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ENVIRONMENT DESIGN



Introduction of the new landscape design  
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FEATURE ASLA 2009 Professional Awards

Vol. 24





Net-Zero Energy Mixed-Use Neighborhood

# Geos Net Zero Energy Neighborhood

The Geos Neighborhood incorporates symbiotic relationships in site planning and architecture, at all scales. Urban density is optimized with passive solar access. Stormwater is integrated and omnipresent within the neighborhood layout. Energy is generated from ground source heat networks and photovoltaics on every rooftop. The architecture utilizes high performance building envelopes and super efficient mechanical systems. The overall town plan aims to foster bio-civic relationships with natural processes, neighborhood ecology, and environmental stewardship.

## Net Zero Energy Site Planning

Net Zero refers to energy production equal to the amount consumed. The key to creating a dense net-zero energy neighborhood in Colorado's climate is to maximize passive solar access to all buildings and dwellings. This begins with the layout of streets, alleys, blocks, and parcels, followed by buildings and trees.

During the planning process many different street-block-parcel-building layouts were analyzed comparatively for their ability to both harvest and conserve energy. Each layout was evaluated using 3-D modeling of seasonal sun and shade patterns to discern the most efficient patterns. Energy modeling (with assistance from the National Renewable Energy Lab in Golden, Colorado) of each building and landscape design provided data on unit loads and production.

## Key Strategies:

1. Macro Layout Parcels and buildings are stretched east-west for maximum solar access within an urban street grid with north-south alleys and greens.
2. Checkerboard Layout Buildings are spaced and staggered for solar access.
3. Geothermal Loop Fields integrated within open space and utility networks.
4. Photovoltaics on every rooftop; Solar Thermal supplements Geothermal.
5. Deciduous tree species, heights, and placement selected to assure both solar access to photovoltaics, and passive microclimate cooling.

## Project Statement

Geos will be the largest net-zero energy, urban mixed-use neighborhood in the United States. Earth and sun power will completely sustain the community's energy needs, and replace all fossil fuels. The neighborhood is intertwined with natural systems, stormwater fed landscapes, and civic places. Rain and snow melt feed street tree rain gardens, percolation parks, plazas, and community gardens. Geos received final development approval from the City of Arvada and will begin construction in Summer, 2009.

"The first project that looks at solar in such a strong way and works with water collection. Great collaboration between the landscape architect and other designers. A model for planning and public presentation."

-2009 Professional Awards Jury-



FEATURE\_ 2009 ASLA Professional Awards\_ Analysis & Planning Category\_ Honor Awards

Location Arvada, Colorado, USA

Total Area 25.2 acres

Landscape Architect David Kahn Studio

Architect Michael Tavel Architects

City of Arvada Project Planner Ben Thurston

City of Arvada Landscape Architect Harry Johnson

Civil Engineer Travis Nicholson, MB Consulting

City of Arvada Engineering Dept. Georgia Simpson

Jefferson Co. Stormwater Quality Coordinator Michelle Delaria

Denver Regional Urban Drainage and Flood Control District National Renewable Energy Lab, Golden, CO

Client Norbert Klebl

Photographer © Geos Neighborhood







6. High performance passive solar buildings with air tight envelopes and heat recovery ventilation systems. Apertures to north are minimized, east and west apertures are controlled and shaded.

### Civic Stormwater Planning

Stormwater is both precious and dangerous in Colorado's arid climate. Conventional Colorado developments typically detain flash flood and monsoon runoff in large unusable detention basins, fenced off from the public realm. The key to integrating stormwater with public experience is to mimic predevelopment conditions by distributing runoff throughout the site. Decentralized detention allows for the design of a tributary system of site specific, multiple use environments.

During the design process many models of stormwater management were analyzed for the ability to detain the 100 year flood on site, and slowly release it in 24 hours. With assistance from the Denver Regional Urban Drainage & Flood Control District, and the Jefferson County Stormwater Quality Coordinator, each layout was evaluated for its capability to combine both stormwater and civic functions. The morphology of water quality, detention volumes, and reduced time of concentration would form the

armature for the community's pedestrian, park, and plaza network.

### Key Strategies:

1. Conceive of stormwater management holistically and at all scales.
2. Permeable paving for water infiltration is used for all pedestrian ways and plazas.
3. Street Tree Rain Gardens receive, detain, and filter surface runoff from streets, alleys, and the surrounding environment, while irrigating streetscape plantings. They minimize directly connected impervious areas, reduce time of runoff concentration, while utilizing infiltration, evaporation, and evapotranspiration.
4. Percolation Parks are stormwater detention basins designed as mixed-use parks and plazas. By mimicking predevelopment stormwater dispersal patterns they reduce the size and extent of the storm sewer system. Percolation Parks feature neighborhood amenities, urban agriculture, and wildlife habitat. They are placed prominently in the neighborhood and provide ease of access, human scale, and a diversity of uses.
5. Localized Rain Gardens are integrated on every parcel through out the neighborhood, from mixed-use courtyards to residential yards. They receive runoff from paving and rooftops, providing an intimate experi-



ence of stormwater management.

6. Level Outlet Spreaders slowly release outflows to the floodway, mimicking predevelopment sheet flow, and eliminating the need for riprap erosion control.

### Planning for Urban Stewardship: Empowering Residents to "Be the Resource"

The aims of Net-Zero Energy and Civic Stormwater serve a larger goal - to foster stewardship in the neighborhood, and enable residents to take active roles in managing their resources and environment. This can fold into participation in the social life and governance of the community.

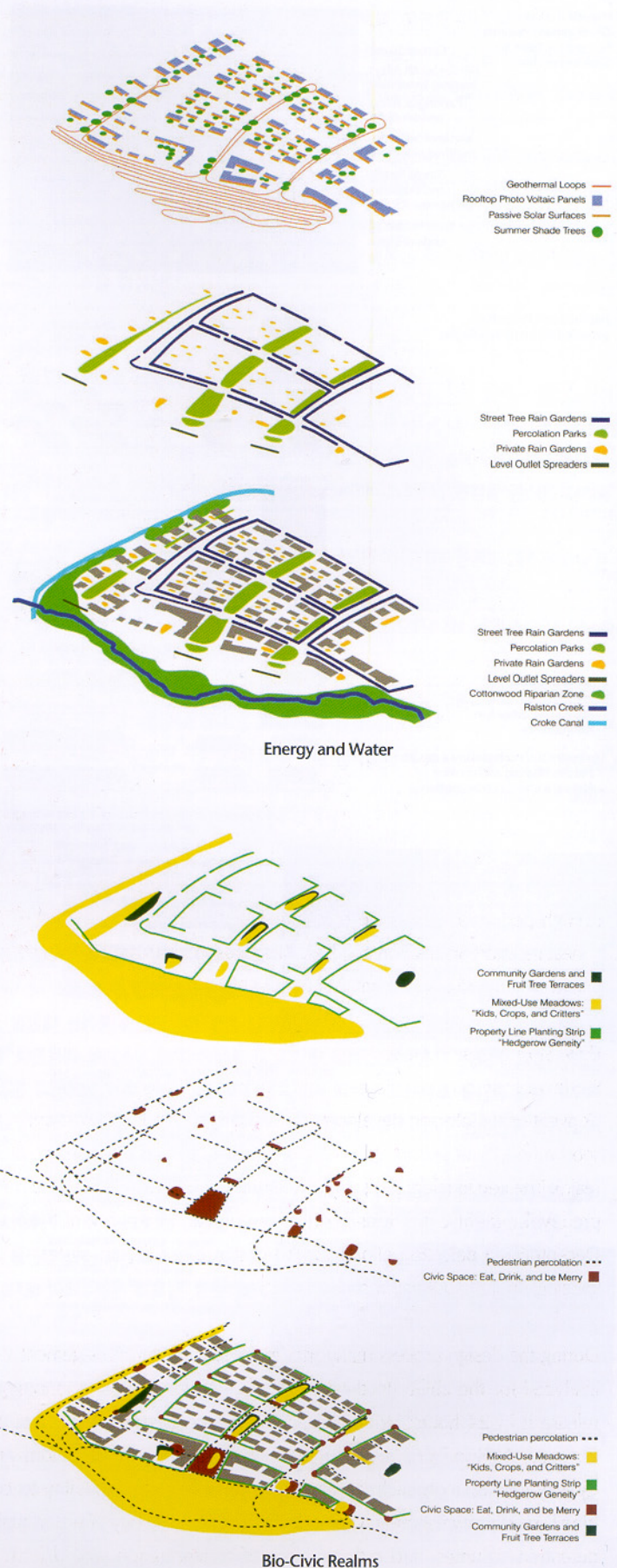
Planning for Goes involves many socially oriented features. A dense layout of varied housing options provides for diversity and affordability. A prolific pedestrian network of pathways, parks, and civic spaces is anchored by mail box kiosks, play areas, and gathering spaces for all occasions, large and small. All paths lead to the Ralston Creek Regional Greenway that connects to schools, recreation centers, and urban centers.

Processes of nature and agriculture are interwoven with civic and community life. Common greens are surrounded by fruit tree terraces, to be maintained and harvested by the adjacent homeowners. Community gardens and composting areas are dispersed throughout the site. All private yards receive great sunlight and are semi-enclosed like courtyards. Gutters and downspouts form tributaries to raingardens in each resident's landscape.

#### Key Strategies:

1. Integrate natural systems and processes within the fabric of everyday life. Mix stormwater management, food production, and biotic habitat with public pathways, parks, and civic spaces. Create complex mutually beneficial networks of unique ecosystems, each adapted for specific conditions.
2. Give residents opportunities to play active roles in managing their resources, and caring for their environments.
3. Provide agricultural opportunities through out the neighborhood, and at a diversity of scales; from pocket community gardens and orchards in each sub area, to larger Community Supported Agriculture.
4. Fruit Tree Terraces, Property Line Planting Strips, and Landscape Foyers unite the pedestrian realm while enfranchising residents to personalize their environment.
5. An Energy Systems Guide and Xeriscape Plant and Landscape Maintenance Manuals provide residents with detailed information on indoor and outdoor stewardship.
6. Working with the local municipality and surrounding neighborhoods to identify and provide eco-amenities that serve the larger community.

Text: David Kahn Studio 





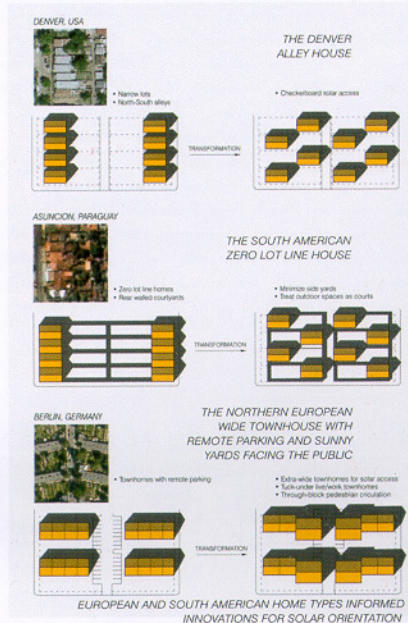
## ■ Optimize Density with Solar Access

Historic Denver Development Patterns Formed the basis for Solar Innovations

Corner Stores  
North+South Alleys Support Snow Melt  
Parking at Alleys and on street  
Minimal Setbacks, minimal side yards  
Single Family and Duplexes on narrow 25' lots  
Townhomes at ends of block



International Precedents provided alternate typologies



Density supports:

- Energy conservation
- Mixed-Use Urbanism
- Affordability

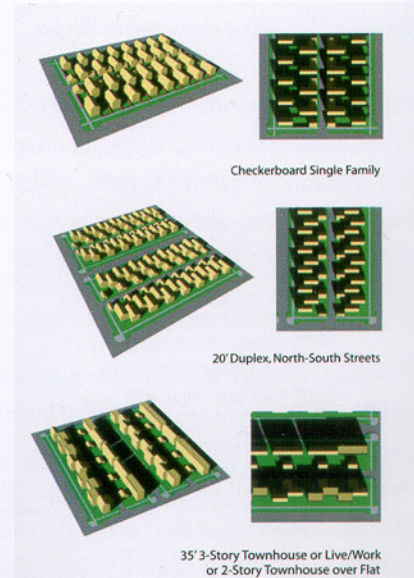
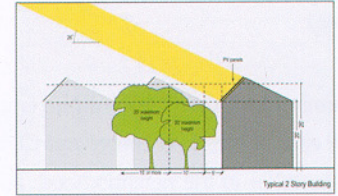
Optimum solar orientation supports:

- Passive Heating and cooling
- Net-zero energy consumption

Homes spaced-apart for winter passive solar gain



This shadow cast by one three branch in winter can drop the performance of an entire string of photovoltaic panels. Design regulations coordinate tree heights with preservation of active solar access.



With assistance from NREL(National Renewable Energy Laboratory), Dozens of development patterns were comparatively evaluated for solar orientation, Passive heating and cooling, overall energy conservation, interior daylighting, Snow-melt on streets and alleys, and gross urban density.

## 지열 네트 제로 에너지 근린 주거

모든 스케일에서 지열 근린 주거는 부지 계획과 건축에 공생관계를 통합시켰다. 도시 밀도는 자연형 솔라 액세스를 최적화된다. 유수는 통합되고 근린 주거 장소 내 어디에나 배치되어 있다. 에너지는 지열 네트워크로부터 생성되며, 모든 지붕에는 태양광 전지 시설이 있다. 건축은 고성능의 건축물 영역과 고 효율의 기계 시스템을 이용한다. 총체적으로 생태 환경을 조성하고 있는데 자연적인 프로세스, 근린 주거 생태학과 환경 관리 관계를 촉진하는 주거계획을 세웠다.

### 네트 에너지 부지 계획

네트 제로는 소비되는 양과 같은 에너지의 생산을 말한다. 콜로라도 주의 기후에서 제로 에너지 근린 주거를 만드는 핵심은 모든 건축물과 주택에 자연형 솔라 접근을 최대화하는 것이다. 이것은 빌딩과 나무들은 물론 가로, 소로, 블록과 분양주택의 배치에 적용된다.

계획을 진행하는 동안 많은 다른 가로-블록-주택-빌딩 배치가 비교해보면 그것들의 에너지 생산과 수확 측면을 위해 분석되었다. 가장 효율적인 패턴을 식별하기 위해 각 방의 배치는 계절적인 태양과 음영 패턴의 3차원 모델링을 사용해 평가하였다. 각 건축물과 경관 디자인에서 모델이 되고 있는(콜로라도 골든에 있는 국립 재생 가능 에너지 실험실로부터의 지원과 더불어)에너지는 단위 적재하물과 생산에 대한 기준을 제공했다.

### 핵심 전략

1. 거시적인 배치- 주택과 건축물은 최대 태양을 받기 위해 동서로 자리하고 있으며, 남북으로 소로와 녹색대가 형성되어 있다.
2. 서양 장기판 식의 배치- 건축물은 간격을 두게 되고, 태양의 접근을 위해 엇갈리게 하였다.
3. 오픈 스페이스와 건축 설비 네트워크 내에서 통합된 지열의 루프 필드
4. 모든 지붕에 태양열 전지 설치 태양열이 지열을 보충
5. 태양열의 태양전지 접근과 수동의 미세기후 냉각을 위한 낙엽수 종의 선택과 높이와 배치 고려
6. 공기 기밀성이 있는 고성능의 태양광 빌딩과 열 회수 순환 시스템. 북쪽으로 개구부를 최소화하고 동쪽을 향하게 하며 서쪽 개구부는 조정되고 그늘지게 한다.

### 시민의 유수 계획

유수는 콜로라도 주의 건조 기후에서 귀하기도 하고 위험하기도 하다. 종래의 콜로라도 개발은 공공지역으로부터 구획되었고 사용이 불가한 넓은 저류지역의 계절풍 유수와 돌발홍수를 전형적으로 막는다. 유수를 공공의 경험과 통합하는 핵심은 그 지역에 유수를 분배하는 사전개발 조건을 모방하는 것이다. 분산하여 계획한 저지(沮止)는 특징의 부지, 다양한 사용 환경의 배분 시스템의 디자인을 가능하게 한다.



설계 과정 동안 많은 호우 관리 모형들은 부지에서 100년 동안의 범람을 지연시키는 것으로 분석됐으며, 24시간 이내에 서서히 방류하였다. 덴버 지역 도시배수 및 홍수 조절 기구와 제퍼슨 주 우수 품질 코디네이터로부터의 지원과 함께 각 방의 배치는 우수와 시민의 기능을 결합할 능력 평가에 초점을 맞췄다. 수질, 저지(沮止)량과 줄어드는 집중 시간의 지형학은 커뮤니티의 보행자, 공원과 플라자 네트워크를 위한 보강재를 형성할 것이다.

#### 핵심 전략

1. 호우 관리를 전체적이고 모든 스케일에서 이해한다.
2. 물 침투를 위한 포장도로는 모든 보행자의 길과 플라자를 위해 사용된다.
3. 가로경관이 관계하는 동안에, 가로수가 우수를 받아들이고 저지시키고, 도로나 계곡, 주위 물을 정화시킨다. 그것들은 침투, 증발을 이용하는 동안 직접적으로 연결된 지역들을 감소하고, 우수량 집중의 주기를 줄인다.
4. 여과 공원은 혼합사용 공원과 플라자로 디자인된 홍수 저지 분지이다. 분산 패턴을 모방하여 그들은 폭풍 하수 시스템의 크기와 넓이를 줄였다. 여과 공원은 근린 주거 쾌적성, 도시 농업과 야생 생물 서식지를 특징으로 한다. 그것들은 근린 주거에 현저하게 보이고, 접근과 휴먼 스케일, 사용의 다양성과 편함을 제공한다.
5. 혼합 사용하는 안뜰부터 주거의 마당까지 지역화된 비 정원은 근린 주거로부터 모든 주택으로 통합된다. 그것들은 포장과 지붕으로부터 우수량을 받아내고 호우 관리의 적합한 경험을 제공한다.
6. 레벨 출구 스프레더는 방수로에 유출량을 천천히 배출시키고, 사전 개발된 생산공정도를 모방해 잡석 부식 제거 필요성을 없앤다.

#### 도시의 책무계획: 거주자에게 "자원이 되는" 권한을 줌

네트 제로 에너지와 시민의 우수 관리 목표는 이웃 간의 책무를 높이고 거주자들이 그들의 자원과 환경을 관리하는 주도적인 역할을 하는 보다 큰 목표를 가지고있다. 지열

시스템 계획은 많은 사회적인 특징을 포함하고 있다. 다양한 주택 선택에 있어서 밀도 있는 레이아웃은 다양성과 적합성을 제공한다. 보도, 공원과 시민 공간은 크고 작은 여러 경우에 있어 우체통 키오스크, 놀이 장소 그리고 모임의 공간을 제공한다. 모든 길은 학교, 레크리에이션 센터와 도시 센터로 통하는 랄스톤의 지역 그린웨이로 인도한다.

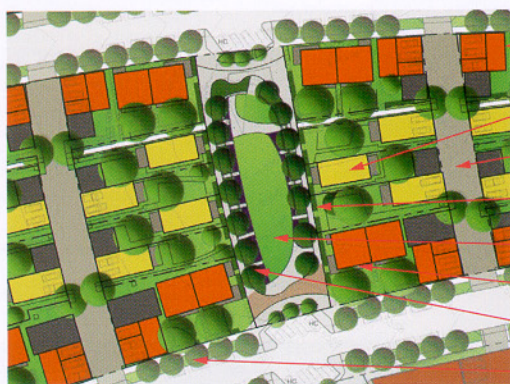
자연과 농업의 과정은 시민과 커뮤니티 삶을 상호 연관시킨다. 공공 그린 지역은 과일 나무 테라스로 둘러싸이고 인근 가옥 소유주에 의해 유지되고 수확된다. 커뮤니티 정원 과 비로 주기 지역은 부지 전체에 분산되어 있다. 모든 개인 마당에는 햇빛이 크게 비치지고, 반 정도 공개된 안마당이다. 배수와 낙수 흐름은 각 거주자의 마당에 있는 레인 가든의 지류를 형성한다.

#### 핵심 전략

1. 일상생활의 틀 안에서 자연 시스템과 과정들을 통합한다. 호우 관리, 식량 생산과 생명의 서식지를 공공 보도, 공원과 시민의 공간과 혼재시킨다. 유일한 생태계, 특정의 상태에 적응시키게 되는 각각의 복잡한 상호 간에 유익한 네트워크가 조성된다.
2. 거주자들에게 능동적으로 그들의 자원을 관리하고, 그들의 환경을 관심을 갖게끔 기회를 제공한다.
3. 이웃을 통해 농업 기회를 갖게 한다. 작은 규모의 커뮤니티 정원과 과수원에서 큰 커뮤니티의 농업을 경험케 한다.
4. 과일 나무의 테라스, 부지 경계선, 전경 조망지는 주거자 자신들의 환경을 개인화하면서 보행자 영역을 결합시킨다.
5. 에너지 시스템 안내서와 건식 조경 식물, 조경 유지 지침서는 거주자들에게 옥내·외의 상세한 정보를 제공한다.
6. 지방 자치기관과 근린 주거들과 함께 일을 함으로써 주체성이 생기고 큰 공동체 사회 형성에 기여하는 생태적 쾌적함을 제공한다.

글: David Kahn Studio

#### Checkerboard Layout for Solar Access



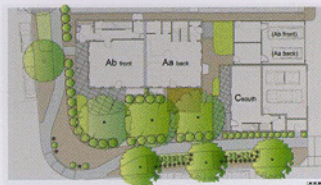
- Checkboard Live/Works
- Checkboard single Family
- North-South Alleys, Support snow melt
- Property line, Planting strip
- Percolation Parks, Replace streets
- Checkboard Live/Works
- Fruit Tree Terraces
- Street Tree Rain Gardens



- CHECKERBOARD LIVE/WORKS
- Townhouses or live/work homes with ground level home offices
- A wide townhouse layout permits solar gain to side-by-side bedrooms or living spaces
- Homes open to sunny, south-facing yards
- Service spaces are to the north
- Doors and windows to the north are minimized
- Windows and overhangs are optimized for passive solar heating and cooling



Checkerboard Live/Works

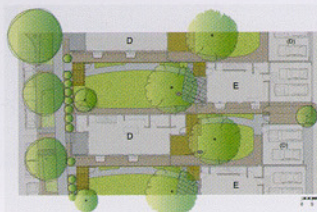


The 4' property line planting strip frames south-facing yards at the Line/Works

- CHECKERBOARD SINGLE FAMILY
- For solar access, every other home is either an alley house or at the street front
- Alternating front and back yards are shaped like courtyards
- Yards contain rain gardens that receive roof runoff
- Service spaces are to the north
- Doors and windows to the north are minimized
- Windows and overhangs are optimized for passive solar heating and cooling



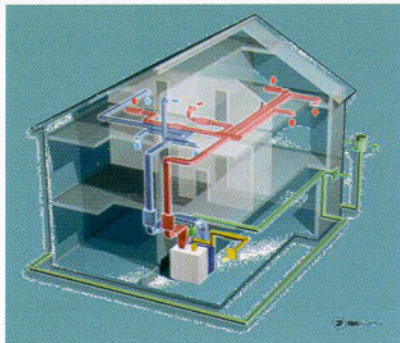
Checkerboard Single Family



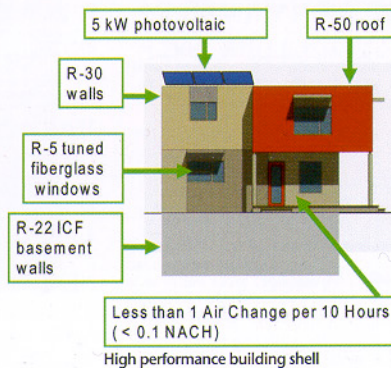
The 4' property line planting strip, and 'Landscape Foyers,' unify the checkerboard street edge



## ■ Net-Zero Energy and Fossil Fuel Free



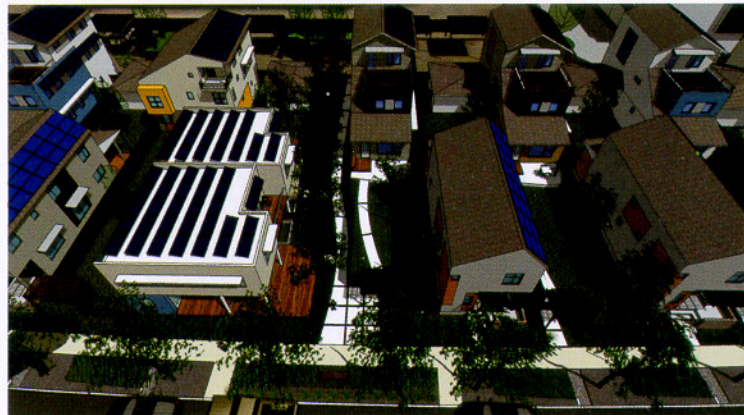
Geo-Assisted heat recovery ventilator



High performance building shell

### THE "PASSIVE HOUSE"

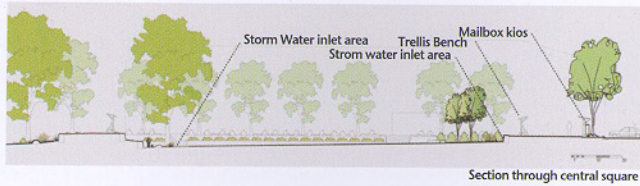
- **Passive Solar Orientation** Reduces Natural Gas Use by 30%
  - Stretch buildings and homes out east to west
  - Minimize apertures to north
  - Solar overhangs on south
  - Deep porches and deciduous trees at east and west
- **High Performance Building Shell** Reduces Natural Gas Use by 40%
  - Air Tight -- less than 0.1 Natural Air Changes per Hour
  - SIPs construction with R-50 Roofs, R-30 Walls, R-5 Windows
- **Geo-Assisted Heat Recovery Ventilator** Reduces Natural Gas Use by 10%
  - No Furnace needed for the passive house. HRV does the job
  - Constant Fresh Air with minimal energy loss
  - Earth Tubes further temper incoming fresh air and provide cooling
- **Geo-Thermal and Solar Thermal** Reduces Natural Gas Use by 20%
  - For Heating, Hot Water
  - Solar Thermal Heat for homes more than one block from loop field
- **No Natural Gas Needed; Therefore, No Natural Gas Lines**
- **Solar Photovoltaic Panels Generate 100% of Electricity Needs**
  - 5KW system per home
  - The passive home uses 35% less electricity
  - Photovoltaics panels offset the remaining 65% of consumption
  - Neighborhood is grid-tied. Electricity Consumption is Net-Zero.
- **Making Net-Zero Cost Neutral**
  - Green Technologies add \$285 to monthly mortgage
  - Energy Savings \$200/month
  - Tax savings on mortgage interest \$85/month



Checkerboard Layout for Solar Access

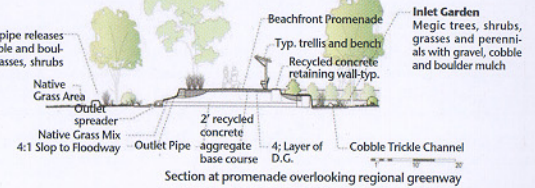


## ■ Percolation Parks: Squares



### Infiltration Garden

At the floodway edge the outlet pipe releases water to an infiltration area. Cobble and boulders interspersed with native grasses, shrubs and trees



The central square is framed by commercial space and the cohousing common house. It links to the greenway and areas for community gardens and agriculture.

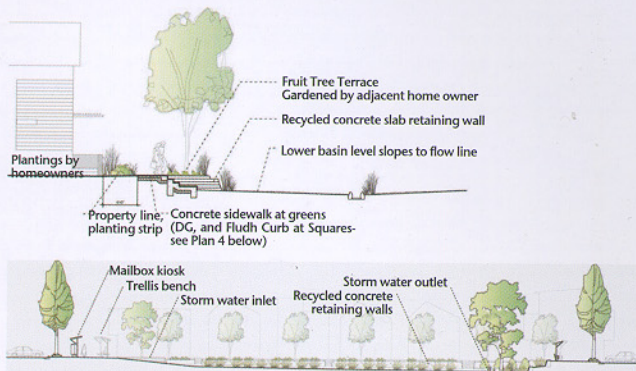


The square are a combination of neighborhood park and storm water detention basin. They must function to receive detain, and outlet run-off from city streets, Street tree rain Gardens, and adjacent properties.

They also function as civic outdoor rooms: featuring playgrounds, and spaces for a farmer's event, and performances. The squares terminate at a promenade that overlooks the regional greenway.

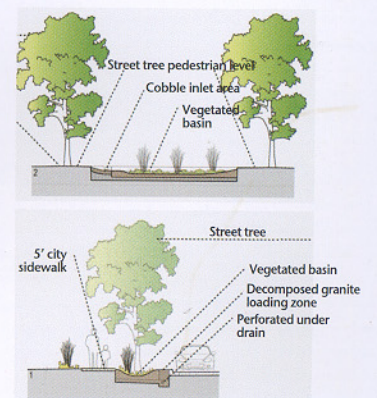
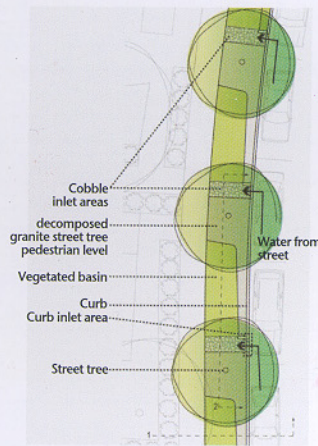


## ■ Percolation Parks: Greens



The greens are engineered to be habitable, multi-functional spaces. the fruit tree terraces are taken card of by adjacent property owners in the same way that typical tree lawn landscaping would be maintained by adjacent owners.

## ■ Street Tree Rain Gardens



Street tree rain gation With stormwater filtration while passively irrigating trees

Street three raingardens filter runoff from streets and form private parcels

