Harvest Waters 03_02

BARNARD TRACE URBAN RESIDENTIAL REDEVELOPMENT

Predevelopment: Millions of gallons of water did not fully infiltrate due to existing poorly draining soils.

Traditional Development: Millions of gallons of water are contaminated and then rushed to storm sewers.

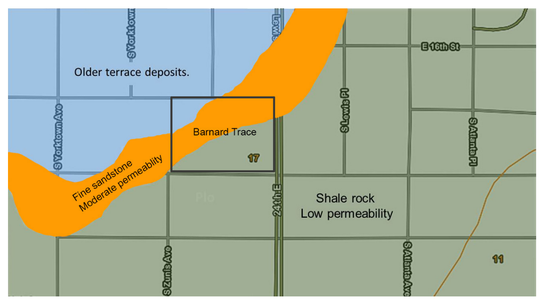
Harvest Water Development: Millions of gallons of water are collected, filtered, and recharged or reused.

Average Family

- A family can use 400 gallons of water per day (EPA, WaterSense)
- Over 30% is used for landscape irrigation (EPA, WaterSense)
- 18 families would use 7200 gallons of water per day with over 2100 gallons used for irrigation alone

Big Picture

- Tulsa's water travels over 50 miles away from Lake Eucha and Spavinaw Lake.
- Tulsa in general has poorly draining soil.
- The current water infrastructure with a 50-year lifespan is about 50 years old.
- Over the next 25 years our nation will spend one trillion dollars ($1,000,000,000,000) to provide and maintain that infrastructure. (AWWA, Buried No Longer)



Barnard site soil identified as Dennis Complex soil series 17, classified as poorly drained.

USDA Natural Resources Conservation Service

Project Goals

Environmental

- Low impact: collect, filter, harvest, recharge, and use the on-site stormwater runoff in order to filter, lower, and delay the peak discharge into the city's underground stormwater network
- Environmental sustainability: make provisions for sustainable measures such as geothermal technology, daylighting design, and reuse of water

Contextual

- Visual character: maintaining the existing character of the surrounding neighborhood
- Historical value: maintaining most of the WPA retaining walls

Economical

- Minimize cost: minimize cost of site preparation by means of utilizing the existing infrastructure, minimize dirt removal, minimize areas of street surface

Marketing

- At least 18 residential lots, all of a desirable area and width
- Pleasant neighborhood design, such as welcoming entrance, lots facing major streets, detached garages in the back, discouraging through traffic, sense of a unified neighborhood, and smooth vehicular movement

Site challenges

- Impervious built environment over impervious soil
- Severe rainfall intensity
- Poorly drained soil
- Offsite water usage
- Dramatic drop to 17th Place
- Unknown future development of private lots

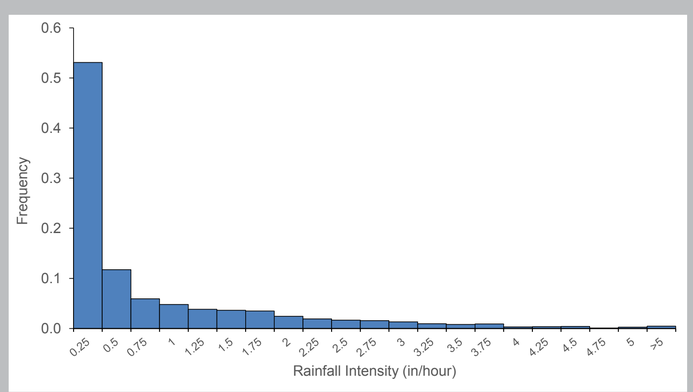
Opportunities

- Historically significant masonry wall
- Interesting architectural context

Rainfall

77-year average = 39.4 in/year (Tulsa International Airport, 1938-2013)
100-year storm event = 4.41 in/hour

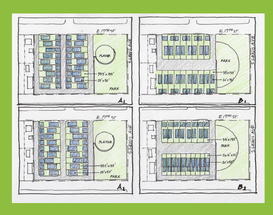
Total water input on Barnard site = 4.25 million gallons/year

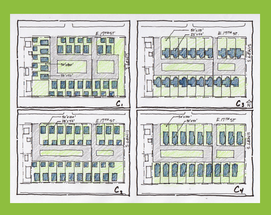


Concept

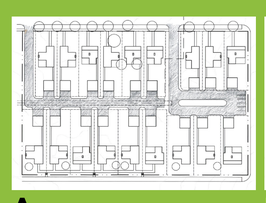
The changes to traditional residential development we propose employ currently feasible technologies and well-established construction techniques in an integrated approach to creating an extraordinary low impact development. The central feature of the design takes what was historically poorly drained grassland which with ordinary development would become even higher runoff-generating urban land with contaminated water, to **a new vision that is well-drained, purifying, and that recharges the ground while making water available for harvesting on site**. This design shows the feasibility of actually retaining more water on the site than an average rainfall produces—thus virtually eliminating contribution by the development to the city's storm water system. This new approach to site development is coupled with smart landscaping design, energy saving home construction measures, and high efficiency ground source heat pump systems that work together to create a development that is both contextually sensitive and looks to the future. **These mutually reinforcing goals of storm water retention and reuse, low-impact landscaping and energy efficiency can be achieved with a modest investment that yields real economic benefits to homeowners.** The end result will not appear revolutionary to the neighbors, but it will fundamentally reorient the way homeowners and the city think about the impact of residential development; from a traditional model that places more burdens on city services to one that actually reduces those burdens.

Early explorations

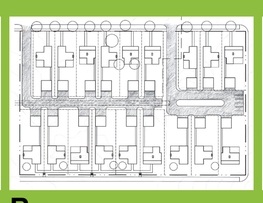




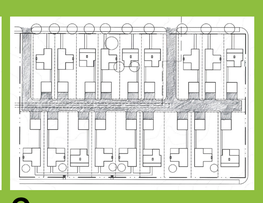
Exploration and Assessment



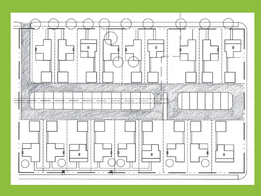
A
Proposed plan
traditional development



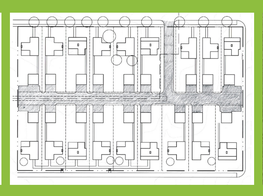
B
Proposed plan
LID development



C
Through-drive plan
LID development



D
Common garden plan
LID development



E
Double cul-de-sac
LID development

F
Grassland

Rational Method for Estimating Peak Discharge (cfs)

	Storm events (in/hour)			
	5-year	10-year	50-yr	100-yr
	1.32	2.16	3.72	4.41
Scenario A	2.87	4.69	8.08	9.56
Scenario B	1.70	2.79	4.80	5.68
Scenario C	1.67	2.74	4.71	5.57
Scenario D	1.71	2.80	4.82	5.70
Scenario E	1.68	2.75	4.74	5.61
Scenario F	2.11	3.45	5.94	7.03

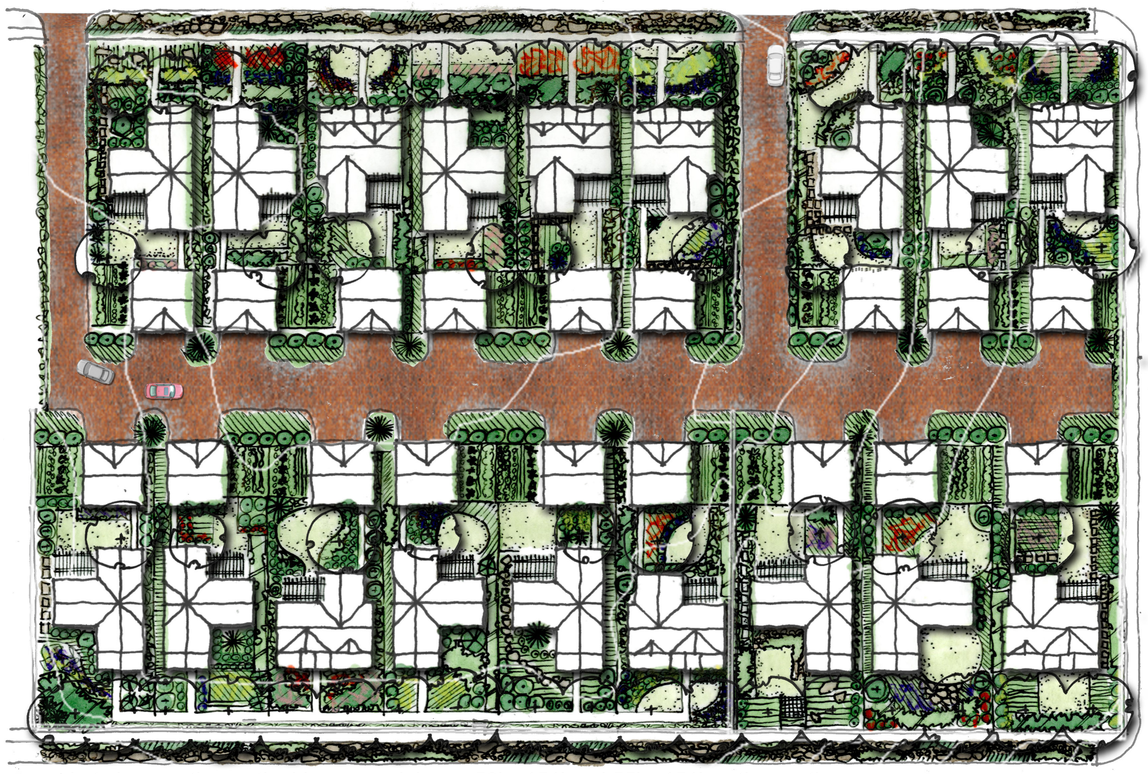
Urban Residential Development

Assessment of planning alternatives

	A	B	C	D	E
Cost reduction measures					
1.1 Using the existing infrastructure	3	3	3	3	3
1.2 Preserving the historic WPA walls intact	3	3	2	2	2
1.3 Minimizing the need for moving dirt	3	3	2	2	2
1.4 Minimizing area of black top surface	2	2	3	1	3
Market value measures					
2.1 Maximizing area of sellable lots	2	2	3	1	3
2.2 Lots face major streets	3	3	3	3	3
2.3 Desirable lot sizes	3	3	3	2	3
2.4 Desirable width of lots	3	3	3	3	3
2.5 No garage doors face streets	3	3	3	3	3
2.6 Detached garages	3	3	3	3	3
Low-impact development measures					
3.1 Allowing efficient stormwater management	0	3	3	3	3
3.2 Minimizing area of black top surface (same as 1.4)	2	2	3	1	3
Neighborhood design					
4.1 Welcoming entrance	2	2	2	1	2
4.2 Discouraging through traffic	3	3	3	3	3
4.3 Sense of unified neighborhood (street design)	2	2	3	3	3
4.4 Smooth vehicular movement (including trash collection)	1	1	2	3	1
4.5 Minimizing areas of shared responsibility	3	3	3	1	3
21st Century ready					
5.1 PV-ready	3	3	3	3	3
5.2 GSHP-ready	3	3	3	3	3
5.3 Providing a community green space (conflicts with 2.1)	0	0	0	3	0
	47	50	53	47	52
Scoring					
0 Does not achieve the objective					
1 Marginally achieves the objective					
2 Somehow achieves the objective					
3 Successfully achieves the objective					

Scenario A – Proposed plan (No changes)
Scenario B – Proposed plan (with LID)
Scenario C – Adjusted plan (Through drive)
***Best in Peak Discharge and Overall Planning Score**
Scenario D – Common garden plan
Scenario E – Double cul-de-sac
Scenario F – Grassland

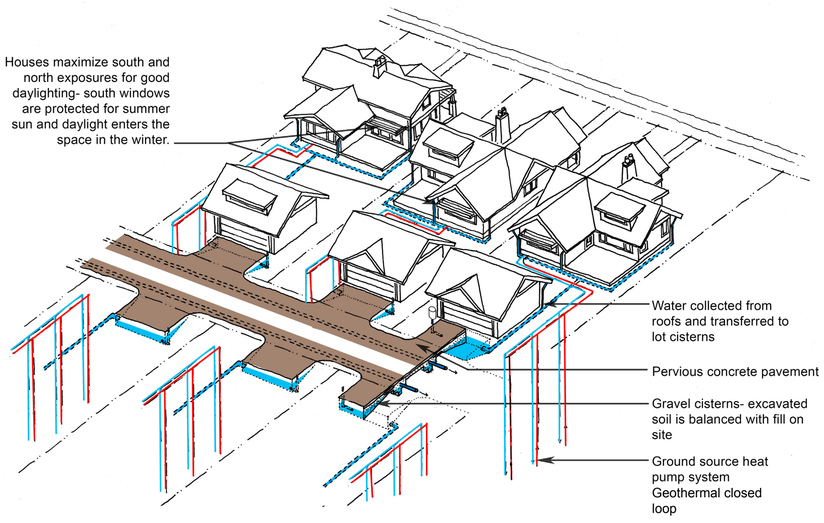
Final Overall Plan



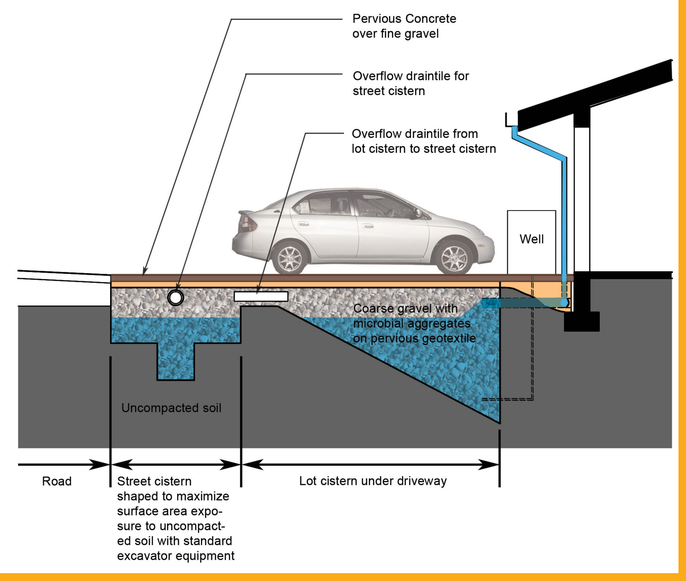
- Lot sizes on the north side are a minimum 50’ x 151’ and 55’ x 151’ on the south
- Excavated soil from the cisterns balances needed soil for regrading
- Middle wall is intact to the through-street

Streetscape view

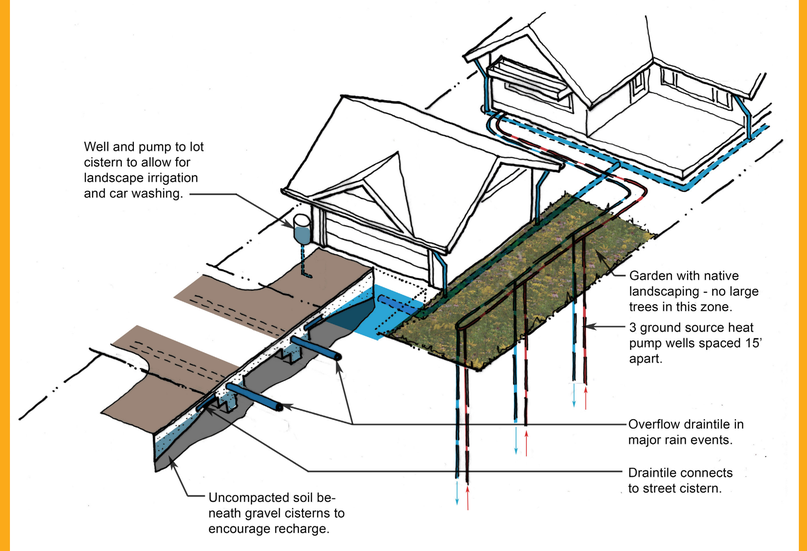
New cistern infrastructure



Sufficient storage capacity to harvest a 1” rainfall

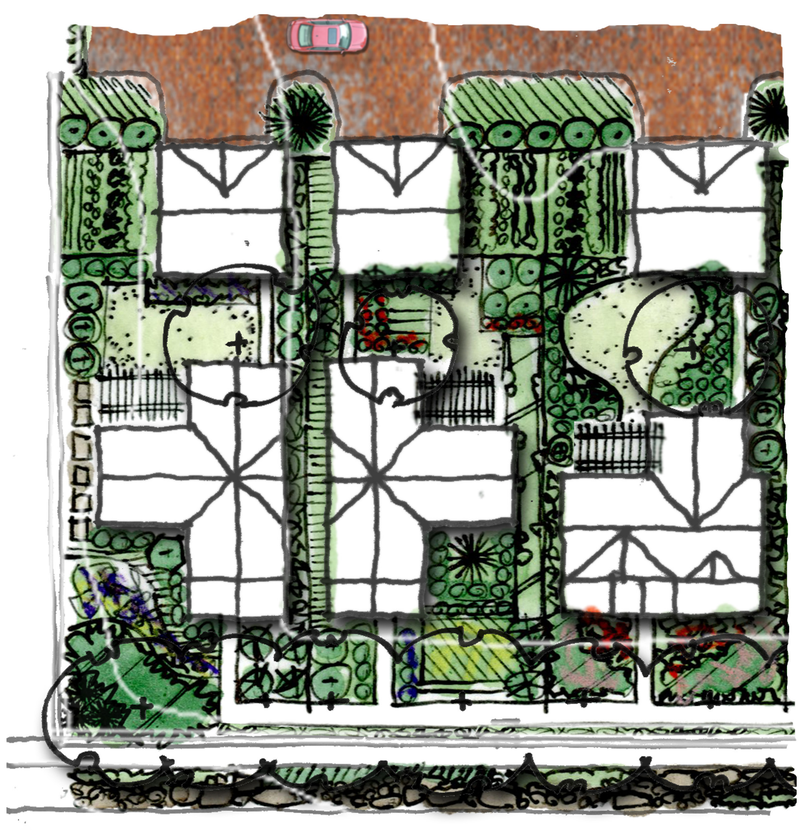


Stormwater storage in a single residential lot: 8400 gallons

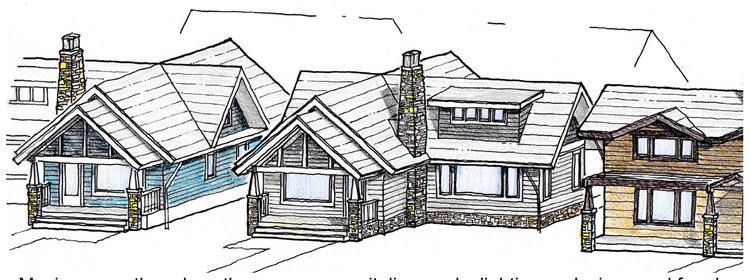


Total development stormwater storage: 150,000 gallons

Landscape and Architecture Features

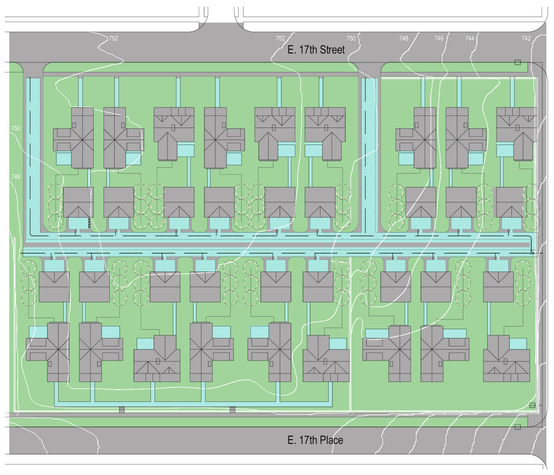


- Water harvesting reservoirs
- Permeable paving
- Minimize footprint and paved surfaces
- Minimize turf areas
- Three trees per lot
- Increase landscape structure
- Create organic soil material
- Rain gardens



- Maximum north and south exposures capitalize on daylighting, reducing need for electric lighting
- Summer sun is blocked, reducing cooling load
- Winter sun penetrates windows, assisting in heating
- Each room connects with an outdoor space
- Water collected with durable concrete roof tiles is cleaner than most options
- Deep roof overhangs and the drain tile for collection of rainwater from gutters aid in moving water away from the house

Drainage Features



TYPICAL DESIGN		NEW DESIGN	
Impervious Road and driveways	$140,000	Pervious Concrete Road and driveways	$156,000
Curb & gutter	$40,000	Curb & gutter	$0
Hauling off site	$12,600	Hauling off site	$0
Lateral drainage, catch basins & stormwater structures	$15,000	Lateral drainage, catch basins & stormwater structures	$0
Cisterns	$0	Cisterns	$120,000
Total	$207,600		276,800

The net initial cost difference is approximately $70,000 or $3,900.00 per lot.

ANNUAL SAVINGS	
30,000 x $.0083 (City of Tulsa water + sewer rate)	$250.00 / year
City stormwater annual fee per house	$65.00 / year
Total annual savings	$315.00 / year

Savings:
$3,900.00 per unit cost / $315.00 = 12.3 year payback period or a rate of return of approximately 5% over 20 years.

Cost Assessment

Ground Source Heat Pump System

Net cost of upgrade from conventional system: $8,000.00
Savings: $800.00 annually (7% rate of return over 20 years)

Concrete Tile Roof

Concrete tile is to be specified to improve the thermal performance of the roof, increase its longevity, and to make for cleaner stormwater runoff into the cisterns. The $6000/house cost of the concrete tile upgrade will be largely offset by:

- **increased property values**
- **lower property insurance costs**
- **lower repair costs**
- **less frequent replacement**
- **improved thermal performance of the house**

Total savings from an approximate $14,000 initial investment per home is $1,115.00 annually.