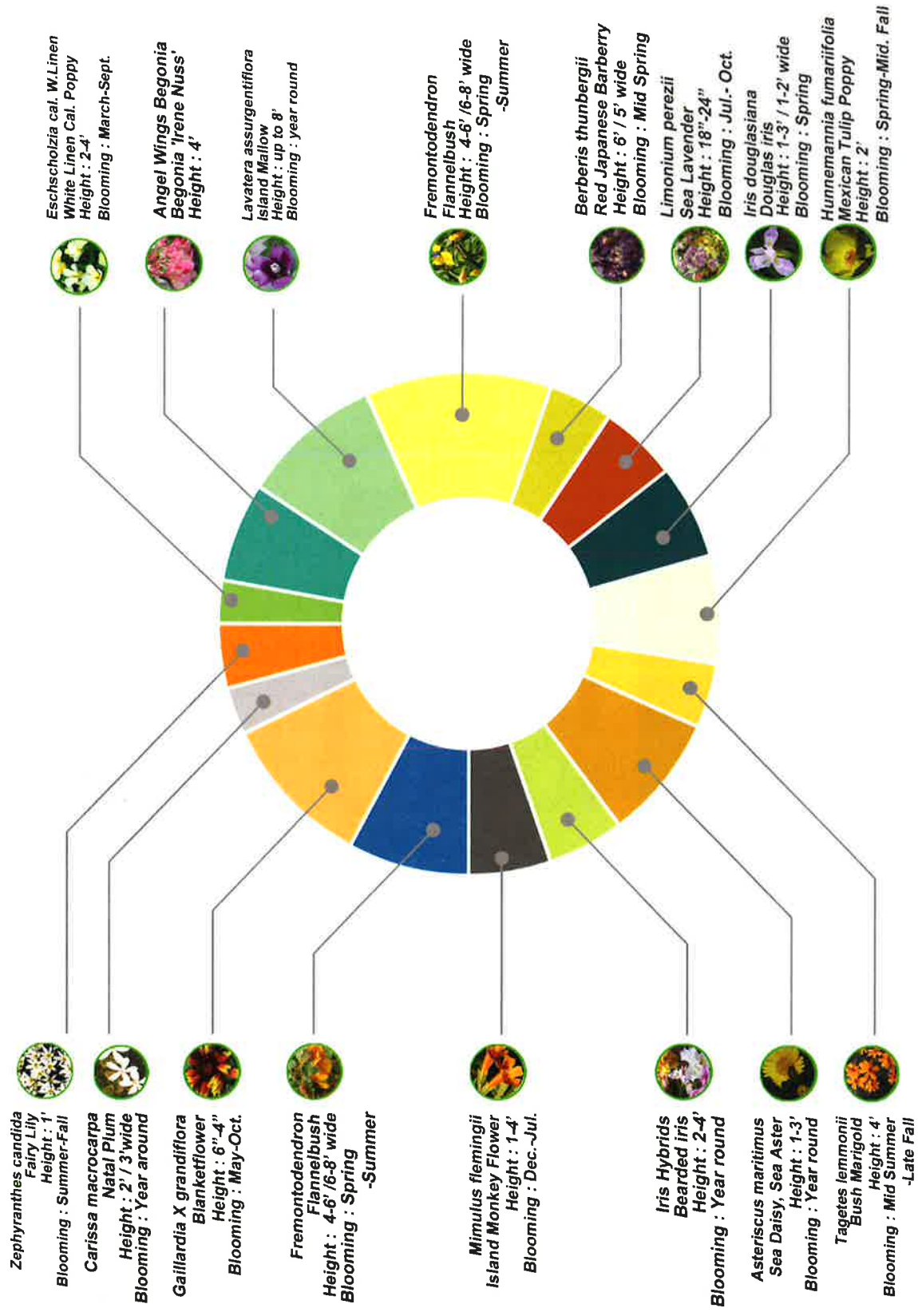
Landscape on Swales : Bioretention(Low Impact Development)



Avoiding water runoff is easy when working on a sand site. To accomplish this, the design approach for surface water throughout the site is to avoid collecting water into a point source. The use of roadway swales, avoidance of curbs and implement permeable

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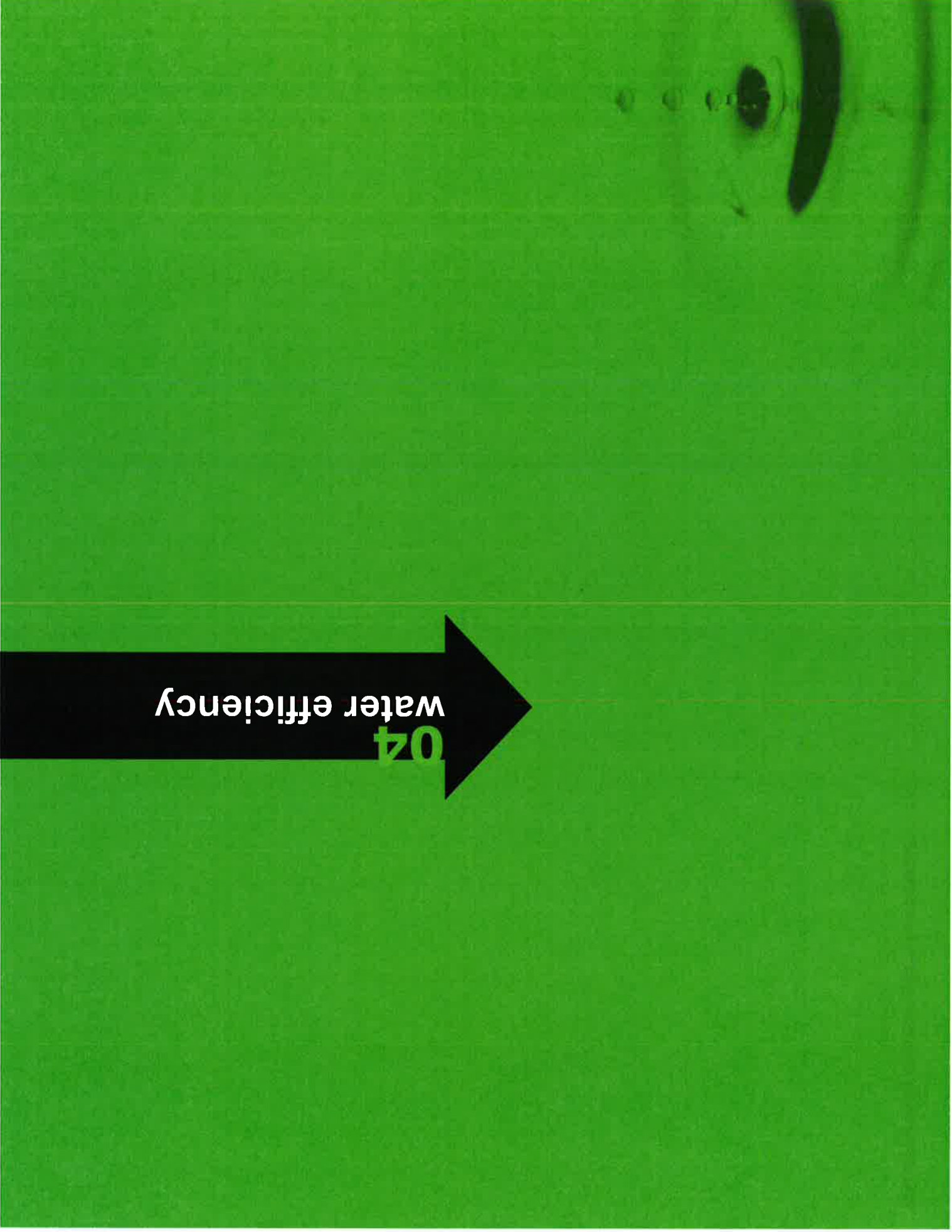
Xeriscape Plant List





water efficiency

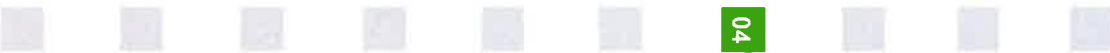
04





WATER EFFICIENCY  **04**

- Water Efficient Landscape
- Water Use Reduction
- Water Fixtures



Water Use Reduction



Fixture



Certified by
GSA International

	Gallons (Per Flush)	Estimated Daily Flushes	Estimated Daily (Gallons)	Yearly Savings (Gallons)
Toilets				
Conventional	1.60	10	16.0	N/A
High Efficiency (WaterSense)	1.28	10	12.8	1168
Ultra High Efficiency	0.80	10	8.0	2920
Urinals				
Conventional	1.00	15	15.0	N/A
High Efficiency (WaterSense)	0.50	15	7.5	2738
Ultra High Efficiency (Pint)	0.13	15	1.88	4791
Waterless Urinals	0	15	0	5475

Gallons Estimated Daily (Per Minute) Minutes

	Gallons (Per Minute)	Estimated Daily Minutes		
Faucets				
Conventional	2.20	13	28.6	N/A
High Efficiency (WaterSense)	1.50	13	19.5	3322
Showerheads				
Conventional	2.50	5	12.5	N/A
High Efficiency (WaterSense)	2.00	5	10	913

Total Achievable Savings

12629

WaterSense, a partnership program by the U.S. Environmental Protection Agency, seeks to protect the future of our nation's water supply by offering people a simple way to use less water with water-efficient products. Product and services that have earned the WaterSense label have been certified to be at least 20 percent

more efficient without sacrificing performance. The outlined data showcases estimated savings that can be achieved if WaterSense fixtures are specified.

2

Landscape

By specifying native and adaptive plant species for the newly landscaped area, after establishment of plants over the first couple of years, irrigation will not be required for these plants to continue to thrive.



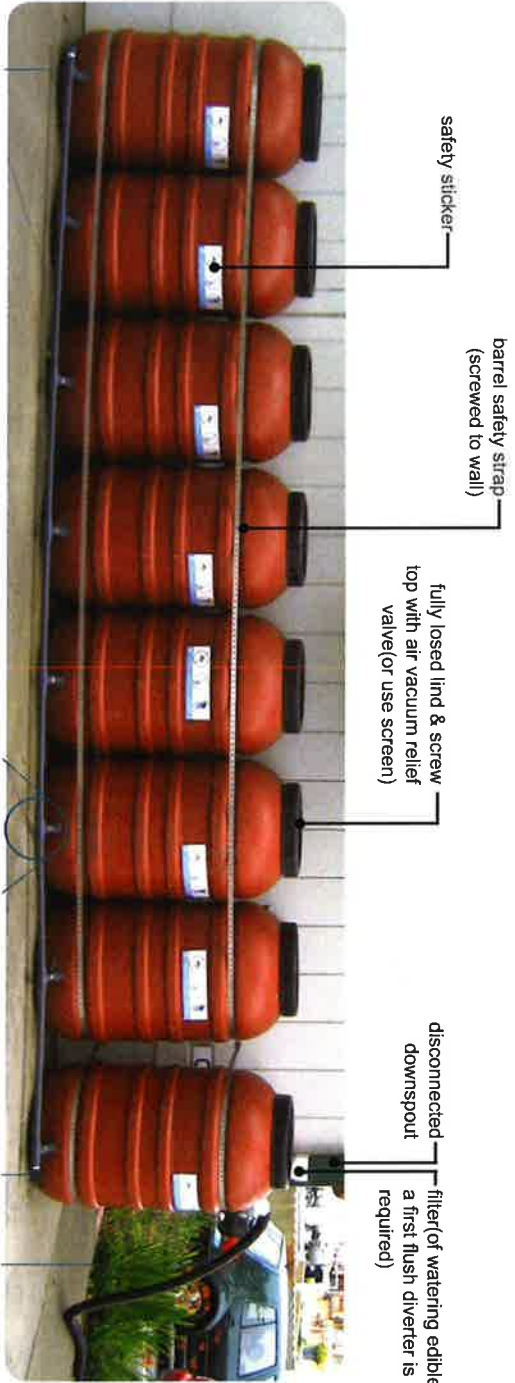
04

3

Rainwater Capture

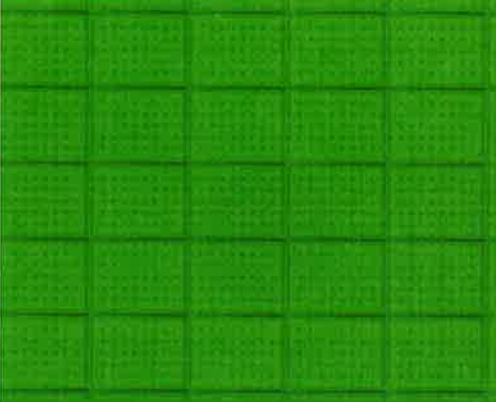
Captured rainwater that falls on building roofs can be used for non-potable uses such as irrigation, toilet flushing and cleaning. This will reduce water usage. A simple low cost ways to achieve this goal is displayed on the photograph "Rainwater Harvesting".

See Research Report Appendix for more details on rainwater harvesting.



energy & atmosphere

05





ENERGY & ATMOSPHERE



05

- Optimized Energy Performance
- Overall Energy Diagrams
- Solar Energy Diagrams

06

07

08

09

10

11

12

13

14

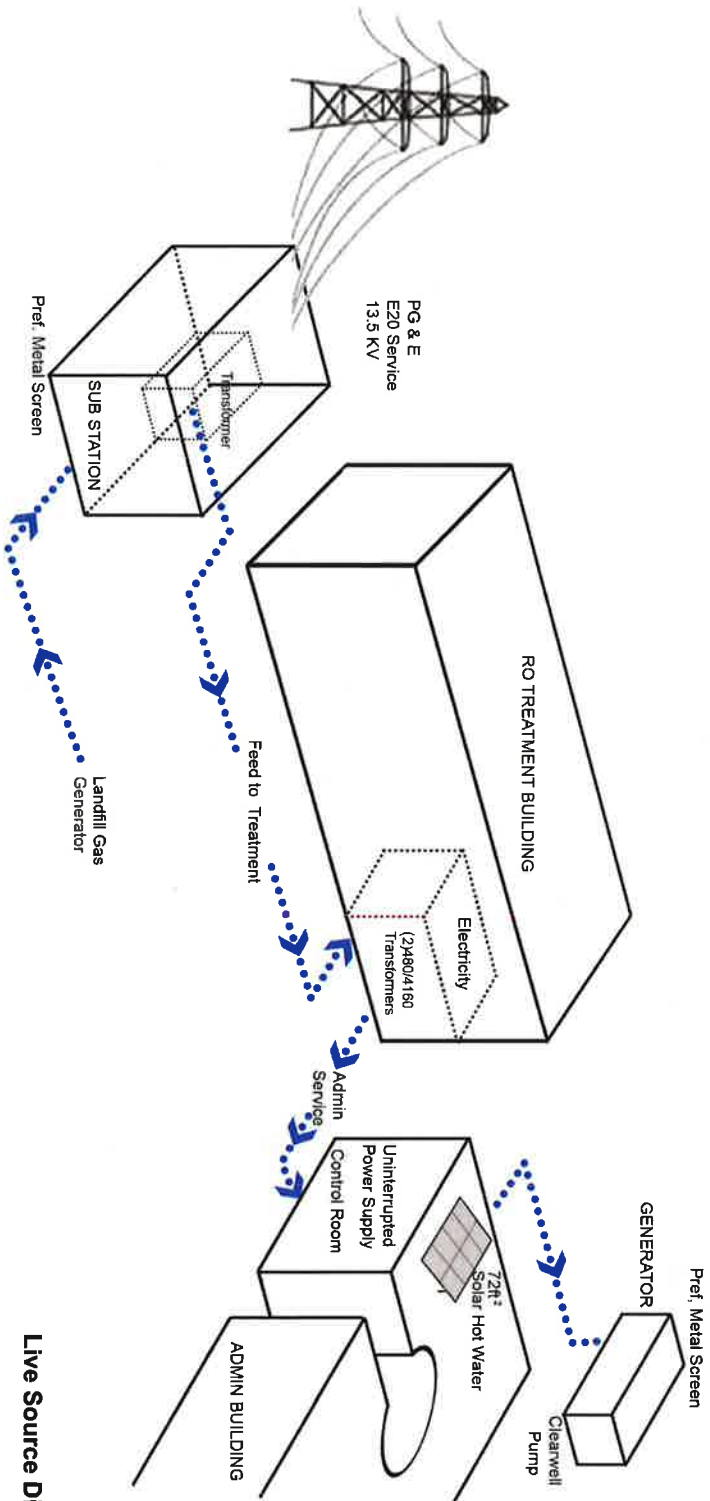
Power Sources:

1. Pacific Gas and Electric, 13.4 kV transmission line. Shown in Section 26 of the RFP, page 2-69
2. Monterey Region Waste Management District. The solid waste facility nearby may provide energy from their methane recovery and electrical generation facility.
3. Generator and Uninterrupted Power Supply (UPS). The emergency diesel generator will supply specific parts of the facility with power in an emergency. See Section 27 of the RFP, pages 2-71. The UPS serves the electronic components of the administration building.
4. Solar Development. The roof should be designed to carry approximately 4 extra pounds per square foot for solar photovoltaic panels (PV panels.) The rate payers can benefit from a positive cash flow immediately using a Power Purchase Agreement (PPA.) The net result is that the only power purchased from PG&E will be for the desalination process itself. All the power required for treatment building lighting, office use and site lighting can be delivered directly by solar panels. Supply of conduit for the PV panels, and space for inverters in the electrical rooms will be needed for providing the options to the owner to enter into a PPA.

Power Reduction Strategies:

1. Daylighting in treatment and administration buildings. See daylighting diagrams in Section 7 of this book. Daylighting reduces the main source of electrical consumption in office buildings.
2. Occupancy detectors. These tools can greatly reduce the electrical consumption in low occupancy facilities. In the treatment building, the lighting requirements can be significantly reduced by narrow-band lighting corridors and occupancy detectors. In the exterior lighting along the back of the treatment building, occupancy detectors can lower lighting use in the servicing area on the north side of the building.
3. Solar Hot Water heaters. The administration building requires hot water for staff use. This can be supplied from roof top solar water heaters that occupy less than 100 square feet.
4. Lighting fixtures. The treatment building can use metal halide high-bay lighting with narrow band illumination design. The exterior roadway lighting and treatment building supply area can be illuminated with LED fixtures to reduce energy consumption.

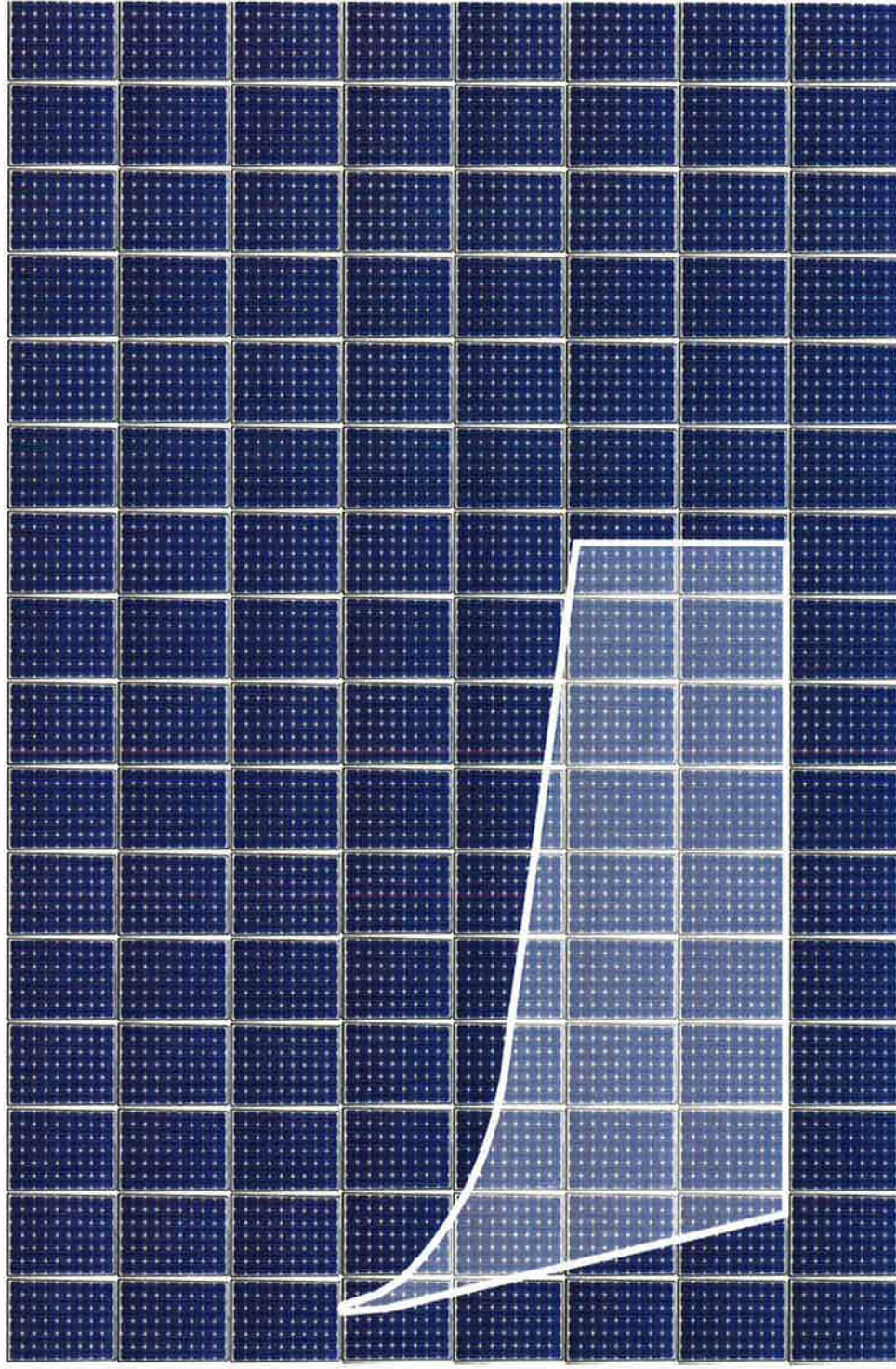
Overall Energy Diagram



Live Source Diagram

1. PG&E will supply 13.5 kilo volt service, under a negotiated "E20" service agreement with CAW. See Section 26 of the RFP, page 2-69.
2. The electrical substation at the farthest west part of the site, will receive the 13.5 kV line voltage and transform it into the 480/4160 service to be delivered to the treatment building. The treatment building will contain 2 transformers to supply power to the RO pumps, the high-bay lighting and the remainder of the site.
3. The feed to the administration building will join the feed from the solar PV panels to supply the electrical needs of the office use.
4. An uninterrupted power supply (UPS) will supply the control room and emergency lighting in a power failure.
5. A diesel generator will supply power to one clear-well pump, the admin bldg and other facilities listed in Section 27 of the RFP on page 2-71.
6. The 480/4160 transformers will supply site lighting. This system will consist of LED lightollers at roadway entrances and exit, intersections and visitor parking. Chemical unloading area, at the rear of the treatment building should have motion detector activation to prevent long-term light pollution to the valley below.

Solar Energy Diagram

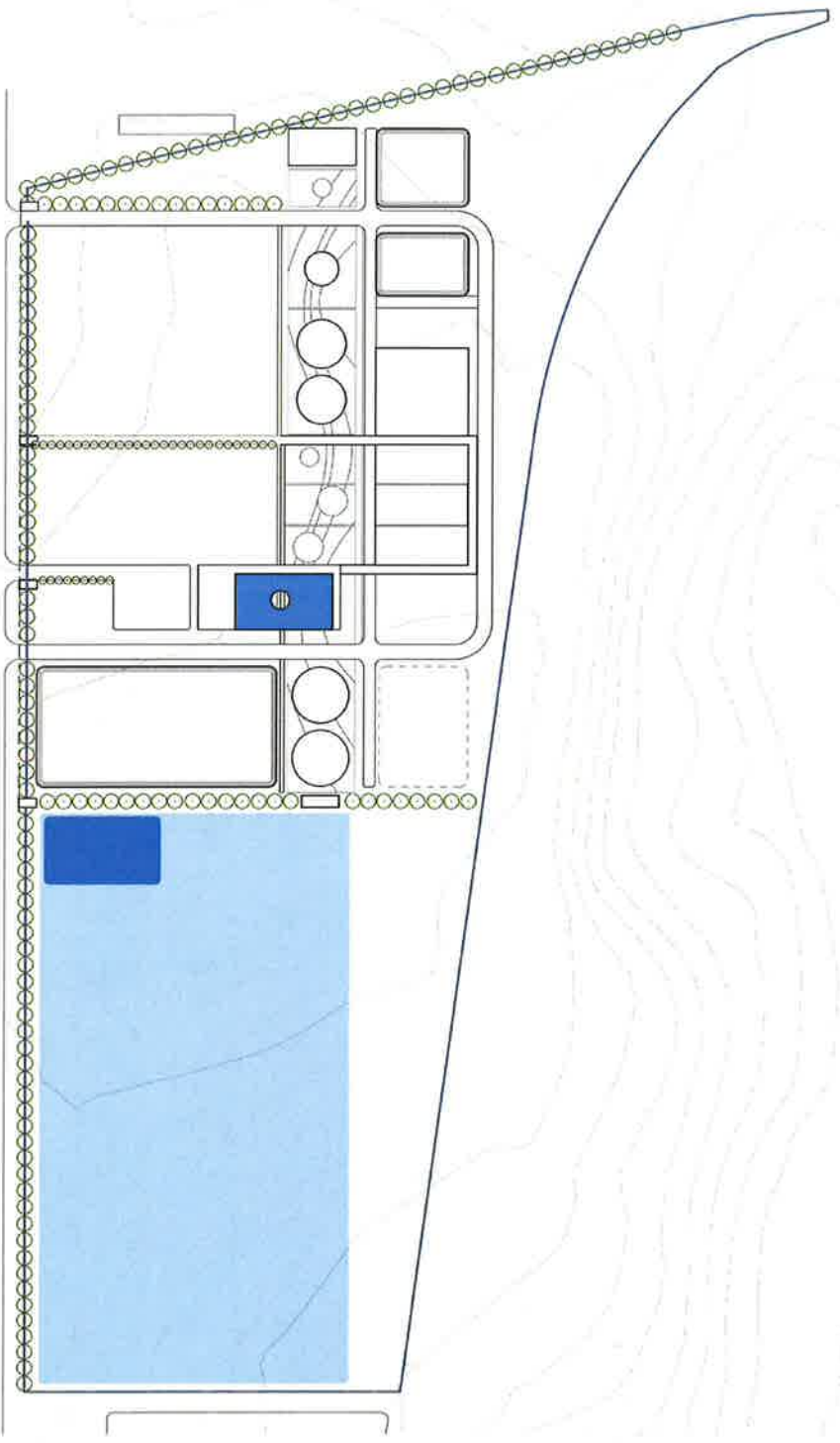


Amount of solar panels to power entire site

If on-site renewable energy in the form of solar panels were installed on site, it would take approximately six times the site area to power the facility 100% during the day as outlined on the drawing. Powering the Administration Building and the general lighting

around the site with solar panels is a viable option since the majority of power required is for the water treatment process.

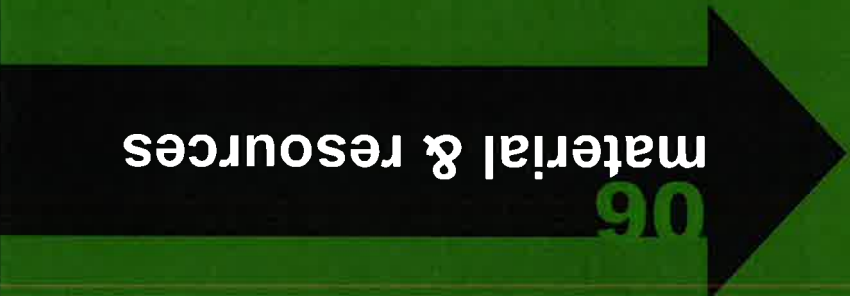
Solar Energy Diagram



Solar panel location options to power admin building.

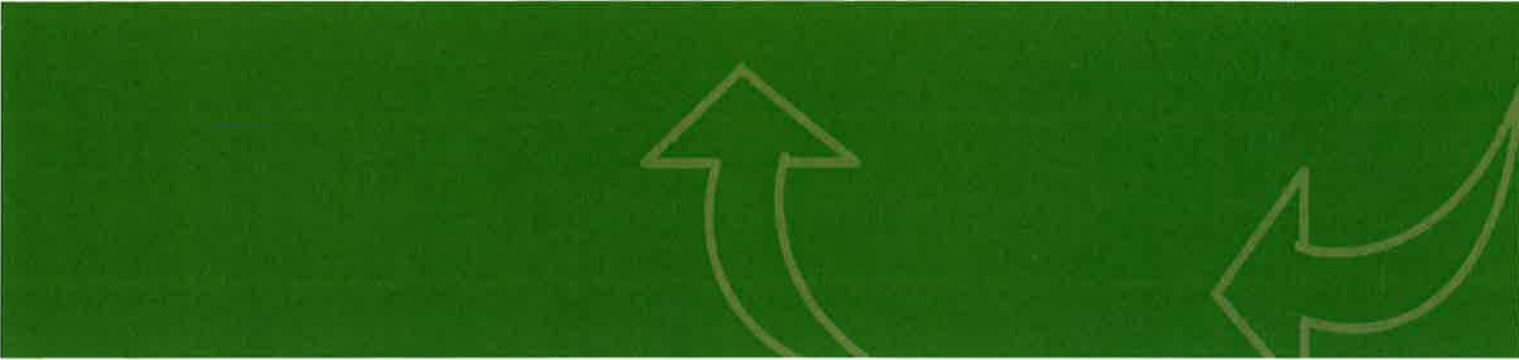
Installing solar panels on the roof can power the Administration Building during the day. There is also an opportunity to install solar

panels in the adjacent open space to power the Administration Building and other facilities.



material & resources

90



MATERIALS & RESOURCES



06

- Materials Goals
 - Material & Building Systems
 - Material Diagrams
 - Paving Diagrams
 - Surrounding Facilities Relationships



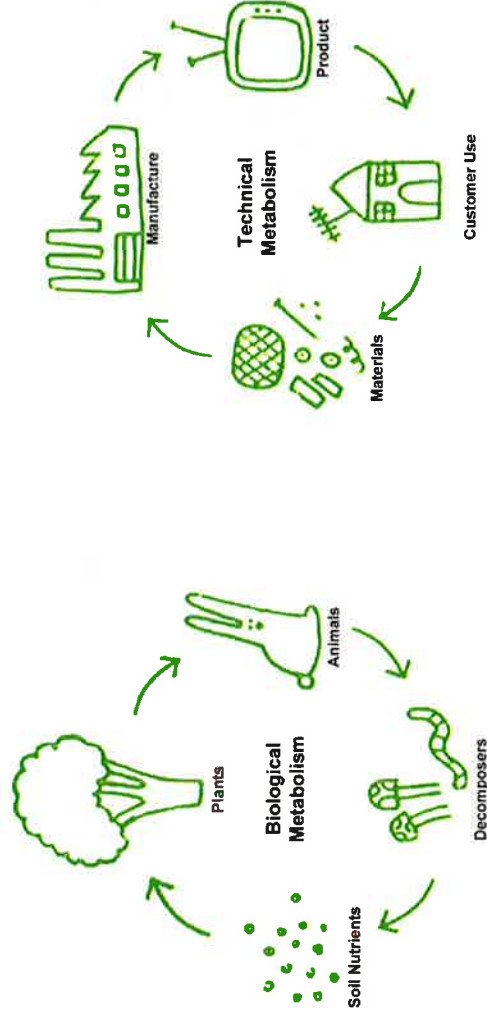
Materials Goals : Material Selection

Material selection criteria

- Cost effective
- Locally available
- Minimum environmental impact
- Reduces maintenance/replacement costs over the life of the building
- Energy conservation-Resulting in minimum operation cost
- Improve occupant health and productivity

Cradle to cradle design

Cradle to cradle is an innovative sustainable industrial model that focus on design of products and a production cycle that strives to produce no waste or pollutants at all stages of the materials lifecycle.



Cradle to Cradle Design : Biological and Technical Cycles

Materials Goals : Material Selection



Introduction

When it comes to materials and resources, the goal should be clear: Attempt to use locally sourced materials whenever possible; use sustainable products; and try to use products that have a good life cycle.

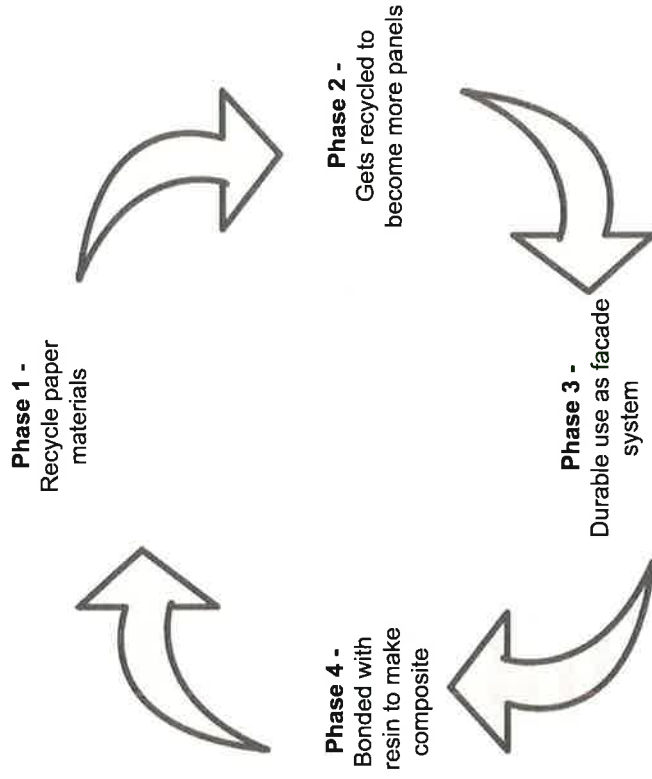
In regards to the life cycle, the process is called cradle to cradle. What this means is that the product can be taken from nature and/or fabricated in some way. Then the product is put to use on a job site. Over time the product either

biodegrades in a natural way or when the product is defective or simple too old and worn, the product is return and recycled to reenter the same manufacturing process that it began in. The idea of sustainability is paramount to the success of this process. This has already been mentioned several times and it doesn't stop when it comes to materials. Materials choices that last longer, have a better recycling process, and have less impact on the environment should be the primary choices in this project.

Plastic Wall Laminates



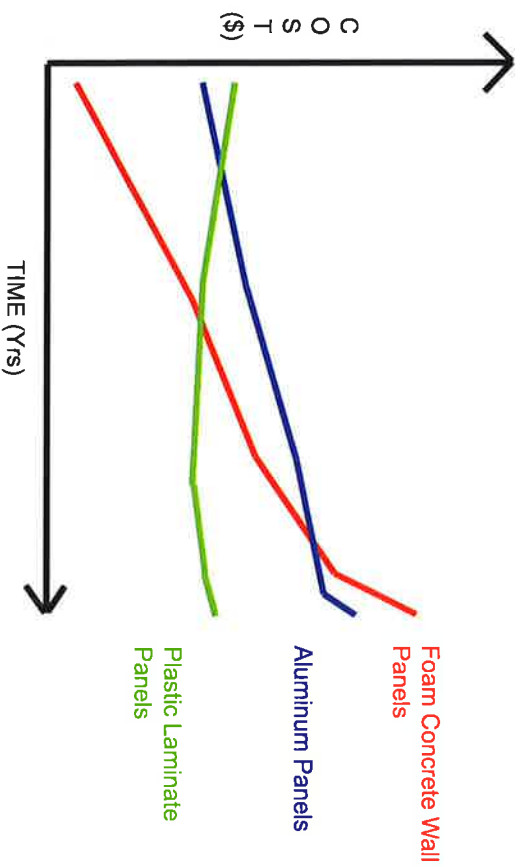
- A Blend of wood-based fibers containing up to 70% of recycled craft paper and thermosetting resins
 - Solid and sturdy
 - Weather Resistant and Color Stable
 - Specifically Resistant to Salt Fog
 - A broad range of color choices
- Durable
 - Low maintenance
- *www.trespa.com



Panel installation on framework is simple and quick.
 Operation is non necessary but panels could be attached to operable framework.
 Maintenance is cleaning every 6mos - 1 yr and simply involves wiping panels clean assum

ing construction methods follow specifications. Panels have moss and algae repellent and do not allow for dirt to accumulate internally. Replacement panels can easily be changed as needed, estimated 20 year warranty or parts.

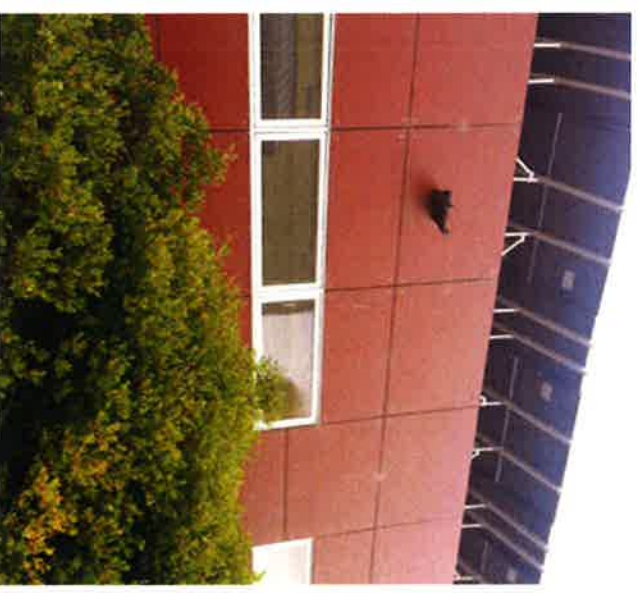
Time Frame Payoff Period Graph:



Plastic Wall Laminates

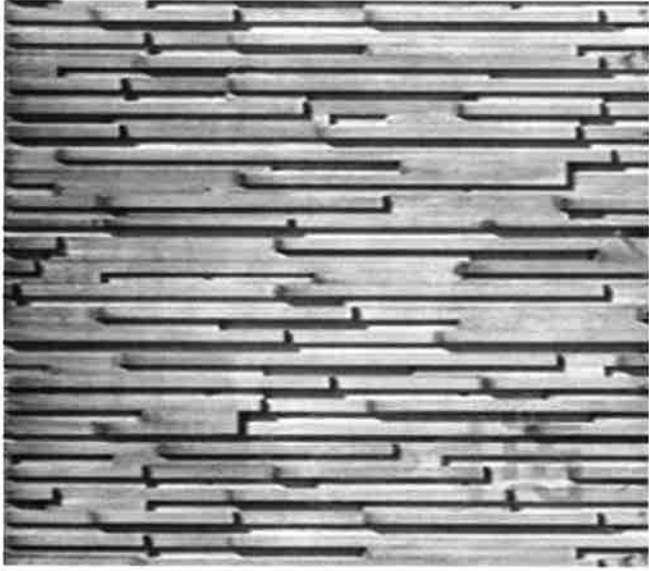


06

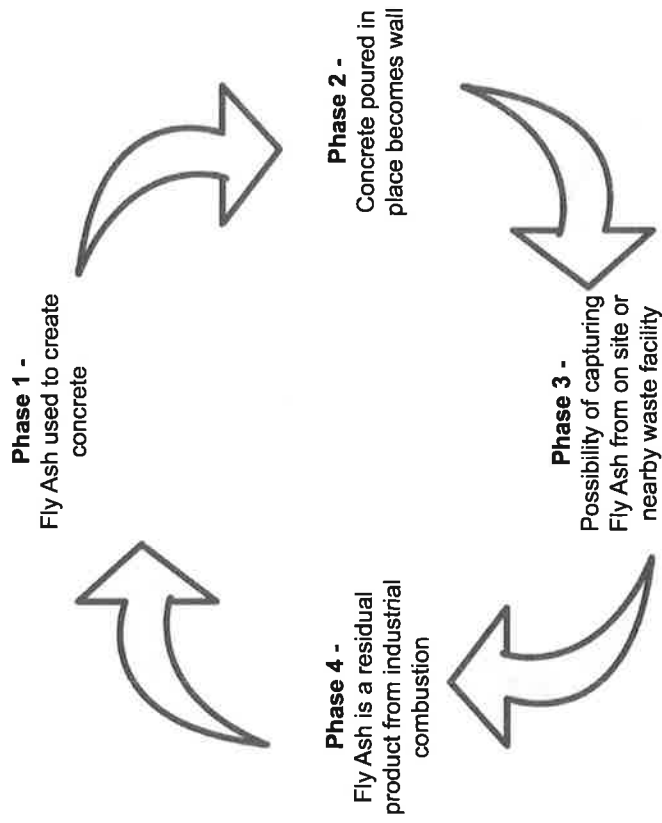
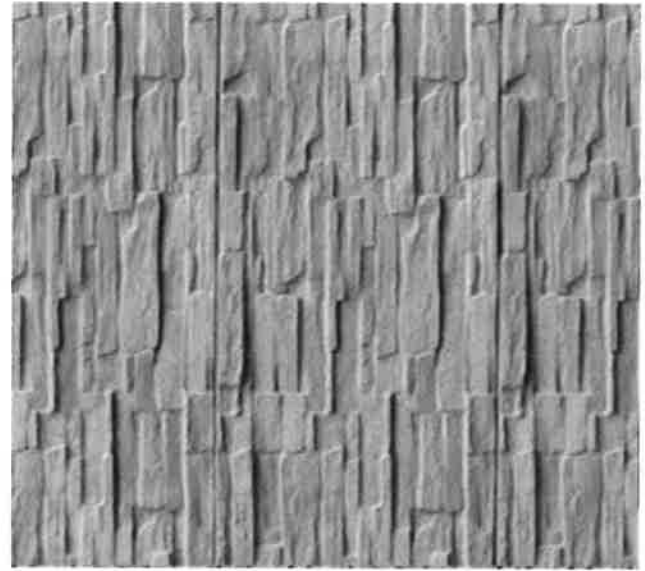


45

Tilt-Up Concrete Wall

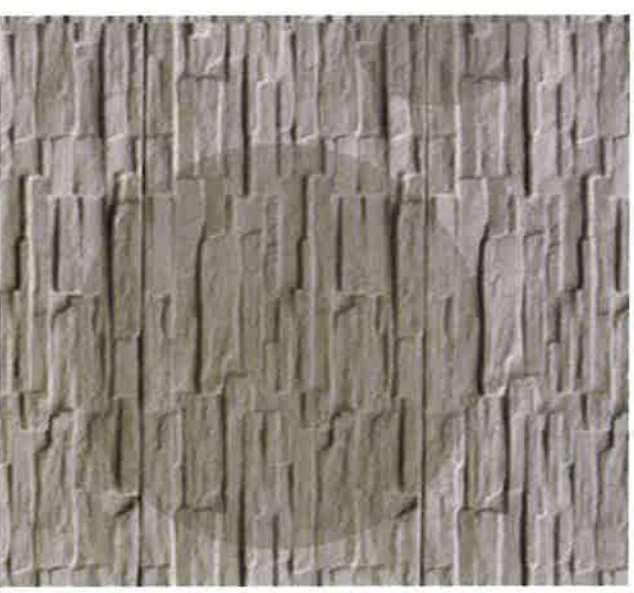
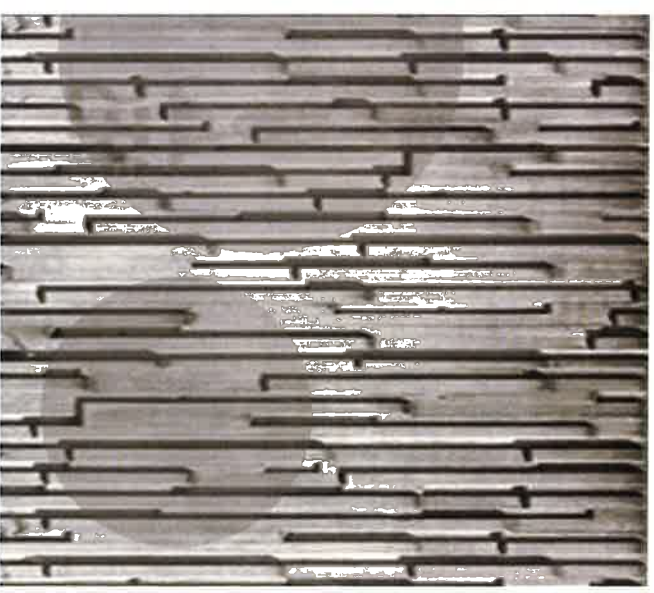
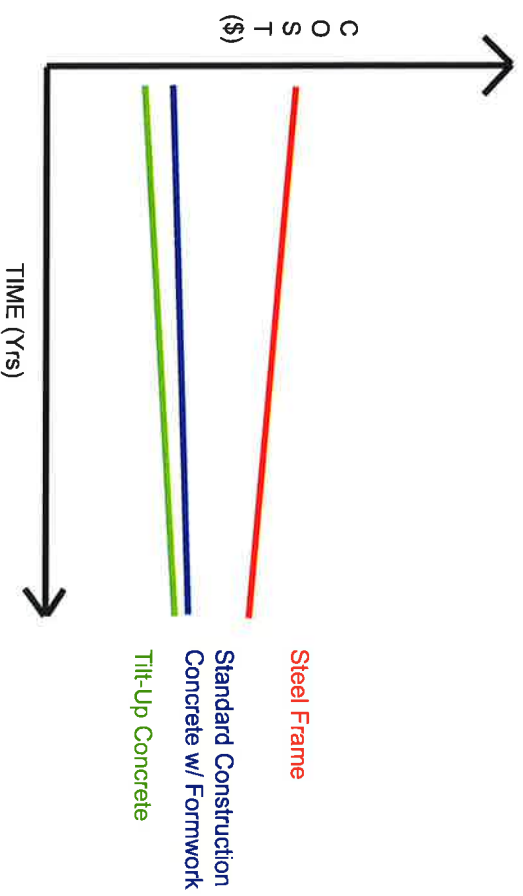


- Low construction cost
- Low maintenance
- Easy and effective construction
- Offers the ability to create custom artistic or educational patterns
- Durable



Installation is simple and quick following initial framework.
Framework can be reused for each panel.
Concrete sealers extend the life of the panel by reducing the amount of wear caused by weather and reduces the effects of fluid staining.

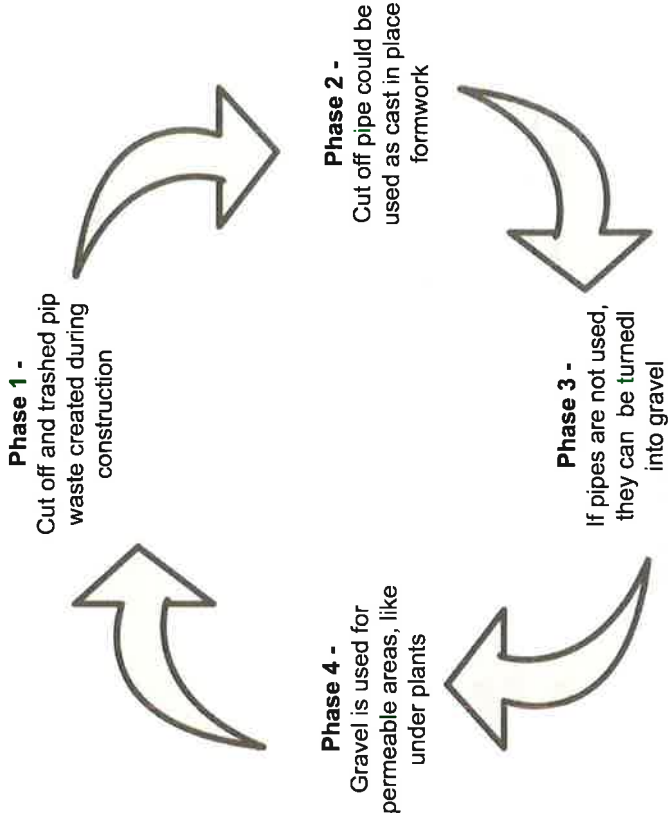
Time Frame Payoff Period Graph:



Storm Drain Tubes



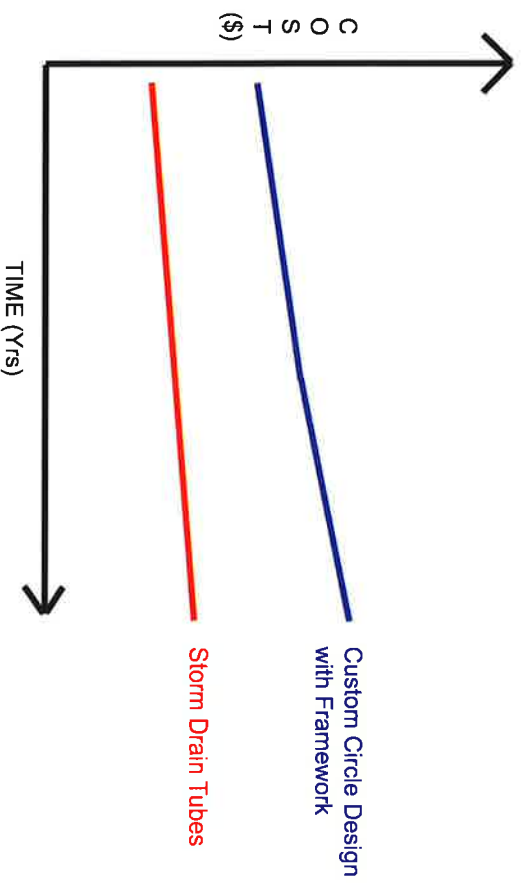
- Variety of reusable material choices: PVC, ABS, Concrete, PP, PE, etc.
- Possibility of creating unique façade or entry wall in the admin bldg.
- Helps to maintain the building at a moderate temperature.
- Tubes can be use as planters
- Tubes can provide educational activities and relationships



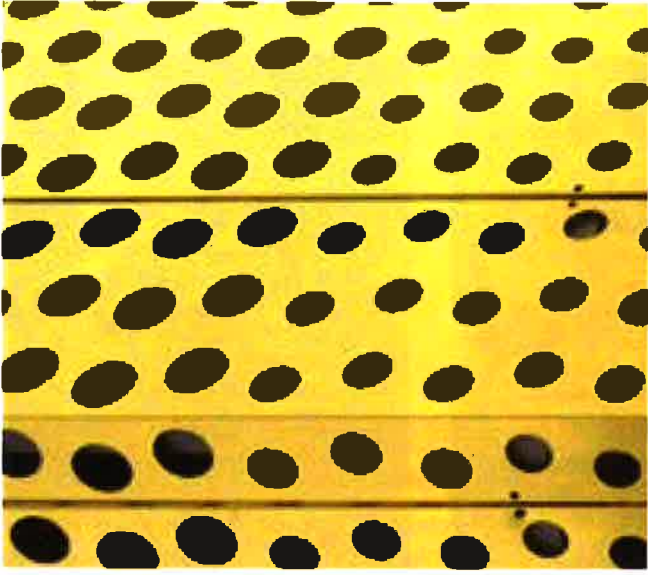
The recycled tube can easily be used as formwork and be left in the tilt-up concrete panel it is used with. Concrete sealers can also be used to prevent weathering. Cleaning the interior of pipe often can prevent water damage over time and mold build-up. To avoid this problem, consider adding a drainage feature.



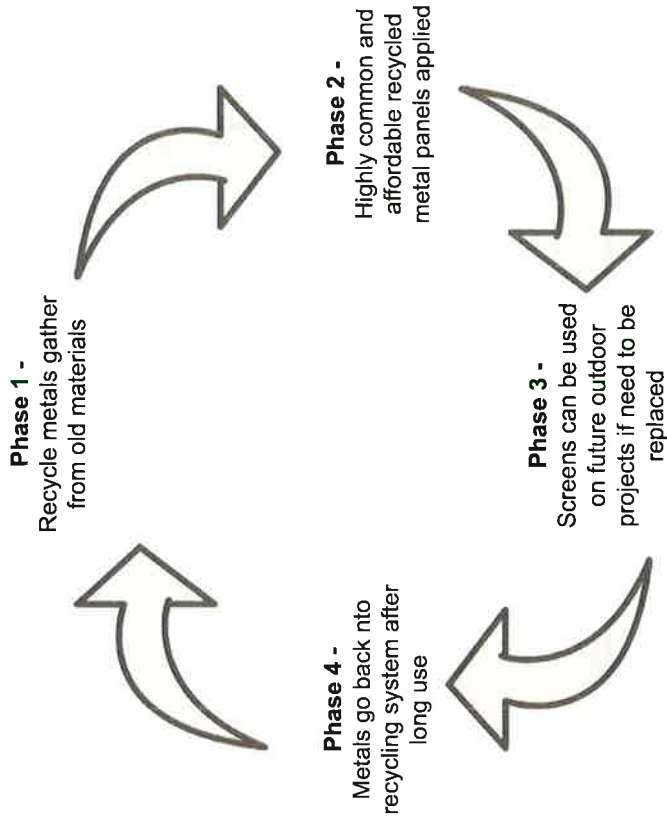
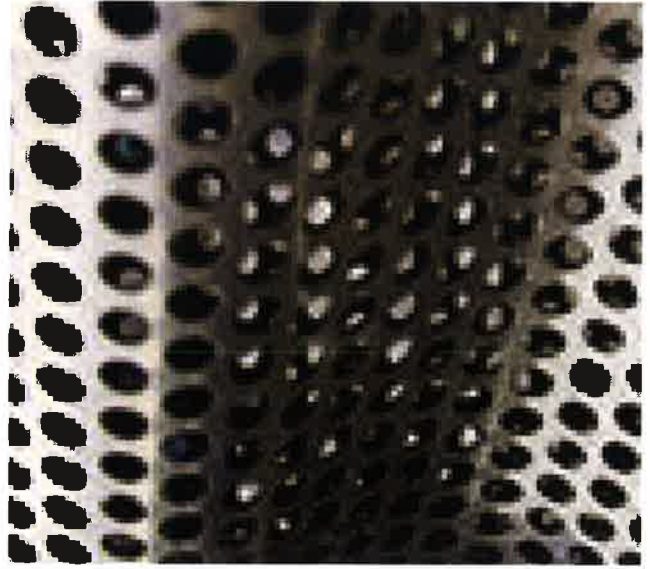
Time Frame Payoff Period Graph:



Steel or Aluminum Screen

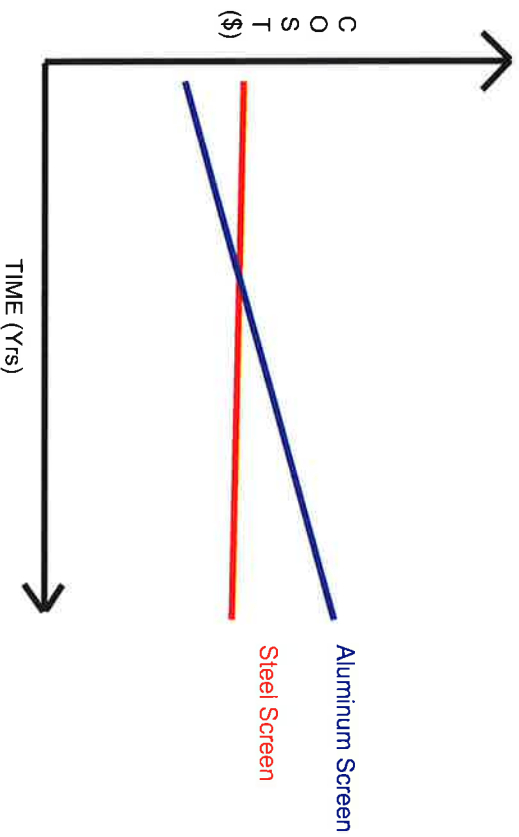


- More affordable than full wall (in the case of the Media Filter building)
- Most affordable way to add architectural aesthetic
- Affordable way to reduce dead load on building
- High Potential for local sourcing
- High Potential for recycled materials

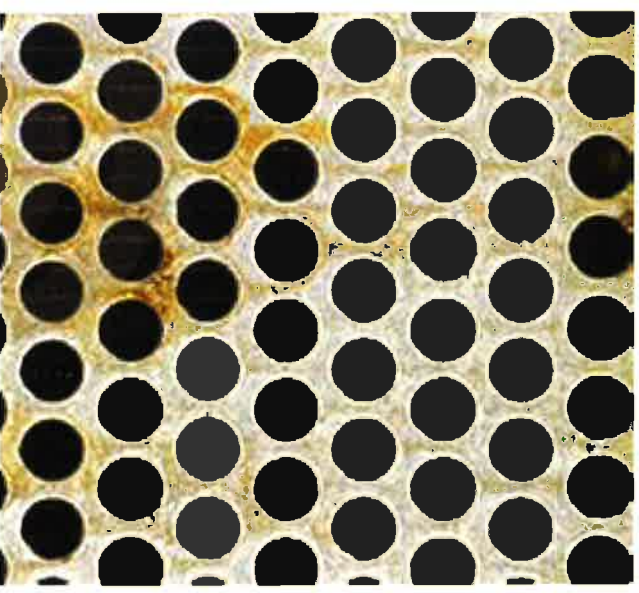
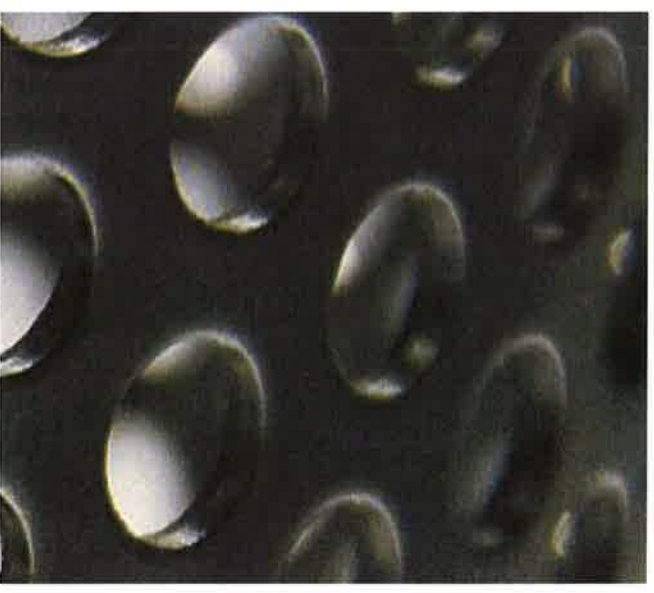


Use stainless steel to avoid rusting over time.
 With aluminum oxidation will occur but will only affect the finish, not the structure. The finish can be polished or can remain oxidized for aesthetic affect.
 Occasionally cleaning of debris from screen will prevent issue relating to long term water damage or staining.
 Steps may need to prevent birds from inhabiting parts of the screen. Perhaps encourage birds to nest elsewhere by providing a better habitat option.

Time Frame Payoff Period Graph:



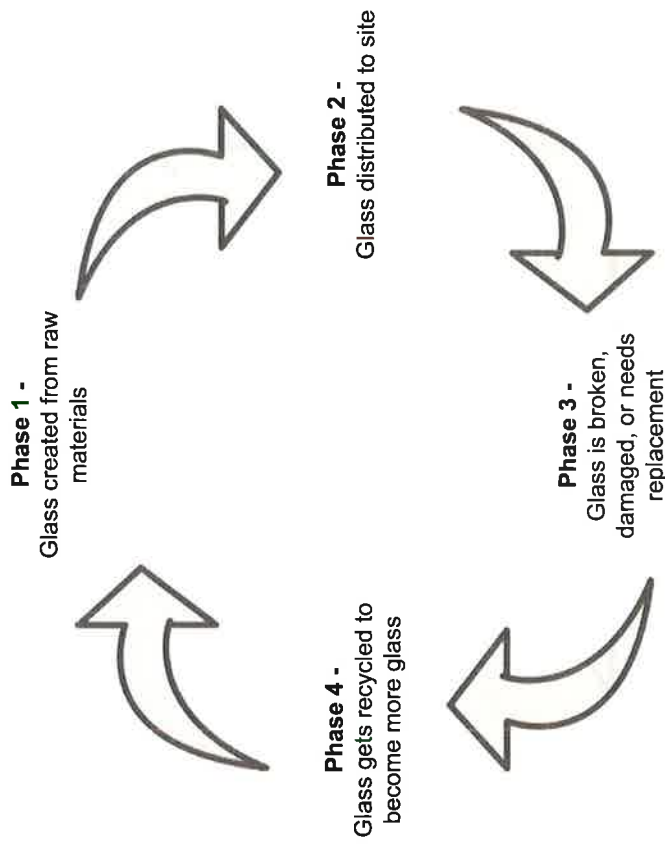
Steel or Aluminum Screen



Glass

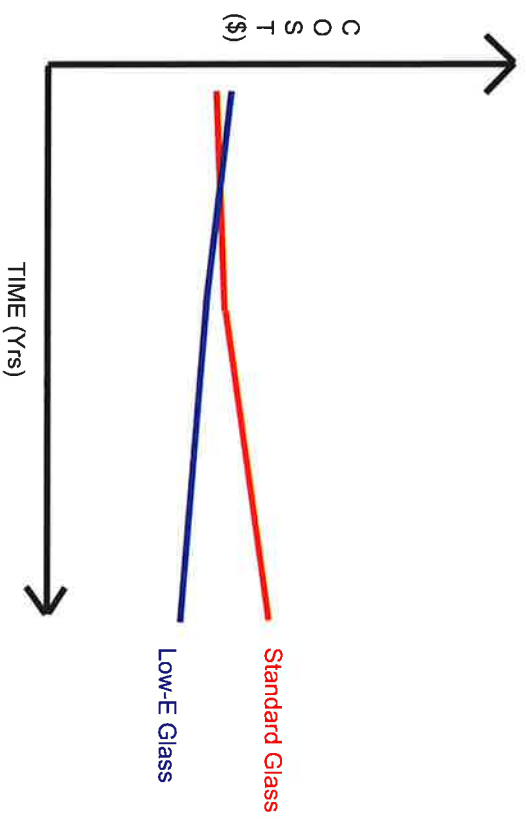


- Low-E options available
- Decreases need for artificial lighting therefore lowering overall cost
- Our design has decreased the amount of glass needed on site
- In the case of the educational tour, glass serves dual purpose for lighting and for visitor viewing from outside
- Availability of companies that specialize in Cradle to Cradle glass



Clean often to allow the glass and the natural greenhouse effect to take place.
If glass is damaged, return to manufacturer to continue cradle to cradle process whenever possible.

Time Frame Payoff Period Graph:



See Through Roll Up Doors



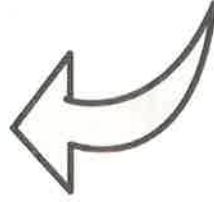
- Provides a panoramic view of the landscape
- Creates bright and lively space
- Use of polycarbonate for strong, durable * semi-transparent panels in doors.
- Flexibility of moving large equipment, machines and vehicles through-out facility



Phase 1 -
Doors created and distributed

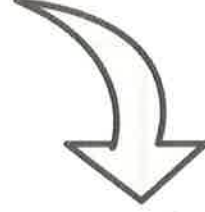


Phase 4 -
Panels replaced while materials re-enter process



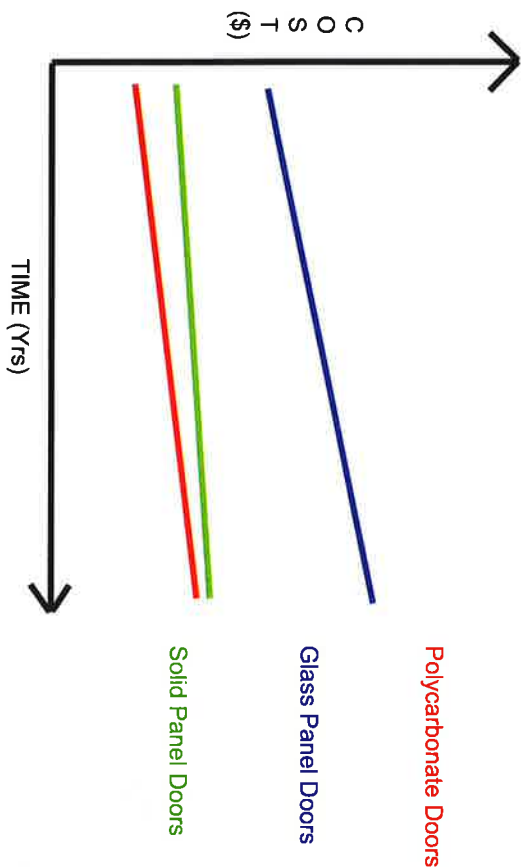
Phase 3 -
Metal, Glass, and Polycarbonate panels can all be recycled

Phase 2 -
Door frame has panels that can be changed and replaced



A variety of panel types can all be replaced or updated as needed.
 Proper lubrication of gears and chains is necessary for continued use.
 Occasionally remove panels when clean for the most thorough cleaning possible.

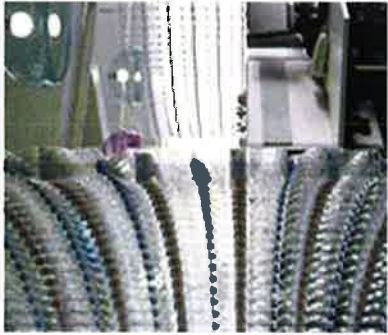
Time Frame Payoff Period Graph:



See Through Roll Up Doors



Interior Materials & Sustainable Products



- Cork Flooring
- No VOC paints
- Rapidly Renewable Materials (Bamboo Cabinetry)
- Reclaimed Material (Water Bottles) as internal dividers
- Dual-Flush Toilets
- Sensor Exterior Lights

The list goes on.

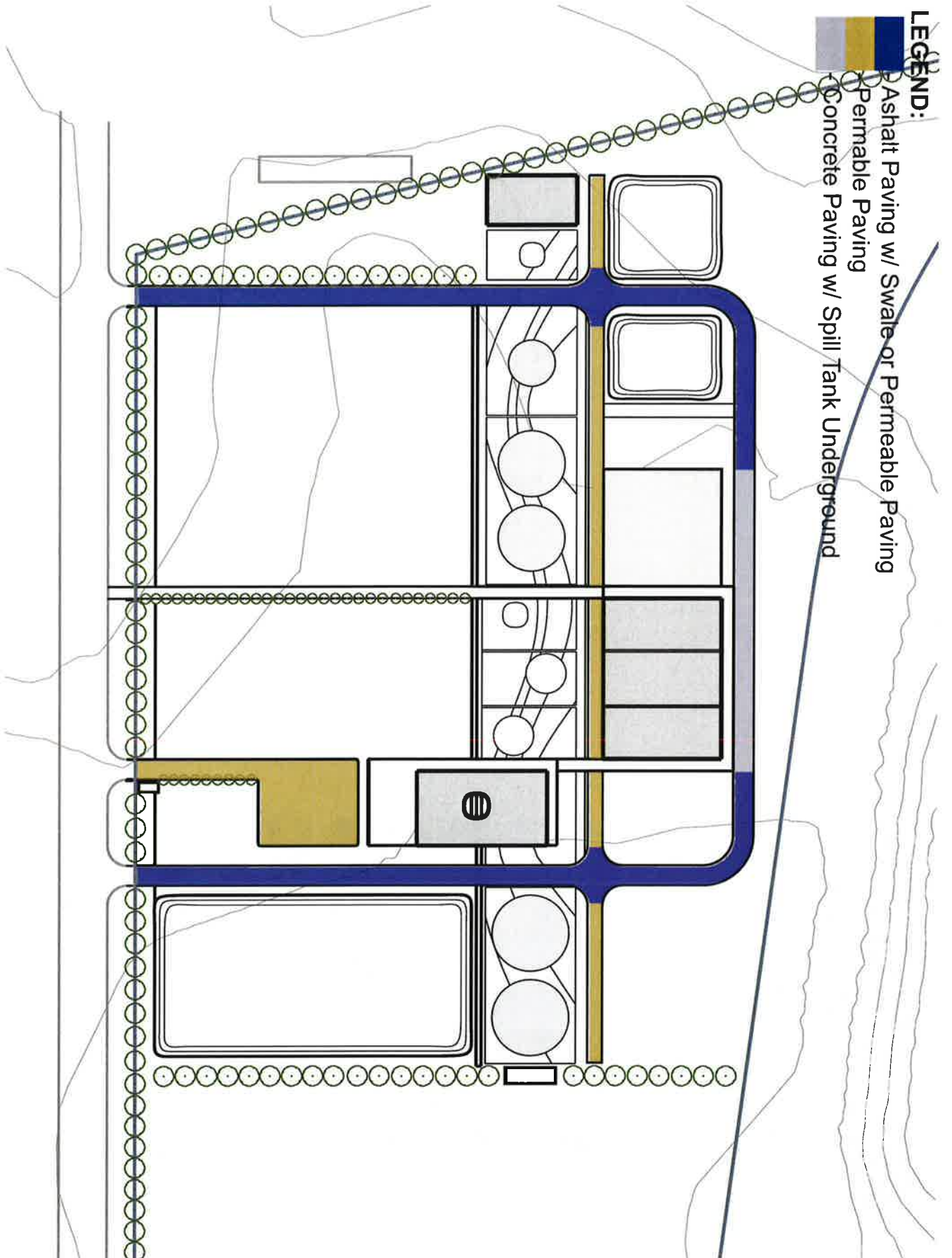
Secondary Text goes here? Or another image

This is a text section about the relationships to surrounding facilities when it comes to materials. Gravel could be obtained from nearby sites, etc.



LEGEND:

- Asphalt Paving w/ Swale or Permeable Paving
- Permeable Paving
- Concrete Paving w/ Spill Tank Underground

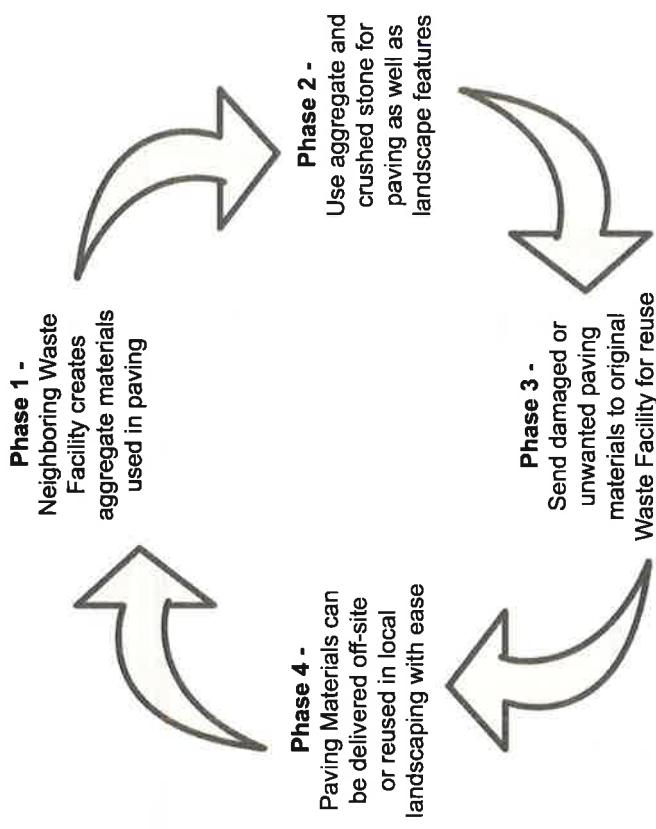


Paving Materials



Paving Materials

- A variety of options are available including asphalt, permeable pavers, and concrete.
- Permeable option allows water infiltration directly into the ground
- Asphalt should be paired with a swale for drainage purposes.
- Concrete, when pair with drainage to enclosed underground storage tanks, allows for a safe option in an area where chemical spills could occur. Consider this near the delivery areas on site.



Surrounding Facilities Relationships

LEGEND:

- Desalination Proposed Site
- MRWMD
- MRWPCA

The site is near the ocean and two useful neighbors: The Monterey Regional Waste Management District (MRWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA.) The waste management district produces electricity and may provide a substantial amount of energy needed to operate the Desalination Plant.

Both of these industrial facilities take in a product seen as waste and create something of value, something the Desalination Plant intends to do as well. The location also offers the extremely beneficial opportunity for the desalination plant to tap into the recycled water plant's outfall discharge pipeline. This will save the plant the large cost of building a completely new outfall line to the ocean.



interior and environment

07

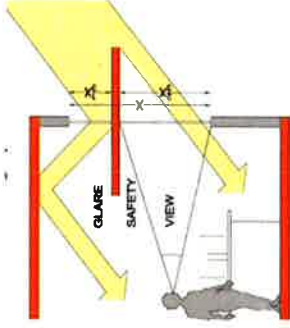
INTERIOR AND ENVIRONMENT



07

- Daylighting Diagram
 - Views Diagram
- Interior Environment Efficiency
 - Passive Strategies

Views and Daylighting Diagrams



Sustainable design depends on using natural sources for lighting as much as possible. In our design we utilize high windows to supply light far into the interior of the administration building. Also, the central space in the Admin building provides light to the interior rooms.

Shading devices and innovative light shelves on south-facing windows reflect natural light deep into or spaces while at the same time shading lower windows from direct sun, reducing cooling loads and glare. The use of incandescent and fluorescent lighting can be reduced.

The LEED category Indoor Environment Quality aims to promote better indoor air quality and access to daylight and views for residents, works and visitors. This objective combined with the importance of creating a safe and scenic path for visitors and staff to travel along has been recognized.

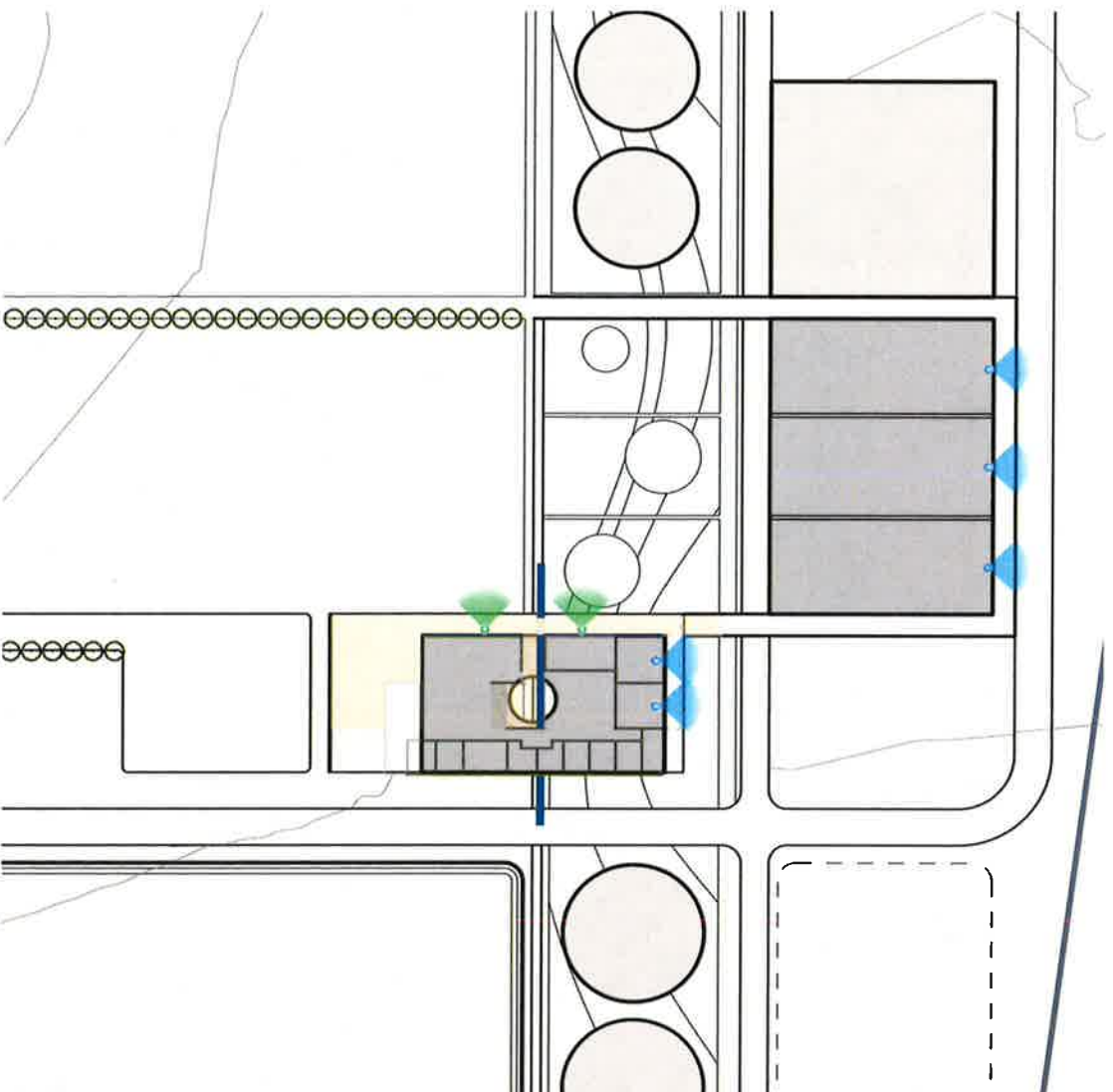
The design incorporates a raised walkway that runs around the treatment building to accomplish this goal. This pathway provides a scenic view and fresh air, while offering the opportunity for those interested in the treatment process to peer down on the equipment through strategically placed windows and openings.

The surrounding building envelopment provides a

sound barrier between visitors and the operating equipment, which in turn reduces and possible will eliminate the need for hearing protection for those observing the process from the outside. This reduced level of noise will provide opportunities for tour guides to verbally communicate with visitors at each stage of the process. Keeping members of the public off the working floor will allow operators to work uninterrupted, while protecting the safety of those visiting the facility.

Furthermore, this walkway provides greater accessibility to disabled visitors and staff since the walkway provides a wheelchair accessible path, which is free from obstructions that may hinder the visual impaired.

Views and Daylighting Diagrams



Three rooms in the administration building on the north end of the building have spectacular valley views. They are the facility manager, laboratory and control room. The conference room has a courtyard view.

innovation in design

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INNOVATION IN DESIGN

- Community Group Outreach
- Education at Detail Level



08



Community Group Outreach

Community Outreach

There are a number of local community, non-profit and governmental groups in the surrounding area that have similar conservation and sustainability goals as those proposed through the sustainability plan. Working with these groups offers many benefits for both the local community and the facility operators.

Monterey Peninsula Regional District (<http://www.mprpd.org/>)

The Monterey Peninsula Regional Park District was formed in order to preserve and protect as much natural beauty as possible for future generations.

The project has an opportunity to work with the Monterey Peninsula Regional District to preserve and protect the large amount of nature open space available on the site. Community access to the open space between the brine pond and the adjacent waste management facility is a possible option.

City of Monterey <http://www.monterey.org/en-us/environmentalprograms.aspx>

The City of Monterey is involved in a variety of efforts to alter city operations and strategies to be more environmentally friendly.

The city promotes green building practices through its Green Building Ordinance, which requires new developments to meet LEED certification standards. This project has the opportunity to showcase its sustainability elements to City of Monterey community members including its approach to meet the intent of LEED.

The city is also working with PG&E to reduce energy load reduction during times of peak demand. The project's operations can consider such a Energy Demand Response Strategy to potentially receive financial incentives from PG&E while working in line with The City's goal.

Monterey Regional Stormwater Management Program <http://www.montereysea.org/>

Working with this organization can aid in the creation of Construction Site Storm Water Runoff Controls and long-term post construction BMPs (Best Management Practices) to protect future stormwater quality.

Citizens for Sustainable Marina <http://c4smarina.weebly.com/> and Citizens for a Sustainable Monterey Peninsula <http://www.sustainablemontereycounty.org/>

Are two local groups that promote sustainable within

Community Group Outreach

Are two local groups that promote sustainable within the community. Working hand-in-hand with such groups can benefit the project and the community including the extension of existing bike routes, the creation of a community vegetable garden and through the promotion of local green energy.

An exciting opportunity to work with local community groups, local government, the waste management facility and recycled water facility to extend the existing bike route out to these facilities, included the proposed project along the way currently exists. See the exciting Marina City bike map attached as part of the Appendix. <http://c4smarina.weebly.com/uploads/4/0/3/6/4036822/marinacomunitymap.pdf>

Working with the Gardens For People project to establish a vegetable garden on a portion of the open space adjacent to the waste management facility. <http://c4smarina.weebly.com/gardens-for-people.html>

Support local green energy programs by investing MCE Clean Energy. <https://mcecleanenergy.com/>

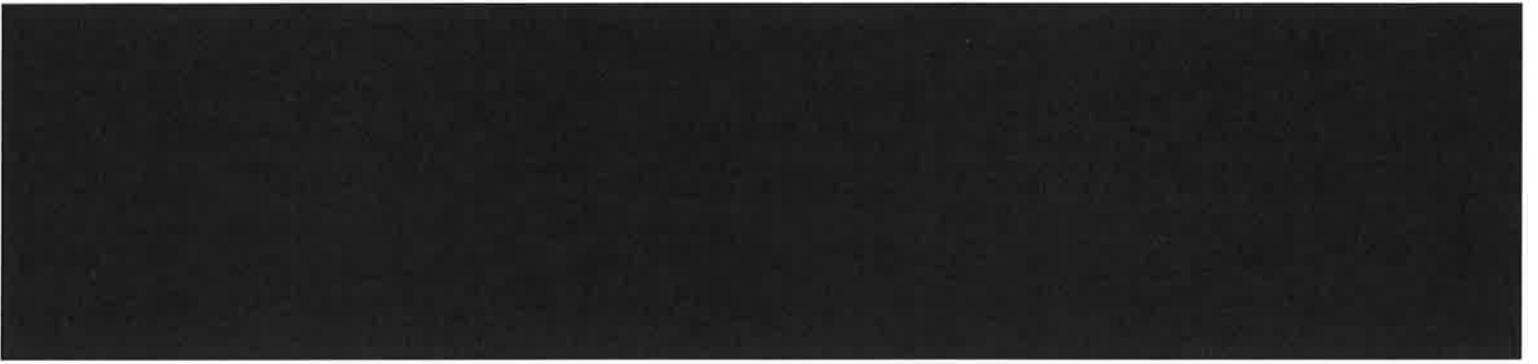
Society of Cruel to Animals for Monterey County <http://www.spcamc.org/index.html>

An opportunity exists to work with SPCAMC through the creation of natural habitats for rescued wildlife.

quantity comparisons

60





AMOUNT COMPARISONS



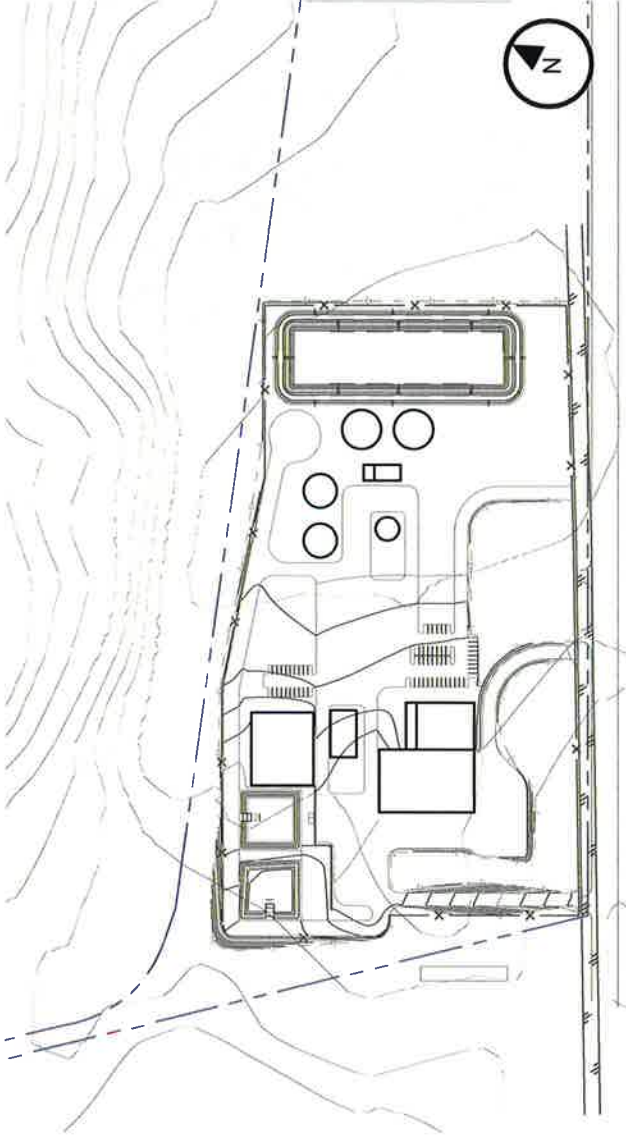
09

- Site Comparisons
- Quantity Comparisons
- LEED Elements and Materials Selections
 - Cut and Fill Comparisons

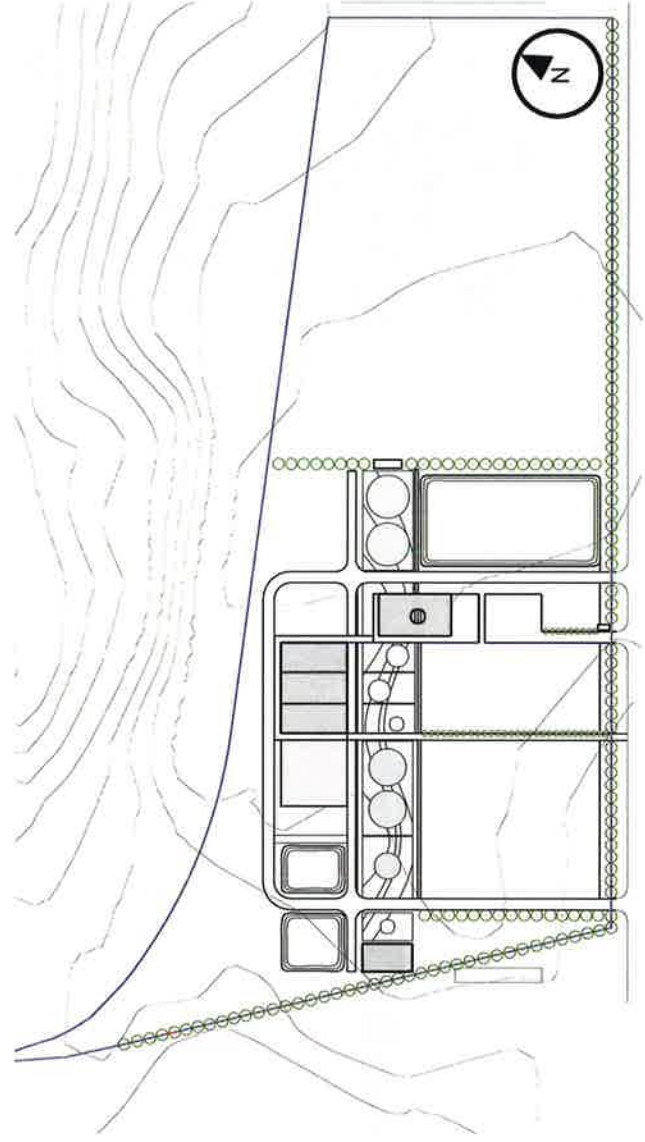


Site Comparisons

Original Conventional Design



Proposed Sustainable Design



In comparison to a standard engineering preliminary view of the project, we have made some dramatic changes in scope of work.

The square footage of buildings. The bulk of this change is that we eliminated the building around the multi-media filters. We have replaced it with a perforated metal screen around the perimeter of the space. We feel that the Administration Building might be reduced even further than we have it shown.

The bulk excavation is reduced substantially and is largely the result of grouping the buildings and reducing the amount of paving. We placed the buildings in site contours as much as possible.

Quantity Comparisons

Scope Comparisons

In comparison to a standard engineering preliminary view of the project, we have made some dramatic changes in scope of work.

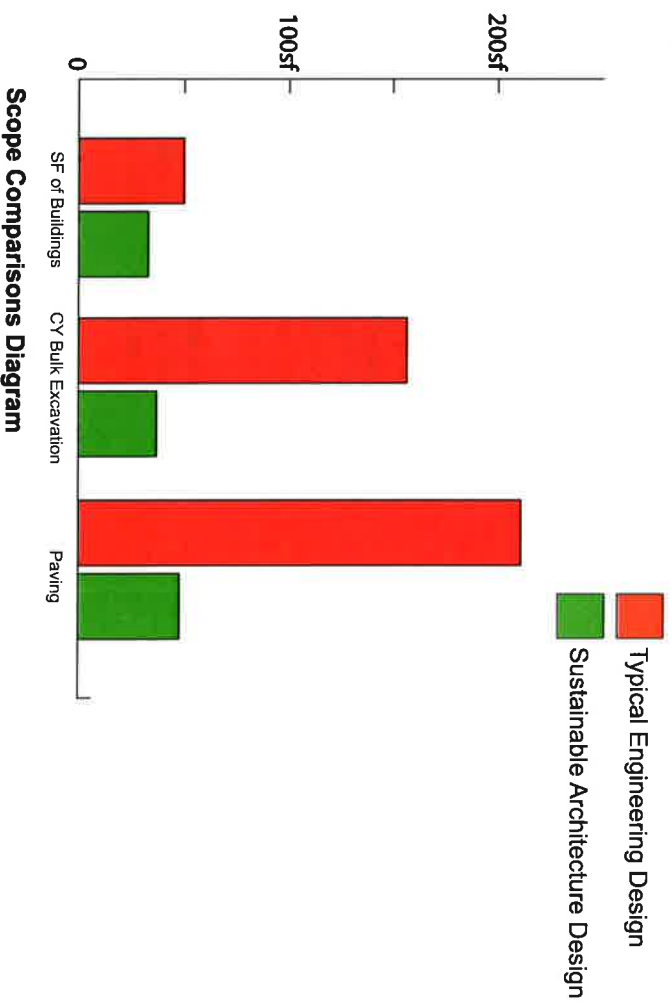
The square footage of buildings. The bulk of this change is that we eliminated the building around the multi-media filters. We have replaced it with a perforated metal screen around the perimeter of the space. We feel that the Administration Building might be reduced even further than we have it shown.

The bulk excavation is reduced substantially and is largely the result of grouping the buildings and reducing the amount of paving. We placed the buildings in site contours as much as possible.

A Quantity Survey, attached in Appendix, is a background for the following cost comparisons. We were asked about the cost of sustainable design. These comments arose from our research:

The national average cost premium for green building is reported in RS Means at 3%. This includes heating and cooling costs for buildings across the country. Our climate is much less expensive for heating and cooling as well as reduction in these costs.

SF of Buildings	50,100 sf	33,300sf
CY Bulk Excavation	157,357cy	37,100cy
Paving	211,400sf	48,112sf



Compare Cost Sustainable vs. Non sustainable or Traditional Materials and Building Methods

LEED Elements

The sustainable designs are becoming commonplace. The elements included in sustainable studies are soon becoming standard elements in industrial design, reducing what were previously extra costs of LEED compliance and certification. The main influence driving this change is life cycle analysis. For an industrial design, increasing emphasis on durability is a common expectation. This goal aligns with sustainable design producing similar budgets.

We researched 19 LEED elements applicable to this project if Gold Certification is desired. The Appendix contains our cost review, the LEED analysis is in Section 2 of this book. The research indicates that LEED aspects of our design will not add any cost to the project, when balanced against reductions in scope listed on the previous page.

Increased costs in HVAC efficient devices and approaches are extra costs in any climate. Advanced energy metering will provide efficiency information but costs more to install. These expenses are offset by the overall reduction in building, grading and paving so that our design has a much smaller cost exposure than standard engineering designs.

Materials Selections

Our research covered 5 large-scope elements to inform us as we assembled our Proof of Concept design.

First, the site is sand. We don't have soils reports and have not designed the foundations. Reducing grading and producing a balanced cut/fill can be accomplished by stepping the floor level of the two main buildings and locating the larger one on a lower elevation. While sandy site is half the cost

of clayey site in grading, the reduction in scope is significant.

Second, the building envelope is the most expensive part of the structure. We have selected tilt-up concrete panels and composite rain-screen panels for the two buildings. We propose textured concrete panels and research shows that the costs are similar to other approaches for fireproof industrial structures. The composite panels vary significantly in price, however, the life cycle benefits of aluminum clad composites or fiber cement composite panels are good choices.

Third, our research suggests batten-seam zinc-copper alloy metal roofing would be a good, cost-effective choice for a roof ready for PV panel frames. The batten-seams make the structural attachment points for the panel frames. The alloy panels are the most durable choices available.

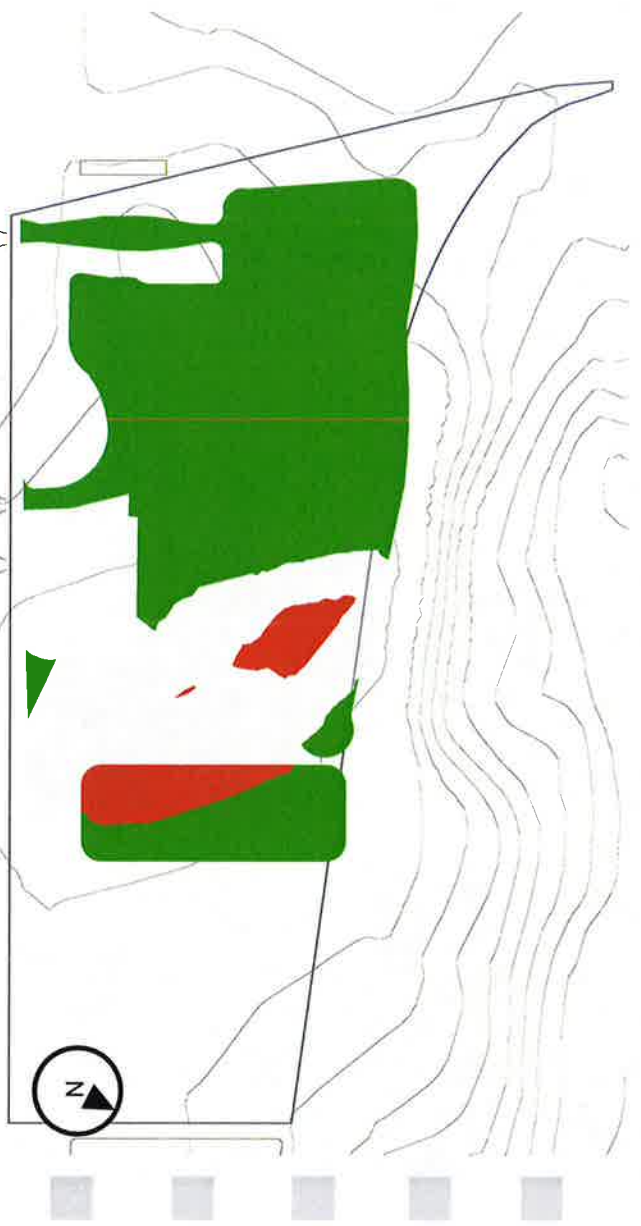
Fourth, lighting for the high-bay building was considered. Two approaches are cost effective, metal-halide and fluorescent lights both are common choices. In this installation, the occupancy detectors will reduce the operational costs of lighting the large area. The life-cycle analysis suggests the metal halide fixtures for the treatment building.

Fifth, roadway and parking surfaces are a question even though we have reduced the scope significantly. The concrete surface is appropriate for the chemical supply are behind the treatment building, The permeable paving blocks are appropriate for the parking lot. The roadways are somewhat similar in asphalt or concrete because neither will have curbs to allow for bioswales on each side of the roadways.

Cut and Fill Comparisons

Original Conventional Design

- LEGEND:**
- Cut
 - Level
 - Fill



Proposed Sustainable Design



In comparison to a standard engineering preliminary view of the project, we have made some dramatic changes in scope of work.

The square footage of buildings. The bulk of this change is that we eliminated the building around the multi-media filters. We have replaced it with a perforated metal screen around the perimeter of the space. We feel that the Administration Building might be reduced even further than we have it shown.

The bulk excavation is reduced substantially and is largely the result of grouping the buildings and reducing the amount of paving. We placed the buildings in site contours as much as possible.

appendix

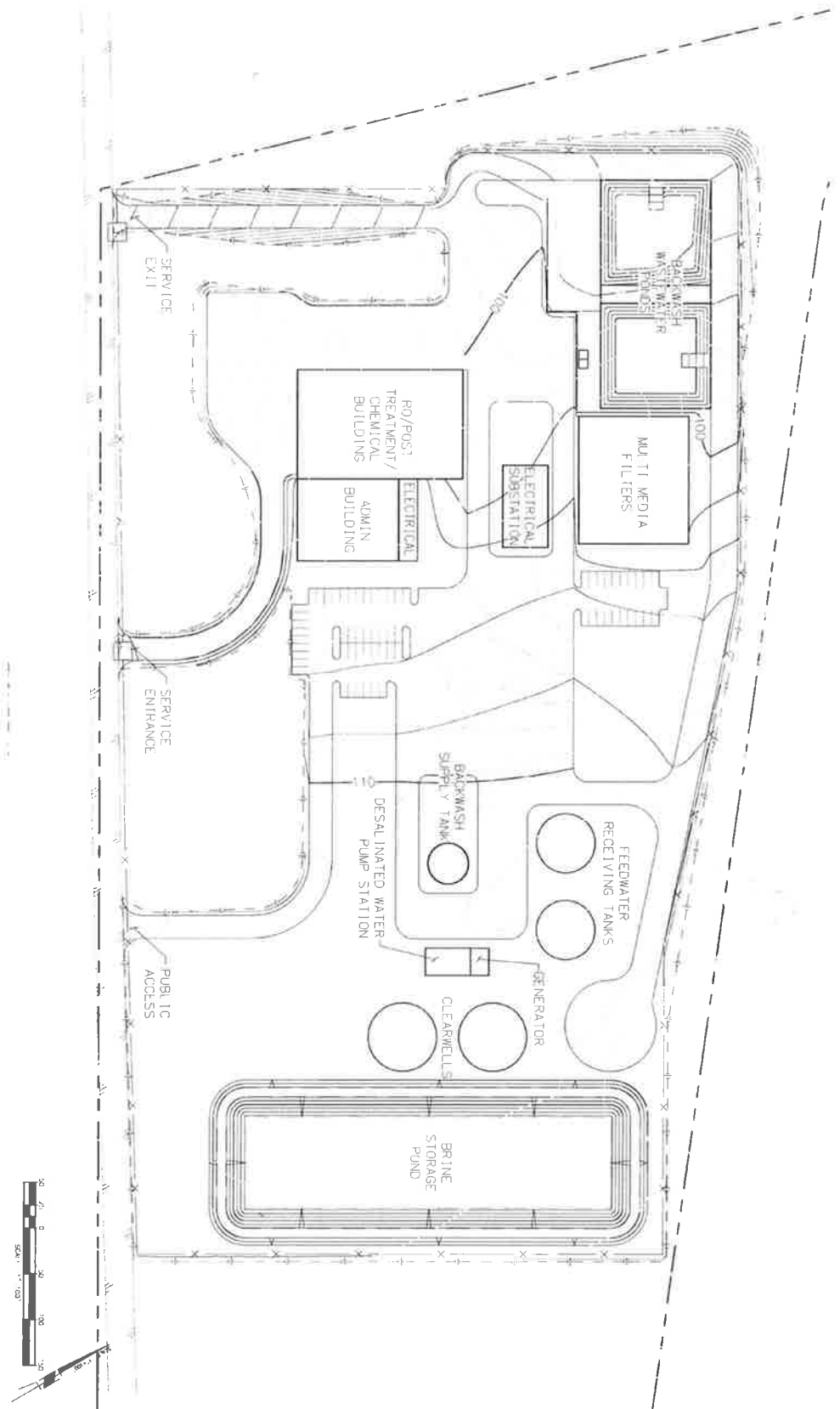




APPENDIX  **10**

- LEED Red-Yellow-Green
- RBF Schematic Plan
- Precedent Research
- Renderings and Images

RBF Schematic Plan



Precedent Research : The Water Reclamation facility

Precedent Research : The Water Reclamation facility



Precedent Research : West Basin Desalination Demonstration Facility in Redondo Beach

Precedent Research : West Basin Desalination Demonstration Facility in Redondo Beach



10

Building your own rain barrel



There are many ways to make your own rain barrel or series of rain barrels. The following is just one example:

parts

- A** Rain barrel ⁽¹⁾ \$ 30 (varies)
- B** Mosquito netting or screen..... \$ 5 (varies)
- C** Male electrical conduit adapter ⁽²⁾..... \$ 0.85
- D** Rubber washer..... \$ <1
- E** Female electrical conduit adapter ⁽²⁾..... \$ 0.85
- F** Reducer (Red Bush SXT SCH 80)..... \$ 1.25 - \$7
- G** Nipple (X close SCH 80)..... \$ 0.35 - \$1.50
- H** Hose bibb/ pipe thread shutoff..... \$ 4 (varies)
- I** Overflow hose (flexible PVC) ⁽²⁾..... \$ 3 / ft. (varies)
- J** Safety sticker..... free
- K** Steel straps (3/4-inch, 24-gauge) ⁽³⁾..... \$ 1 / ft. (varies)
- L** Sheet metal screws and anchors ⁽³⁾..... \$ <0.25

⁽¹⁾ To increase the storage capacity of your system, add more barrels. Barrels can be easily linked together. If subsequent barrels are sealed, install an air vacuum relief valve (\$5 - \$10). See our manual for installing a daisy chain system for more details.

⁽²⁾ Make sure your overflow adapters and hose are at least 1.5" in diameter for contributing roof areas of 1000 sq. ft. or less. A larger hose diameter is recommended for larger contributing areas.

⁽³⁾ You will need these items to secure your rain barrel to a supporting wall for seismic safety. For more detailed information, please see our Rain Barrel Installation Fact Sheet.

tools

- Hand saw
- Teflon tape
- Drill
- Drill bits
- Drill hole saw
- PVC cement

safety

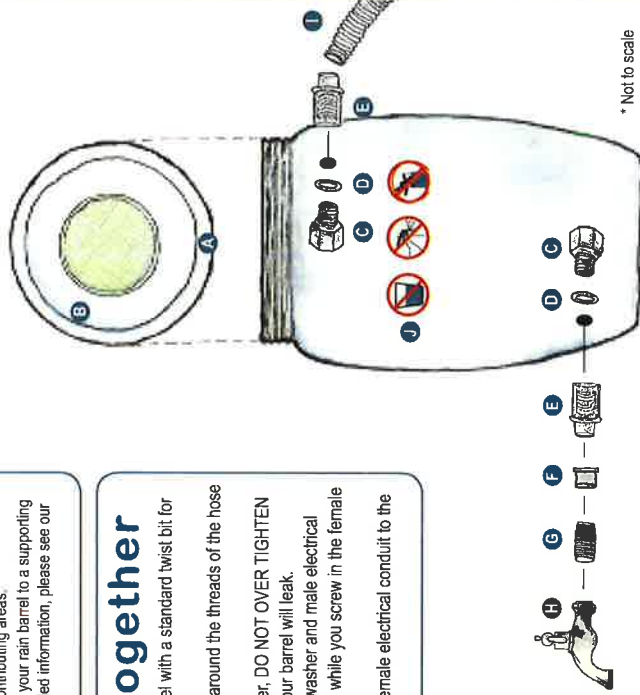
- Cover the overflow hose opening and the rain barrel lid with mosquito netting to prevent mosquitoes from breeding in the rain barrel.
- Label the rain barrel with safety stickers (shown below), provided by the SFPUC at 525 Golden Gate Avenue.

installation

For instructions on how to install your rain barrel, please see our Rain Barrel Installation Fact Sheet online at <http://stormwater.sfwater.org> in the Rainwater Harvesting section.

putting it together

- Drill a hole on the side of the barrel with a standard twist bit for both the hose bibb and overflow.
- Use the Teflon tape to wrap once around the threads of the hose bibb, counter clock-wise.
- When threading nipple into reducer, DO NOT OVER TIGHTEN — this will strip the threads and your barrel will leak.
- You will need a friend to hold the washer and male electrical conduit on the inside of the barrel, while you screw in the female electrical conduit.
- Apply PVC cement to attach the female electrical conduit to the reducer.



* Not to scale

RAINWATER HARVESTING

Rainwater harvesting is the practice of collecting and using rainwater that runs off of hard surfaces, such as roofs. It is an age-old technology that is growing in popularity as people look for ways to use water resources more wisely.

By harvesting rainwater you:

- Keep relatively clean water out of the combined sewer system and make it available for use.
- Reduce the energy and chemicals needed to treat stormwater in San Francisco's combined sewer system, while also reducing the energy used to transport water from distant reservoirs.
- Decrease the volume of stormwater entering the sewer system, thereby minimizing flooding and combined sewer discharges.
- Decrease the volume of potable or "drinking" water used for non-potable applications.

MAKING IT HAPPEN

It is now legal to divert stormwater from San Francisco's combined sewer system. The relevant Plumbing Code is Section 306.2, which reads: "Roofs, inner courts, vent shafts, light wells or similar areas having rainwater drains, shall discharge directly into a building drain or building sewer, or to an approved alternate location based on approved geotechnical and engineering designs."

RAIN BARRELS

Rain barrels are storage containers designed to capture rainwater runoff from your roof for use in irrigation or other non-potable applications. Rain barrels are inexpensive, easy to install and maintain, and are well-suited to small-scale residential sites. They typically range from 50 to 100 gallons in capacity, and the water they collect is most often used to irrigate plants.

PERMIT INFORMATION

If your downspout is disconnected from the combined sewer system, you do not need a permit to install a rain barrel. However, if your downspout is connected to the combined sewer system, you will need a permit from the Department of Building Inspection, Plumbing Division. Permit requirements include a basic site map identifying the locations of your rain barrel, an approved storm drain, and the intended destination for overflow (a drain, garden, etc.). The permit fee covers the permit and site visit by a DBI inspector.

For more information on permits, visit DBI's website at: <http://www.sfdbi.org>, or call 415.558.6570.

WHERE CAN I GET A RAIN BARREL?

You can easily make your own rain barrel, as described on the other side of this handout. You can find low-cost barrels on Craigslist and visit your local hardware store to purchase the other pieces you need. Make sure you only use food grade barrels. Do not use barrels that may have contained hazardous or contaminated materials. You can also purchase rain barrels with the fittings already installed. There are many types of fully outfitted rain barrels available online. The SFPUC strongly encourages customers to purchase barrels that are being reused, rather than those that are being manufactured new.

QUESTIONS? CONTACT US

If you are interested in learning more about rainwater harvesting, please contact us:

San Francisco Public Utilities Commission
Urban Watershed Management Program
Email: greenstormwater@sfwater.org | Phone: 415.554.3289
<http://stormwater.sfwater.org>



<http://sfwater.org/modules/showdocument.aspx?documentid=237>



FREQUENTLY ASKED QUESTIONS

System Design, Sizing and Installation

How do I determine the size cistern or the number of barrels I need?

- The size of your system depends on a number of factors: how big your roof is, how much space you have available for rainwater storage, and what you intend to use the water for. A rough rule of thumb is that you can collect 600 gallons of water for every 1,000 square feet of roof area for every inch of rain. We get an average of 21 inches of rain per year here in San Francisco, so for 1,000 square feet of roof that can add up to over 12,000 gallons of rainwater collected! You will have to carefully plan where the rainwater will go when it overflows. You may direct it to an approved drain or stormwater management facility such as a rain garden.

Does the SFPUC have a cistern-sizing calculator?

- Our Rainwater Harvesting Calculator is now posted on our website. Go to <http://stormwater.sfwater.org> and click on the Rainwater Harvesting section.

What happens when my rain barrel overflows?

- You may direct the overflow back to the sewer via an approved drain, or design a rain garden to accommodate the overflow. Each site is different, so different design solutions are called for in different places.

Do I need gutter screens if I have a "do-it-yourself" 60 gallon barrel?

- Yes, gutter screens prevent debris from entering your system and make your maintenance activities much simpler. Our rainwater harvesting brochure and how-to filer for making your own rain barrel provide a list of parts for installing rain barrel systems. Remember, proper system design, maintenance and use are the responsibility of the system owner, not the San Francisco Public Utilities Commission (SFPUC), the SF Department of Building Inspection (DBI), or the SF Department of Public Health (DPH).

What extra steps do I need to take if I want to use rainwater for toilet flushing?

- Indoor use of rainwater requires a permit from the Department of Building Inspection. For more information on indoor systems, please visit the Department of Building Inspection website at <http://www.sfdabi.org>, or call **415.558.6570**.

Permitting

Do I need a permit for my rain barrel?

- If your downspout is already disconnected from the combined sewer system, you do not need a permit to install a rain barrel.
- If your downspout is currently connected to the combined sewer system, you will need a permit from the Department of Building Inspection, Plumbing Inspection Division to install a rain barrel.

Do I need a permit for my cistern?

- To install a cistern for irrigation, you will need a plumbing permit from the Department of Building Inspection, Plumbing Division. If rainwater from your system will be used to flush toilets, a building permit from the Department of Building Inspection is also required. If your system includes a pump or will be installed on the roof or underground, you will need additional permits.

For details on permitting, visit DBI's website at <http://www.sfdabi.org>, or call **415.558.6570**.



<http://sfwater.org/modules/showdocument.aspx?documentid=1653>

System Operation & Maintenance

How long can I hold rainwater in my barrel or cistern? What are the sanitary precautions I must follow?

- As long as your rainwater harvesting system is opaque (of such color and thickness that sunlight cannot penetrate the barrel), shaded, and screened, and you use the water only for non-potable purposes, there is no strict limit on how long the water can sit in your system. Be sure to inspect your system often and clean it as needed. You can clean your system annually with a non-toxic cleaner such as vinegar. If you intend to water edibles with your rainwater, you must install a first flush diverter, which will ensure that you harvest only the cleanest rainwater.

Will my rainwater system run out of water during the dry months?

- It depends on the size of your system. If you have enough space to accommodate a large cistern and your water needs are low, your catchment system could hold rainwater for all your summer needs. If you are using a small rainwater harvesting system, the rainwater will run out quickly. Even if your system runs dry in the summer, if you are able to flush toilets all winter long and then switch to the municipal supply in the summer, that's still a good achievement. Anecdotally, a local SF rain harvester has reported capturing 60 gallons of water from a summer's worth of fog and condensation from her roof!

Cost & Availability

How much do rain barrels and cisterns cost? How much would an entire rainwater harvesting system cost?

- Prices range with the scale and design of your project and with the amount of research and assembly you are willing to do yourself. You can find barrels ranging in price anywhere from \$15 to \$100, or more, depending on design, material, brand, and supplier. Sometimes people give away barrels for free so they don't have to pay disposal fees! For a cistern, many people use the rule of thumb of \$1 per gallon of storage. This does not include shipping, installation, or any additional plumbing and will vary depending on design, material, brand, and supplier.

Where can I find rain barrels and cisterns? Are there local businesses that carry them?

- Below is a list of suppliers and products. This is a brief sample list to get you started – there are numerous additional products you can find online. **This list is for information only and does not imply SFJUC endorsement:**
 - Bushman Rainwater Harvesting Products: 866.920.8265, www.bushmanusa.com
 - Cole Hardware, San Francisco: 451.753.2653, www.colehardware.com
 - Fairfax Lumber: 415.453.4410, www.fairfaxlumber.com
 - National Storage Tank, Santa Rosa, CA: 888.672.6995, www.nationalstorage tank.com
 - Rainwater H₂O Co: 888.700.1096, <http://rainwaterhog.com>
 - Scotts Valley Sprinklers: 831.438.6450, www.svsprinklerandpipe.com
 - Urban Farmer Store, San Francisco: 415.661.2204, www.urbanfarmerstore.com
 - Water tanks.com, Windsor, CA: 877.655.1100, www.watertanks.com
 - WATERHARVEST SLIMLINE: 877.389.1099, www.bluescopewaterusa.com



<http://sfwater.org/modules/showdocument.aspx?documentid=1653>





- You can also make your own! You can usually find barrels at very low prices at www.craigslist.org. You can use search terms like "rain barrel," "food grade barrel," "plastic barrel," or "metal drum" to find the posts. You will have to purchase and assemble the parts yourself, but if you are the handy type, it shouldn't be a problem. Check out our rainwater harvesting brochures, installation instructions, and installation video on our website at <http://stormwater.sfwater.org>.
- Many of the parts needed to make your own rain barrel system are available at the Urban Farmer Store (www.urbanfarmerstore.com).
- You can find a more extensive list of products and suppliers at www.harvestingrainwater.com/rainwater-harvesting-infosources/suppliers/.

Does the city offer rebates, incentives, or subsidies for rainwater harvesting systems?

- The SFPU's Urban Watershed Management Program is continuing its popular discounted rain barrel program! The City's ongoing subsidy program offers San Francisco residents a discount on the purchase of rain barrels and cisterns from participating vendors. For more information on the subsidy program, please visit <http://stormwater.sfwater.org> and select "Rainwater Harvesting," or call 415.554.3289.
- You can apply for a Watershed Stewardship Grant if your rainwater harvesting project benefits the public realm (private home installations will not qualify). View the Watershed Stewardship Grant program application guidelines at <http://sfgsa.org/index.aspx?page=4264>.

How much can I save by harvesting rainwater?

- A recent analysis by the SF Examiner found that an average house in the city can save nearly \$200 on their water bill every year if they collect all the rainwater falling on their roof. Check out the article at: www.sfoxaminer.com/local/When_rainy_weather_arrives_its_harvest_season.html.

Resources & Continued Education

Where can I take a course or learn more about rainwater capture and use?

- American Rainwater Catchment Systems Association: www.arcso.org.
- GreenPlumbers Training: www.greenplumbersusa.com/training-accreditation/course-information#caringforourwater.
- The Occidental Arts and Ecology Center: www.oaecwater.org.
- [Rainwater Harvesting for Drylands and Beyond](http://www.harvestingrainwater.com), Volumes 1 and 2. Brad Lancaster, 2008 edition. www.harvestingrainwater.com.
- [Design for Water: Rainwater Harvesting, Stormwater Catchment, and Alternate Water Reuse](http://www.designforwater.org). Heather Kinkade-Levario, 2007.
- Dig Cooperative: <http://dig.coop>.
- Greywater Action (formerly The Greywater Guerrillas): www.greywateraction.org.
- Rehbein Environmental Solutions, Inc.: www.rehbeinsolutions.com.
- NSF-certified rainwater harvesting products: www.nsf.org/consumer/rainwater_collection/index.asp?program=RainwaterCol.
- Visit the SF Urban Watersheds facebook page and become a fan!
- Visit the SF Sewers Blog at sfsewers.blogspot.com and view our Rain Barrel Installation Video
- Join the Rain Harvester facebook group!

How are other places encouraging rainwater harvesting?

- Los Angeles, CA: www.LArainwaterharvesting.org.
- Palo Alto, CA: www.cityofpaloalto.org/depts/pwd/flood_+_storm/stormwater_rebates/cisterns.asp.

<http://sfwater.org/modules/showdocument.aspx?documentid=1653>



- Portland, OR: www.portlandonline.com/osd/index.cfm?c=ecbbd&a=bb6ha and www.portlandonline.com/Bes/index.cfm?c=41186.
- Santa Monica, CA: http://www.smgov.net/Departments/OS&E/Categories/Urban_Runoff/Rainwater_Harvesting.aspx.
- Santa Rosa, CA: <http://ci.santa-rosa.ca.us/doclib/Documents/RainwaterRebateInfoFAQs.pdf>.
- Seattle, Washington: www.seattle.gov/UTL/Services/Yard/Natural_Lawn_&_Garden_Care/Rain_Water_Harvesting/index.asp.
- Texas passed state-wide legislation encouraging rainwater harvesting through property tax exemptions and is on its third edition rainwater harvesting manual: www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual_3rdedition.pdf.
- Tucson, Arizona: www.ci.tucson.az.us/water/harvesting.htm.
- Australia: www.yourhome.gov.au/technical/fs73.html.
 - Victoria: www.ourwater.vic.gov.au/saving/home/rainwater.
 - Queensland: www.derm.qld.gov.au/waterwise/gardening/pdf/rainwater_tanks.pdf.
 - New South Wales: www.environment.nsw.gov.au/rebates/ccthw.htm.
 - South Australia: www.sawater.com.au/sawater.
- In Germany, about 50,000 new rainwater harvesting systems are installed each year! The German Association for Water Recycling and Rainwater Utilization: www.fbr.de/english0.html.
- Learn about India's rainwater harvesting programs: www.rainwaterharvesting.org.
- The UK Rainwater Harvesting Association: www.ukrha.org.

And For Inspiration: www.youtube.com/watch?v=4xIMnE98o6s.



A daisy-chained system of the SFPUC's Southeast Wastewater Treatment Plant.



<http://swater.org/modules/showdocument.aspx?documentid=1653>



Renderings

