Form-Based Codes and Sustainability:
Two Case Studies

Daniel Parolek
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New Partners for Smart Growth Workshop
Charlotte, NC
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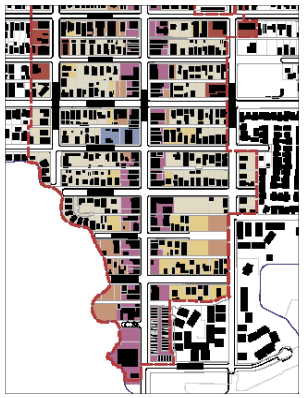

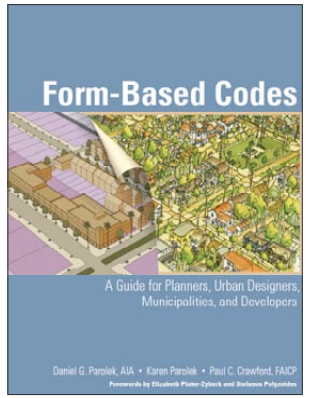

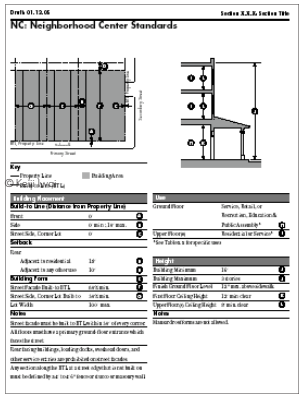

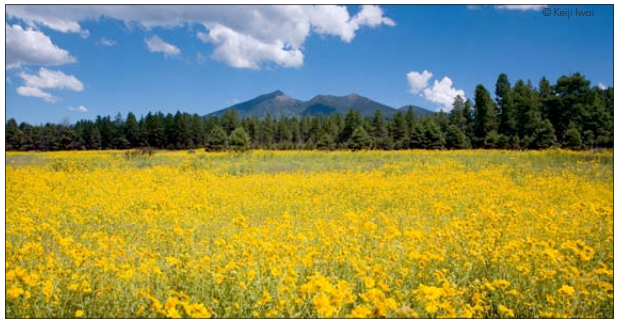

“Top 20 Ways to Make a Green, Smart City”

#2 Replace Your Euclidean Zoning with Form-Based Codes

Rob Dixon - Albuquerque developer
keynote presentation
New Partners for Smart Growth Conference
January 2009

OPTICOS

Sustainability and Form-Based Codes

New Partners for Smart Growth
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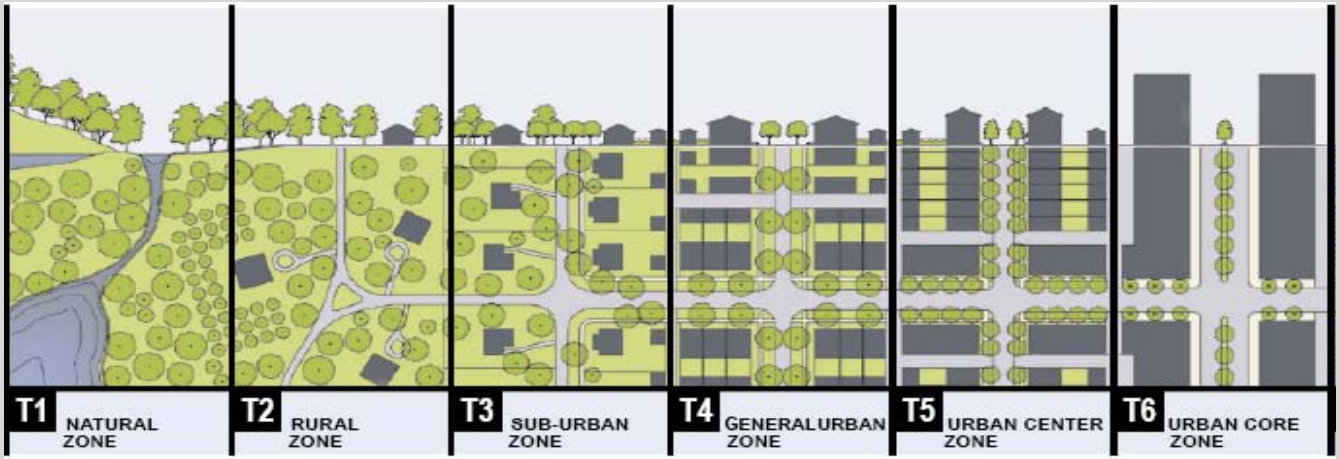
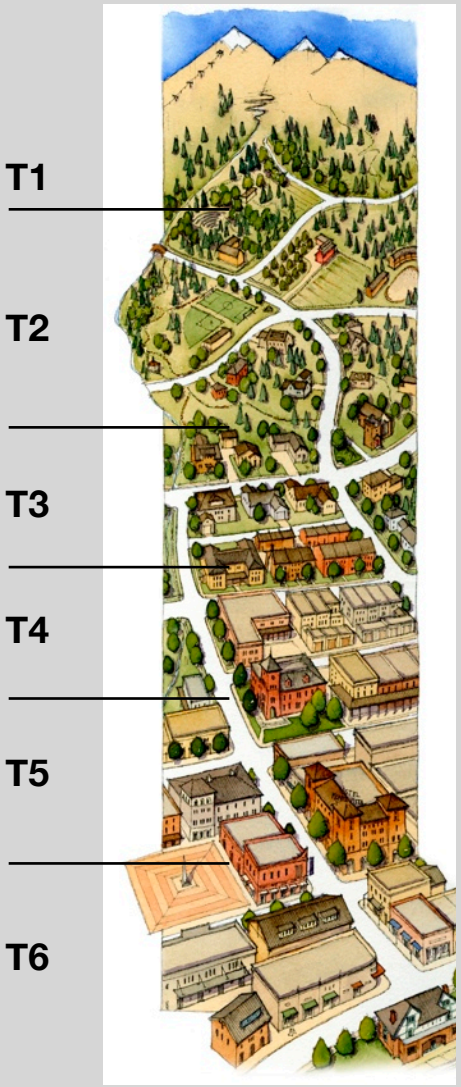
Form-Based Codes and Sustainability

1. Greenhouse Gas Emissions Reductions: Walkability, Vehicle Miles Traveled (VMT)=Walkable, urban development
2. Renewable Energy
3. Water Management
4. Green Infrastructure and Low Impact Development
5. Food Production
6. Solid Waste

This is Where FBC Application Differs from Others





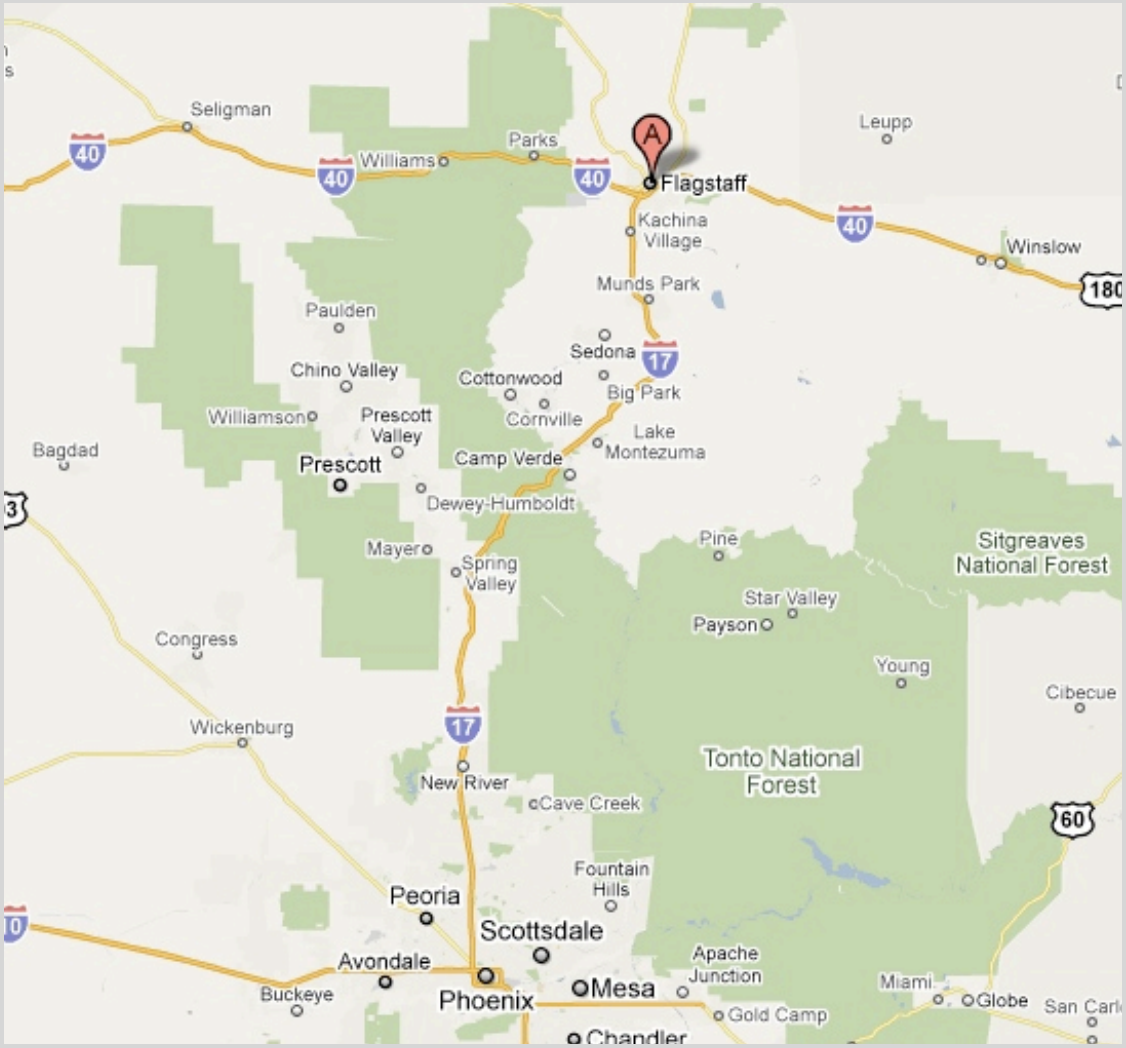
Presentation Overview

1. Flagstaff, AZ Code Update:
   - Solar power
   - Wind power
   - Water management
2. Hercules, CA
   - Carbon reduction results
3. Misc. FBC thoughts

A. Case Study I: Flagstaff, AZ

City Wide Development Code Update

Case Study I: Flagstaff, Arizona

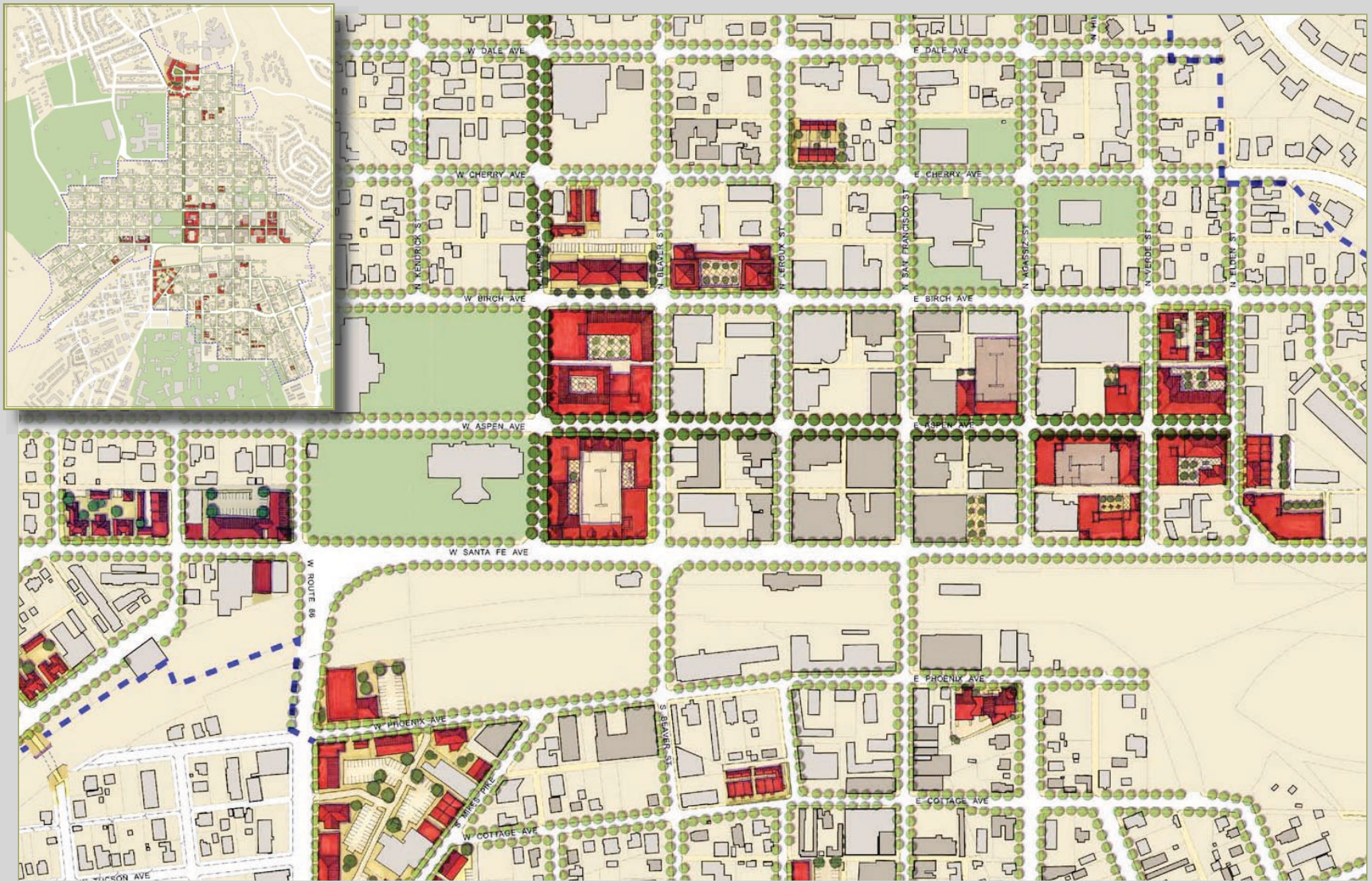


- City: 63 square miles
- Population: 60,288 City, 127,450 in metr. area
- Coconino County
- In 1886, Flagstaff was the largest city on the railroad line between Albuquerque and the west coast of the United States
- Economy: Northern Arizona University, Tourism
- Mild weather throughout year
- High altitude (7,000 ft)
- Colorado River Basin

Important Notes About the Project

1. Complete Rewrite of Zoning and Subdivision
2. Existing Smart Code TND Ordinance in place
3. Dismantle performance based system
4. Prop 207: Private property rights
5. First TND in progress of entitlement under TND Ordinance
6. Regional Plan update happening concurrently
7. Wanted “sustainability” to drive code

FBC is Based on Detailed Vision Plan!



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FBC is Based on Detailed Vision Plan!

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Sustainability and Form-Based Codes

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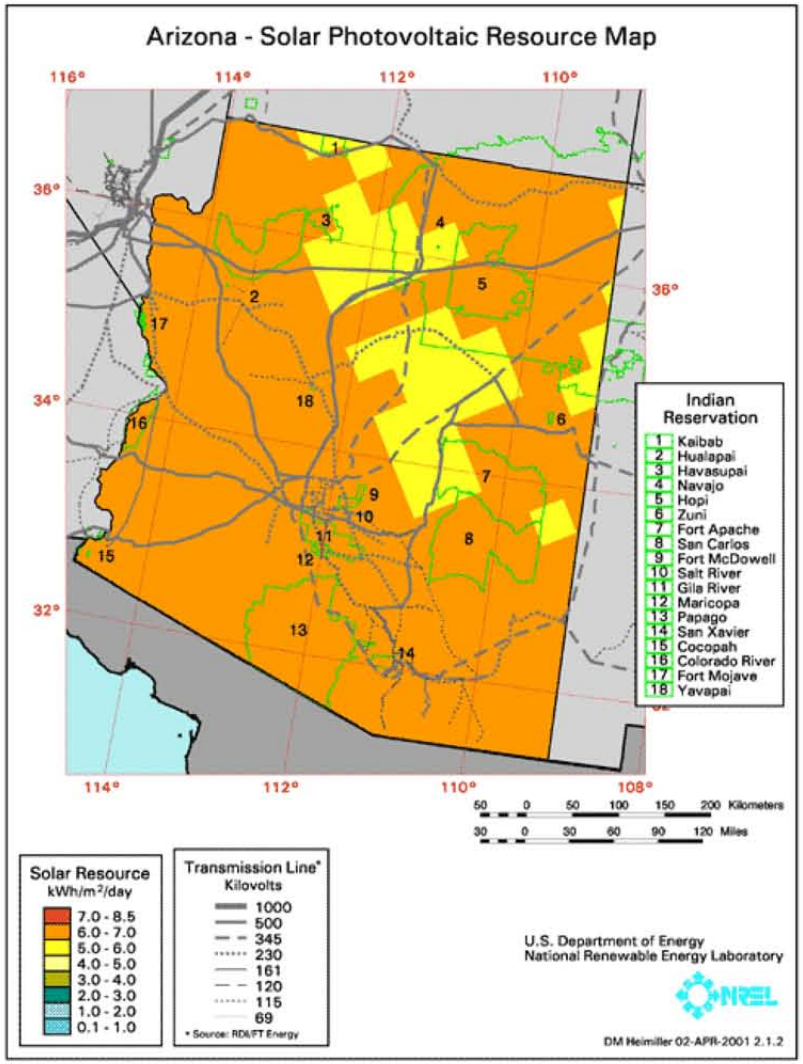
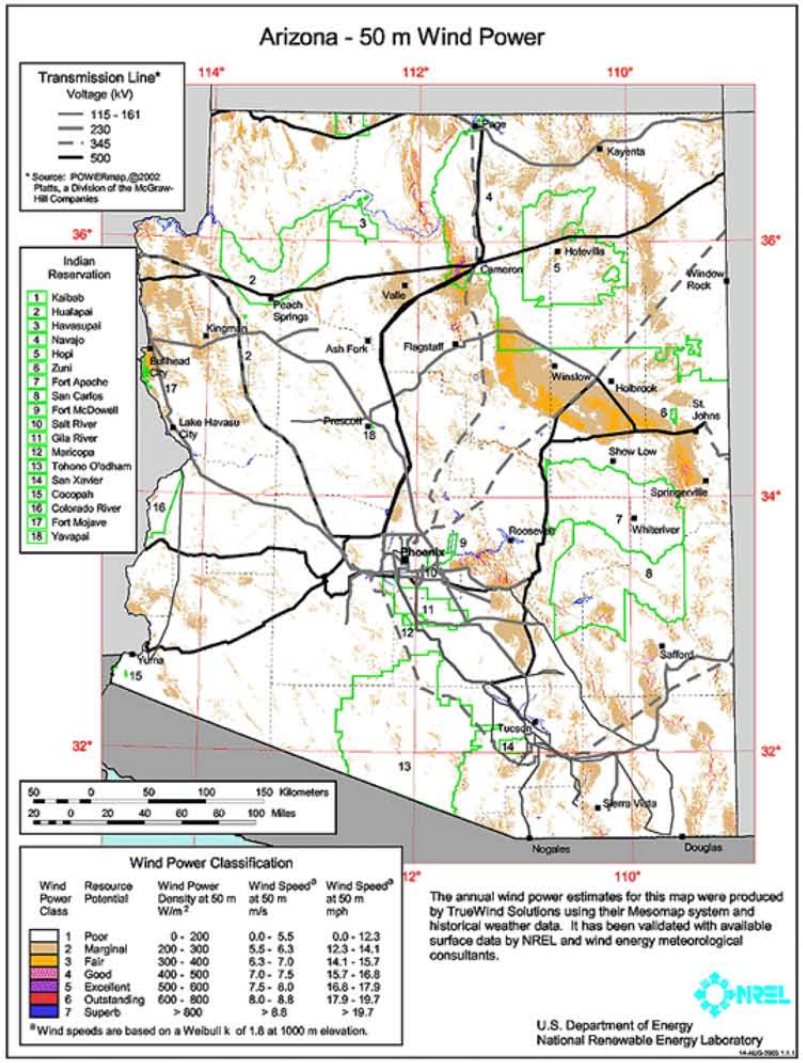
Alternative Energy

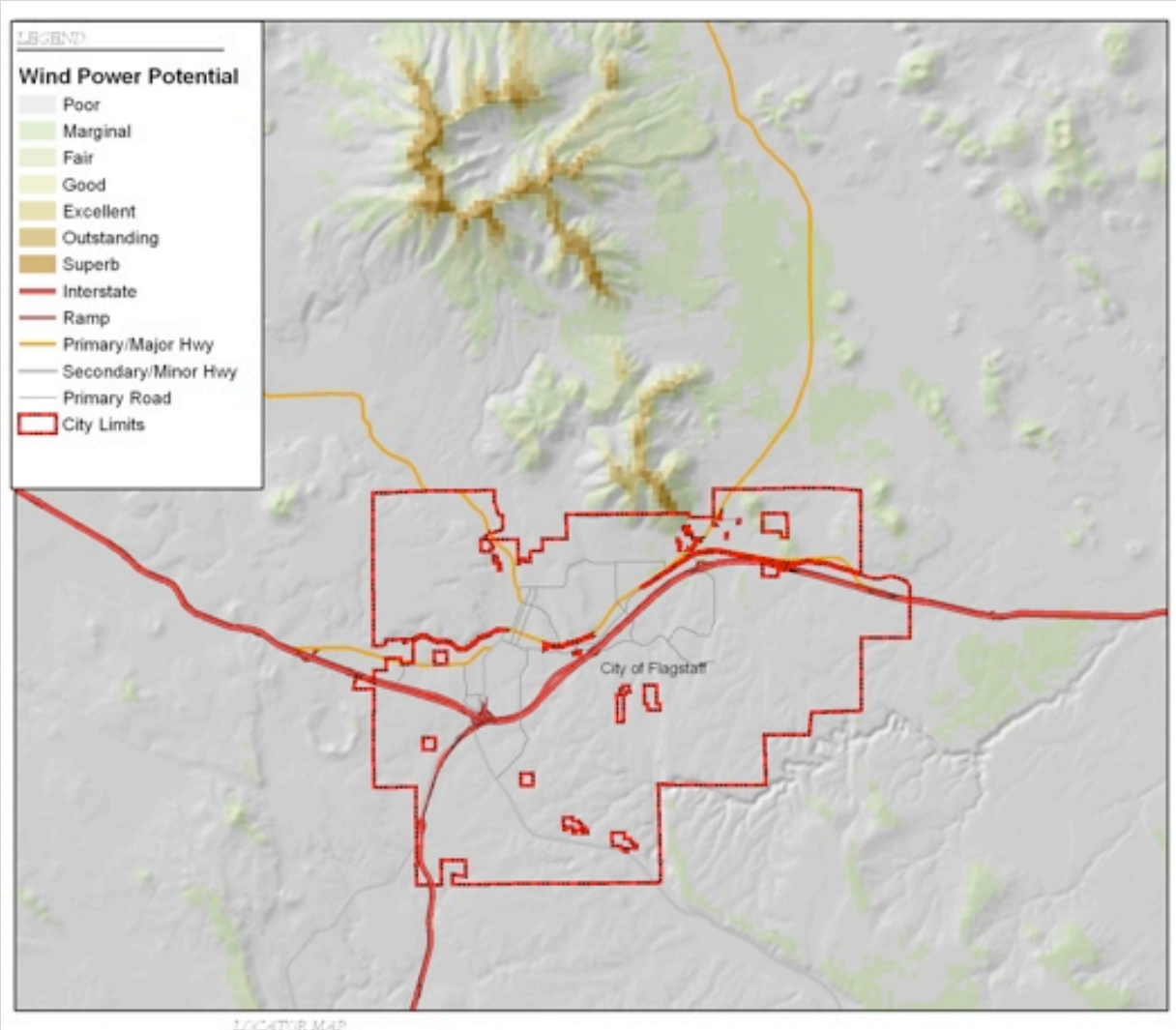
Solar and Wind Power

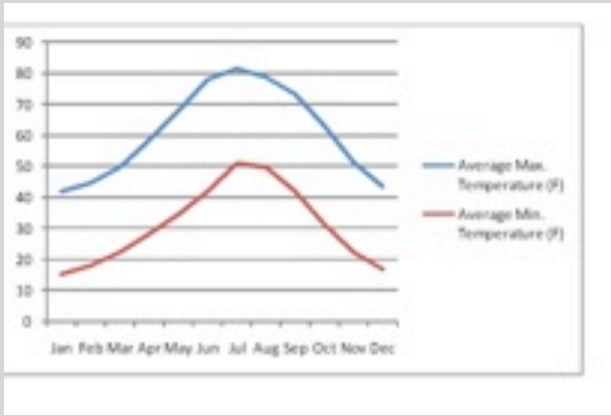
Assessing Solar and Wind Potential

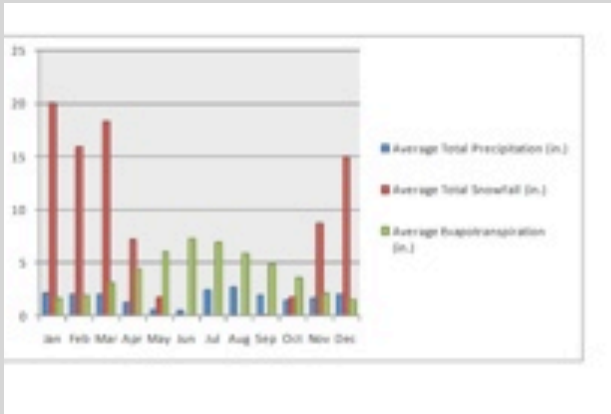




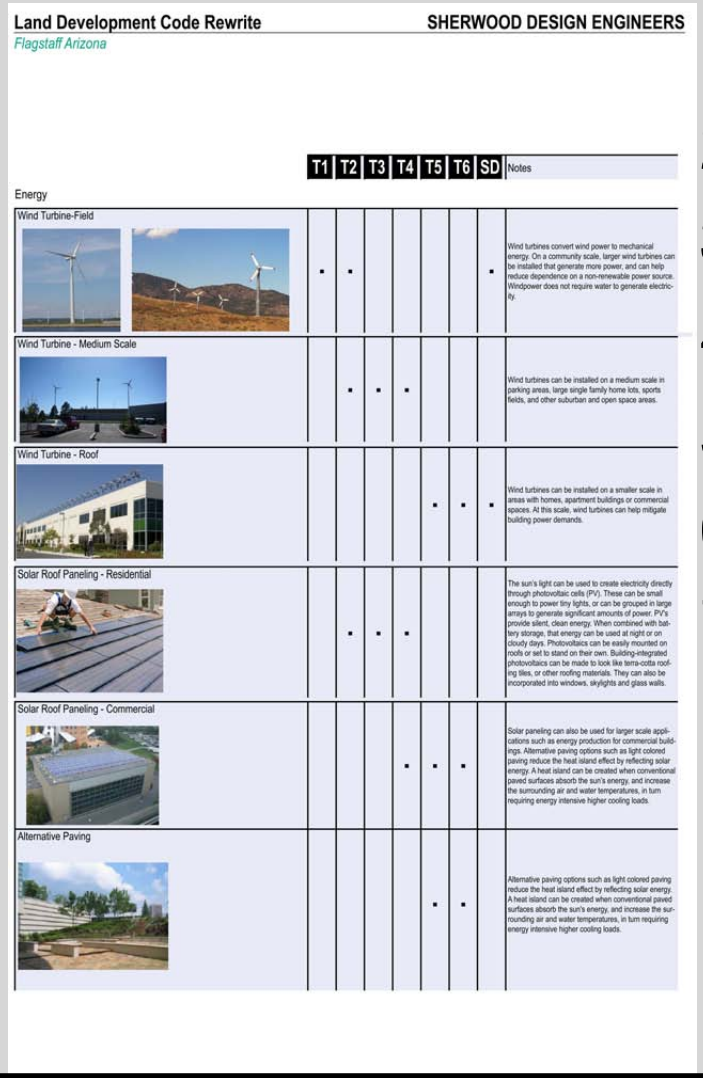
Wind Power is Not a Good Option Everywhere!







Wind and Solar Applications Along the Transect



Land Development Code Rewrite — SHERWOOD DESIGN ENGINEERS

Flagstaff Arizona

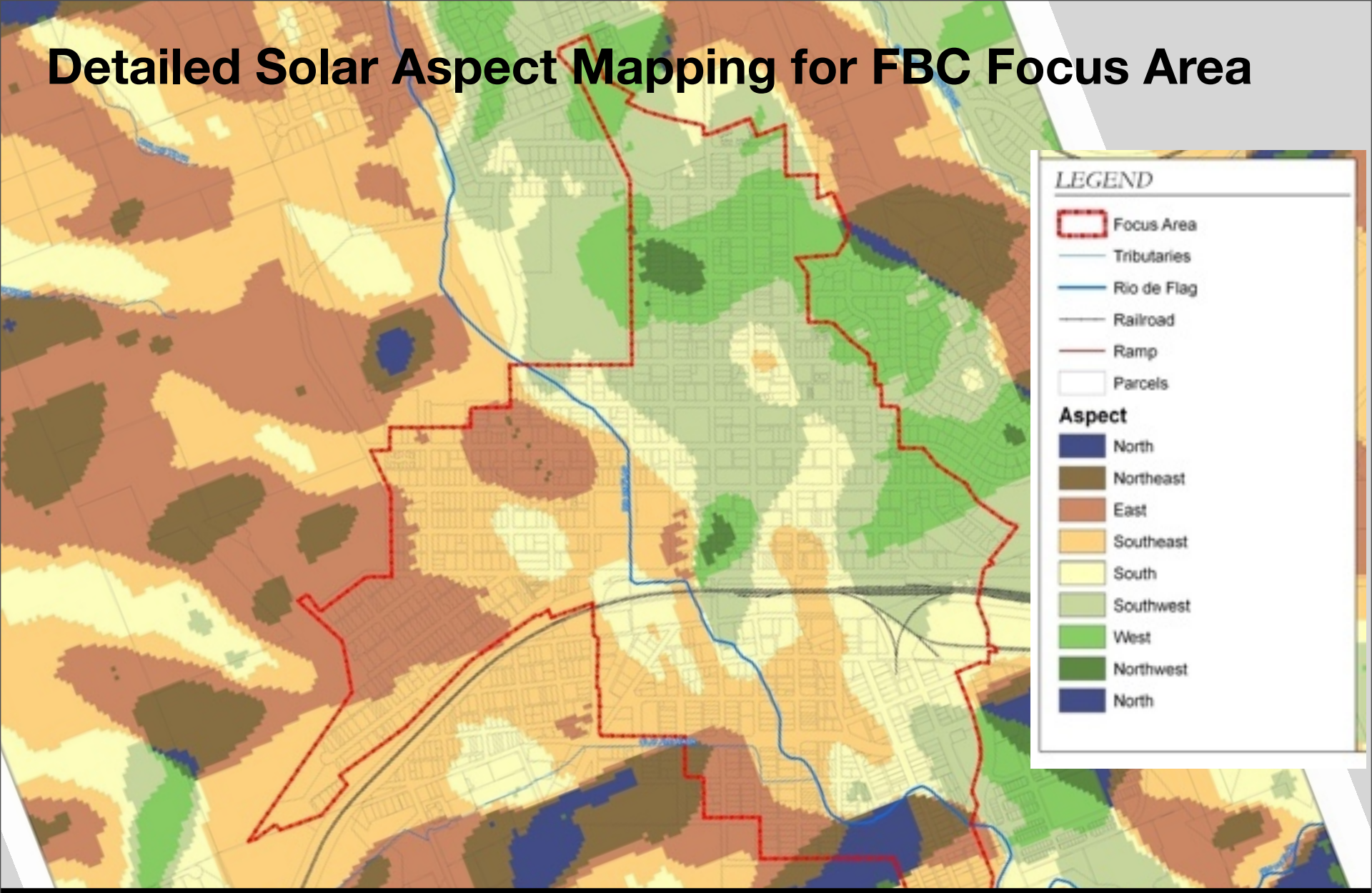
	T1	T2	T3	T4	T5	T6	SD	Notes
Energy								
Wind Turbine-Field	·	·					·	Wind turbines convert wind power to mechanical energy. On a community scale, larger wind turbines can be installed that generate more power, and can help reduce dependence on a non-renewable power source. Windpower does not require water to generate electricity.
Wind Turbine - Medium Scale		·	·	·				Wind turbines can be installed on a medium scale in parking areas, large single family home lots, sports fields, and other suburban and open space areas.
Wind Turbine - Roof					·	·	·	Wind turbines can be installed on a smaller scale in areas with homes, apartment buildings or commercial spaces. At this scale, wind turbines can help mitigate building power demands.
Solar Roof Paneling - Residential		·	·	·				The sun's light can be used to create electricity directly through photovoltaic cells (PV). These can be small enough to power tiny lights, or can be grouped in large arrays to generate significant amounts of power. PV's provide silent, clean energy. When combined with battery storage, that energy can be used at night or on cloudy days. Photovoltaics can be easily mounted on roofs or set to stand on their own. Building-integrated photovoltaics can be made to look like terra-cotta roofing tiles, or other roofing materials. They can also be incorporated into windows, skylights and glass walls.
Solar Roof Paneling - Commercial				·	·	·		Solar paneling can also be used for larger scale applications such as energy production for commercial buildings. Alternative paving options such as light colored paving reduce the heat island effect by reflecting solar energy. A heat island can be created when conventional paved surfaces absorb the sun's energy, and increase the surrounding air and water temperatures, in turn requiring energy intensive higher cooling loads.
Alternative Paving					·	·		Alternative paving options such as light colored paving reduce the heat island effect by reflecting solar energy. A heat island can be created when conventional paved surfaces absorb the sun's energy, and increase the surrounding air and water temperatures, in turn requiring energy intensive higher cooling loads.

1. Wind Turbine-Field
2. Wind Turbine-Medium Scale
3. Wind Turbine-Roof
4. Solar Roof Paneling-Residential
5. Solar Roof Paneling-Commercial
6. Solar Farm
7. Solar Powered Street Lighting

Wind Energy Applications Along the Transect

	T1	T2	T3	T4	T5	T6	SD	Notes
Energy								
Wind Turbine-Field  	▪	▪					▪	Wind turbines convert wind power to mechanical energy. On a community scale, larger wind turbines can be installed that generate more power, and can help reduce dependence on a non-renewable power source. Windpower does not require water to generate electricity.
Wind Turbine - Medium Scale 		▪	▪	▪				Wind turbines can be installed on a medium scale in parking areas, large single family home lots, sports fields, and other suburban and open space areas.
Wind Turbine - Roof 					▪	▪	▪	Wind turbines can be installed on a smaller scale in areas with homes, apartment buildings or commercial spaces. At this scale, wind turbines can help mitigate building power demands.

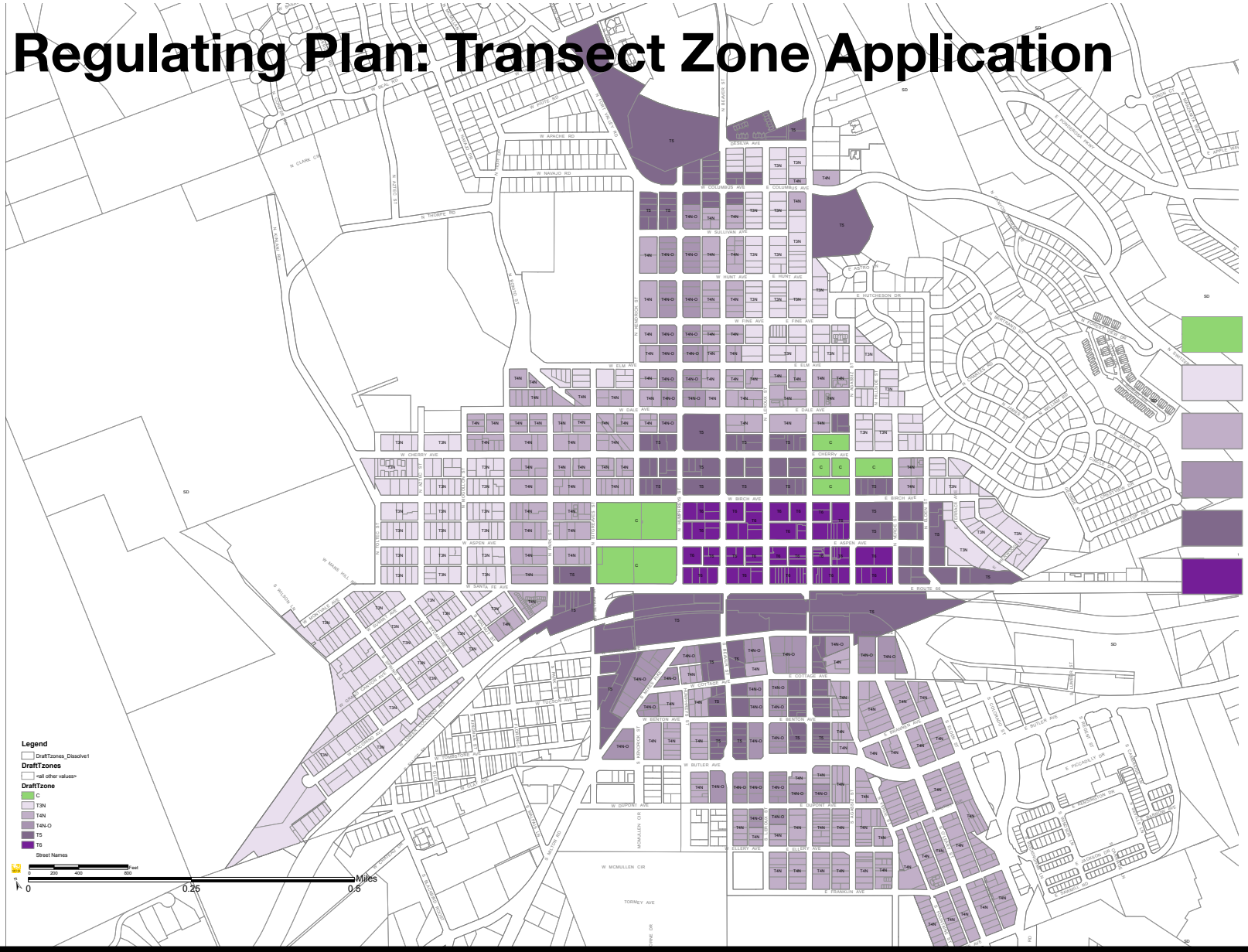
Detailed Solar Aspect Mapping for FBC Focus Area



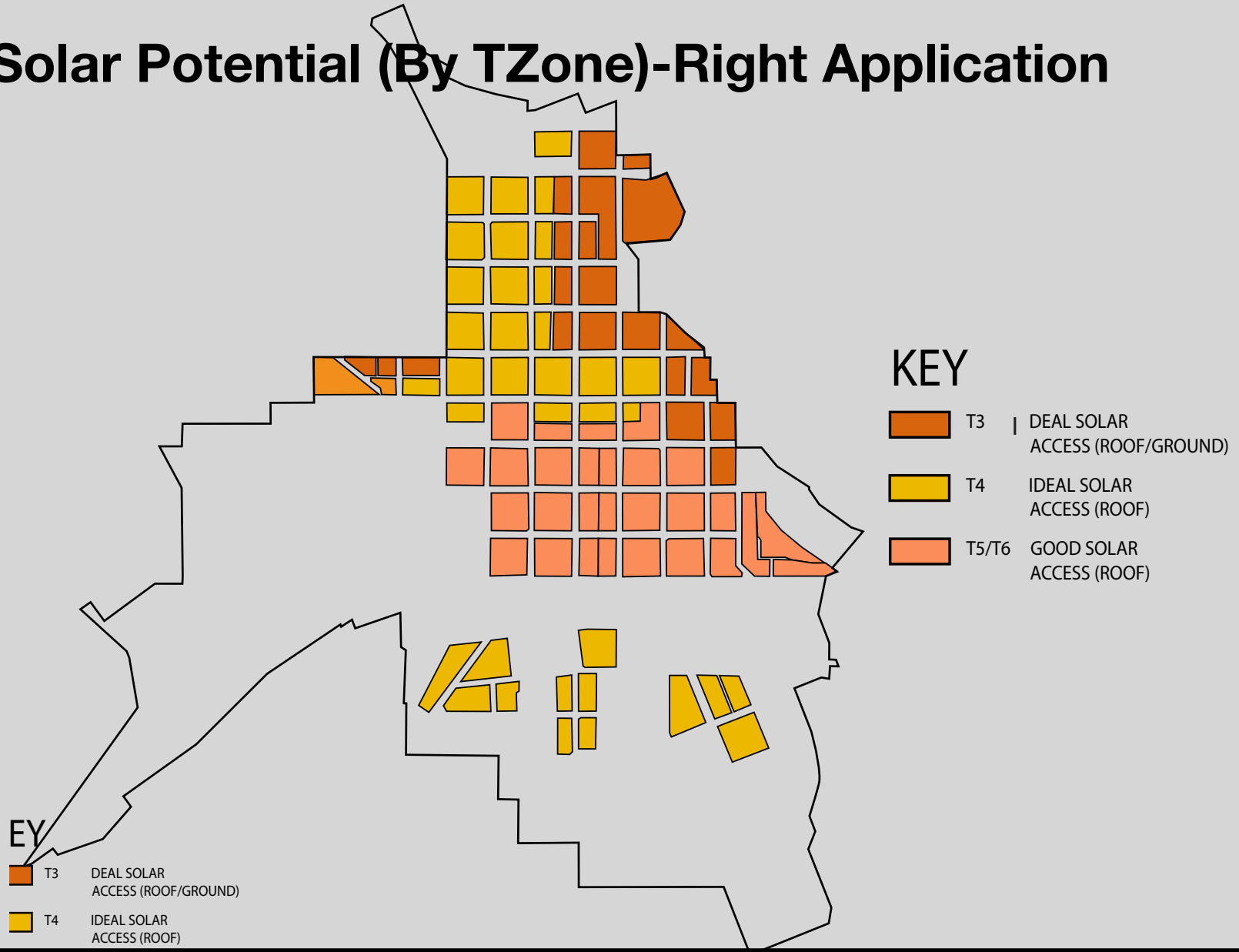
Solar Energy Applications Along the Transect

	T1	T2	T3	T4	T5	T6	SD	Notes
Solar Roof Paneling - Residential 		▪	▪	▪				The sun's light can be used to create electricity directly through photovoltaic cells (PV). These can be small enough to power tiny lights, or can be grouped in large arrays to generate significant amounts of power. PV's provide silent, clean energy. When combined with battery storage, that energy can be used at night or on cloudy days. Photovoltaics can be easily mounted on roofs or set to stand on their own. Building-integrated photovoltaics can be made to look like terra-cotta roofing tiles, or other roofing materials. They can also be incorporated into windows, skylights and glass walls.
Solar Roof Paneling - Commercial 				▪	▪	▪		Solar paneling can also be used for larger scale applications such as energy production for commercial buildings. Alternative paving options such as light colored paving reduce the heat island effect by reflecting solar energy. A heat island can be created when conventional paved surfaces absorb the sun's energy, and increase the surrounding air and water temperatures, in turn requiring energy intensive higher cooling loads.

Regulating Plan: Transect Zone Application



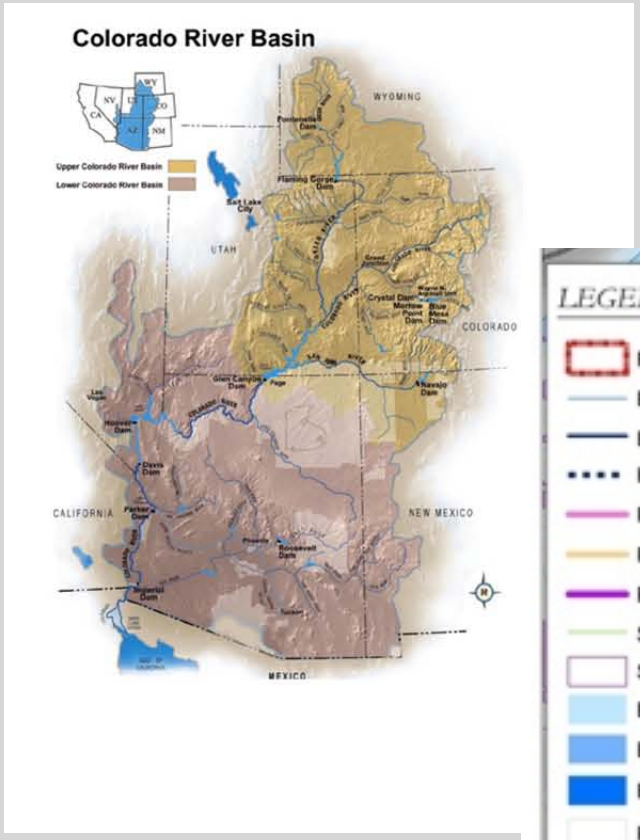
Best Solar Potential (By TZone)-Right Application

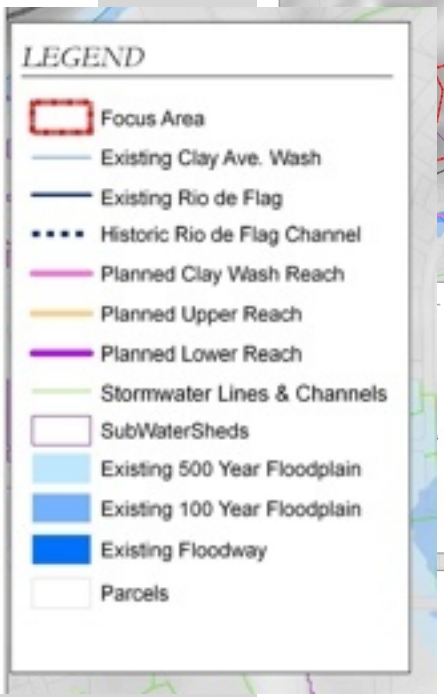


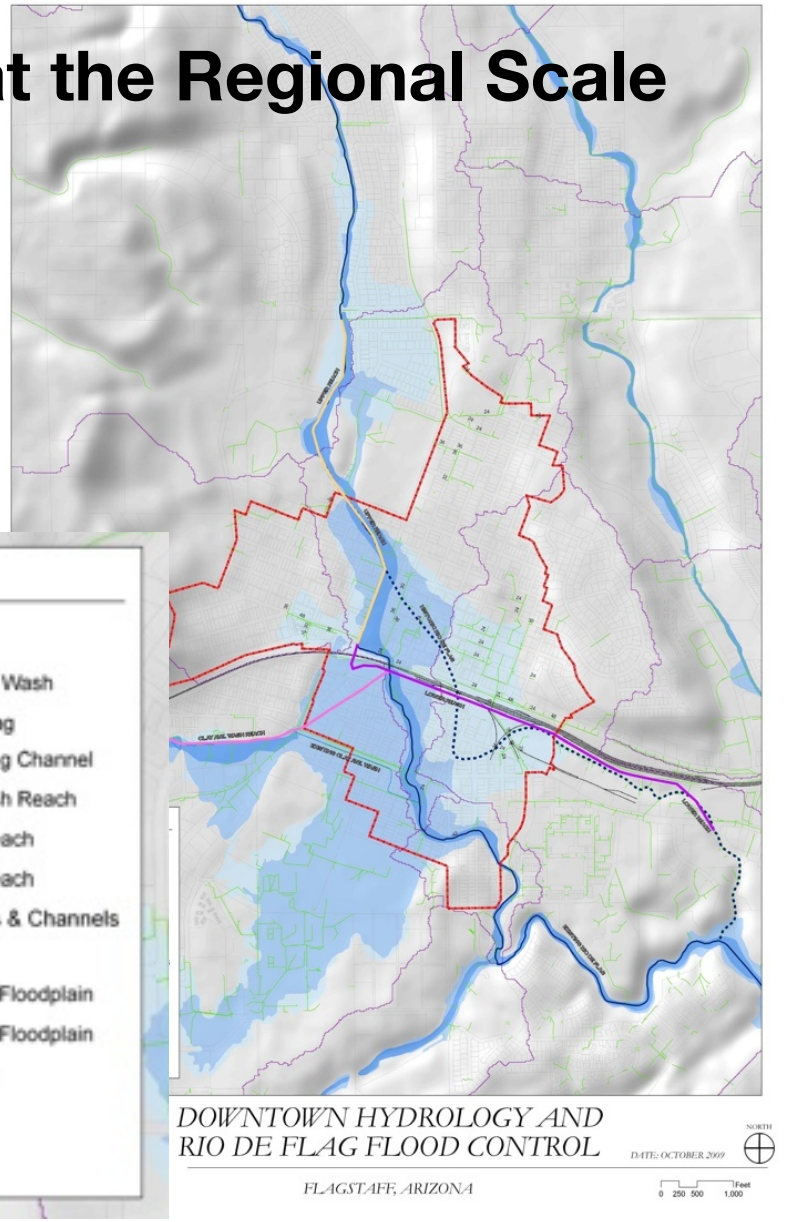
Water Management

Stormwater, Rainwater Harvesting, Wastewater

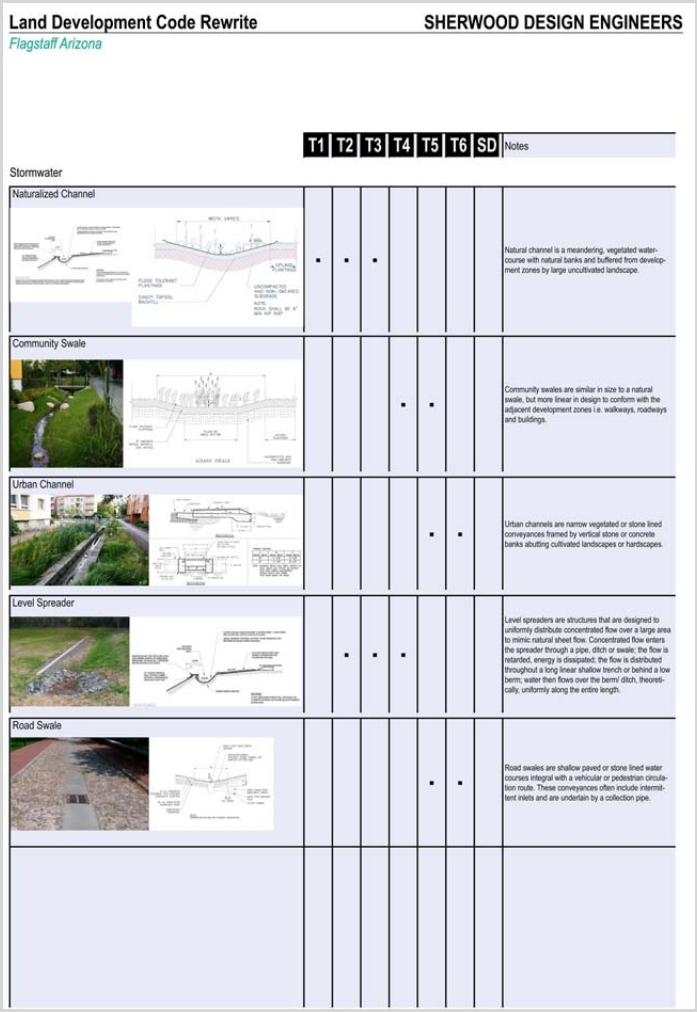
Must Consider Hydrology at the Regional Scale







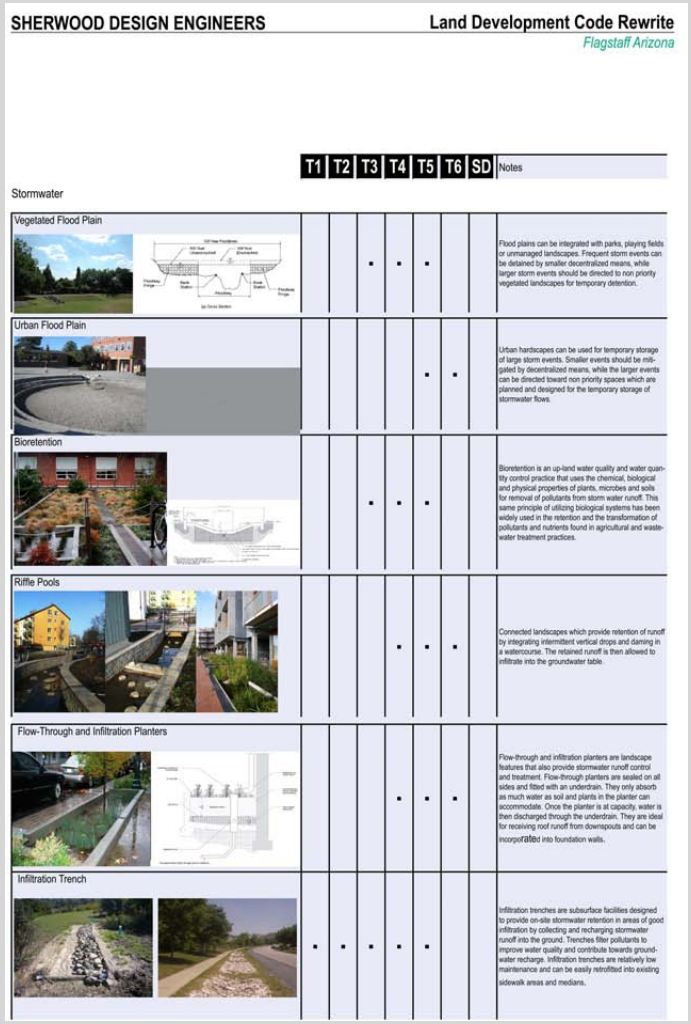
Stormwater Applications Along the Transect


Land Development Code Rewrite — SHERWOOD DESIGN ENGINEERS
Flagstaff Arizona

Stormwater	T1	T2	T3	T4	T5	T6	SD	Notes
Naturalized Channel			.	.	.			Natural channel is a meandering, vegetated water-course with natural banks and buffered from develop-ment zones by large uncultivated landscape.
Community Swale					.	.		Community swales are similar in size to a natural swale, but more linear in design to conform with the adjacent development zones i.e. walkways, roadways and buildings.
Urban Channel						.	.	Urban channels are narrow vegetated or stone lined conveyances framed by vertical stone or concrete banks abutting cultivated landscapes or hardscapes.
Level Spreader			.	.	.			Level spreaders are structures that are designed to uniformly distribute concentrated flow over a large area to mimic natural sheet flow. Concentrated flow enters the spreader through a pipe, ditch or swale; the flow is retarded, energy is dissipated; the flow is distributed throughout a long linear shallow trench or behind a low berm; water then flows over the berm/ ditch, theoreti-cally, uniformly along the entire length.
Road Swale						.	.	Road swales are shallow paved or stone lined water courses integral with a vehicular or pedestrian circula-tion route. These conveyances often include intermit-tent inlets and are underlain by a collection pipe.

1. Naturalized Channel
2. Community Swale
3. Urban Channel
4. Level Spreader
5. Road Swale
6. Vegetated Flood Plain
7. Urban Flood Plain
8. Bioretention
9. Riffle Pools
10. Flow-Through and Infiltration Planters

Stormwater Applications long the Transect

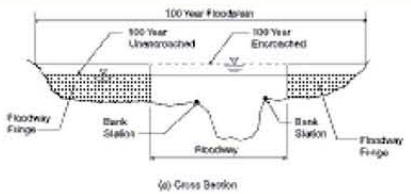


SHERWOOD DESIGN ENGINEERS — Land Development Code Rewrite
Flagstaff Arizona

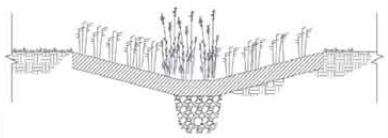
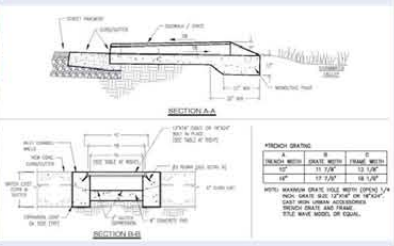
	T1	T2	T3	T4	T5	T6	SD	Notes
Stormwater								
Vegetated Flood Plain			•	•	•			Flood plains can be integrated with parks, playing fields or unmanaged landscapes. Frequent storm events can be detained by smaller decentralized means, while larger storm events should be directed to non priority vegetated landscapes for temporary detention.
Urban Flood Plain					•	•		Urban hardscapes can be used for temporary storage of large storm events. Smaller events should be mitigated by decentralized means, while the larger events can be directed toward non priority spaces which are planned and designed for the temporary storage of stormwater flows.
Bioretention			•	•	•			Bioretention is an up-land water quality and water quantity control practice that uses the chemical, biological and physical properties of plants, microbes and soils for removal of pollutants from storm water runoff. This same principle of utilizing biological systems has been widely used in the retention and the transformation of pollutants and nutrients found in agricultural and wastewater treatment practices.
Riffle Pools				•	•	•		Connected landscapes which provide retention of runoff by integrating intermittent vertical drops and damming in a watercourse. The retained runoff is then allowed to infiltrate into the groundwater table.
Flow-Through and Infiltration Planters				•	•	•		Flow-through and infiltration planters are landscape features that also provide stormwater runoff control and treatment. Flow-through planters are sealed on all sides and fitted with an underdrain. They only absorb as much water as soil and plants in the planter can accommodate. Once the planter is at capacity, water is then discharged through the underdrain. They are ideal for receiving roof runoff from downspouts and can be incorporated into foundation walls.
Infiltration Trench	•	•	•	•	•			Infiltration trenches are subsurface facilities designed to provide on-site stormwater retention in areas of good infiltration by collecting and recharging stormwater runoff into the ground. Trenches filter pollutants to improve water quality and contribute towards groundwater recharge. Infiltration trenches are relatively low maintenance and can be easily retrofitted into existing sidewalk areas and medians.

11. Vegetated Swale
12. Green Roof
13. Pervious Pavers
14. Rain Gardens
15. Disconnected Downspouts

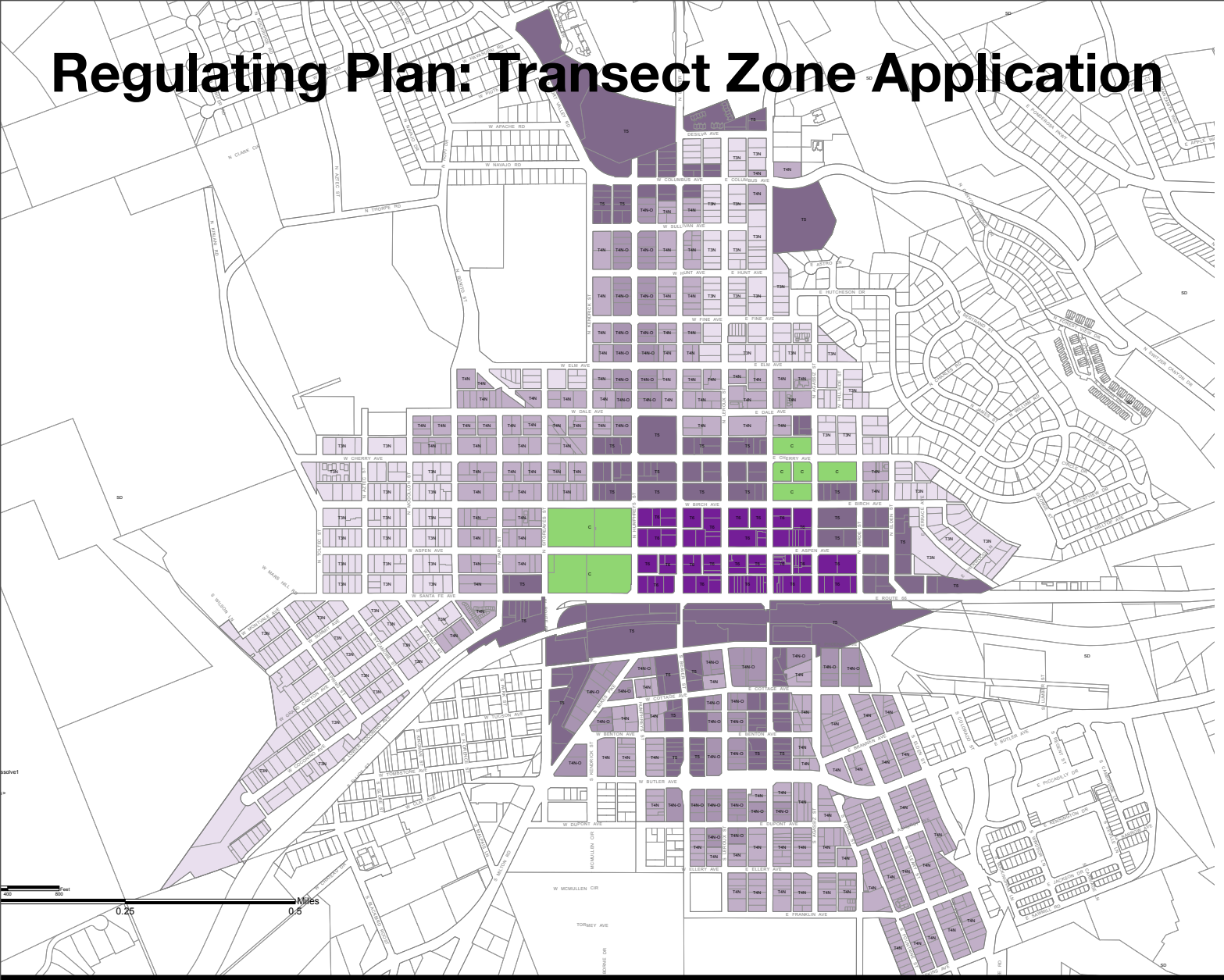
Stormwater Applications Along the Transect

	T1	T2	T3	T4	T5	T6	SD	Notes
Stormwater								
Vegetated Flood Plain  			▪	▪	▪			Flood plains can be integrated with parks, playing fields or unmanaged landscapes. Frequent storm events can be detained by smaller decentralized means, while larger storm events should be directed to non priority vegetated landscapes for temporary detention.
Urban Flood Plain 					▪	▪		Urban hardscapes can be used for temporary storage of large storm events. Smaller events should be mitigated by decentralized means, while the larger events can be directed toward non priority spaces which are planned and designed for the temporary storage of stormwater flows.

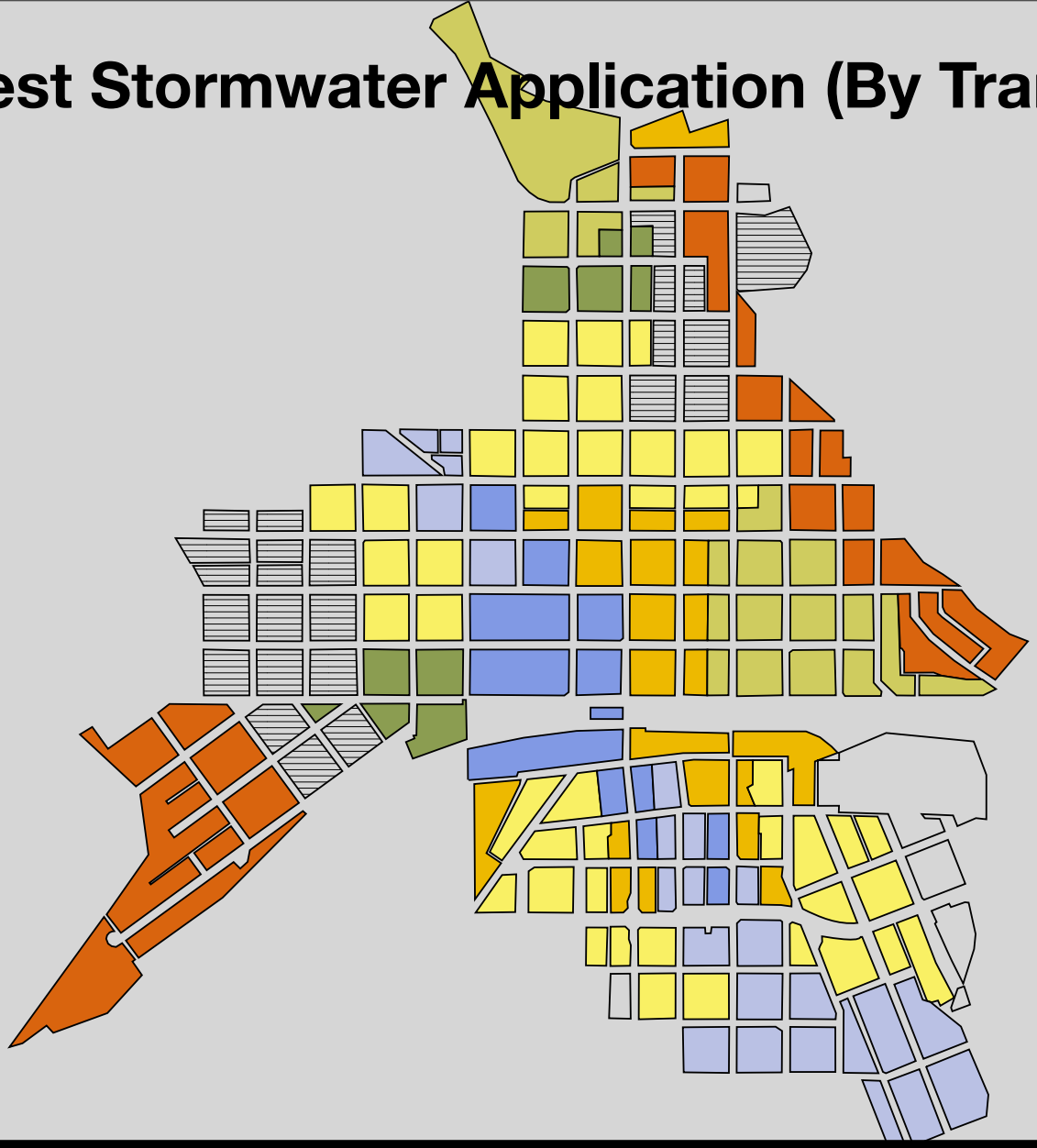
Stormwater Applications Along the Transect

	T1	T2	T3	T4	T5	T6	SD	Notes
Stormwater								
Vegetated Swale  	▪	▪	▪					Vegetated swales are shallow drainage ways that employ landscaping to stabilize the soil while providing water quality treatment via biofiltration. They are designed to remove silt and sediment-associated pollutants before discharging to storm sewers and to reduce volume if soils allow for infiltration. The treatment area can be planted in a variety of grasses, sedges and rushes shrubs, while the side slopes can be planted with shrubs or groundcover.
Urban Channel  					▪	▪		Urban channels are narrow vegetated or stone lined conveyances framed by vertical stone or concrete banks abutting cultivated landscapes or hardscapes.

Regulating Plan: Transect Zone Application



Best Stormwater Application (By Transect Zone)



KEY

T3	SURFACE DRAINAGE SPECIAL CONDITIONS (STEEP SLOPES)
T3	SURFACE DRAINAGE H. INFILTRATION POTENCIAL
T3	SURFACE DRAINAGE LOW INFILTRATION POTENCIAL
T4	IDEAL SOLAR ACCESS (ROOF)
T4	SURFACE DRAINAGE LOW INFILTRATION POTENCIAL
T4	STORM DRAIN, HYBRID BMP OPPORTUNITY
T5/T6	STORM DRAIN, HYBRID BMP OPPORTUNITY
T5/T6	SURFACE OR SUBSURFACE DRAINAGE, HIGH INFILTRATION POTENCIAL
T5/T6	SURFACE DRAINAGE LOW INFILTRATION POTENCIAL

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Best Stormwater Application (By Transect Zone)

T3 Surface Drainage with High Infiltration Potential

In this lower-density area where little to no underground stormwater infrastructure exists, Best Management Practices (BMPs) can be used to provide opportunities to reduce stormwater runoff, promote infiltration and provide for stormwater runoff treatment. Appropriate practices may include infiltration gardens, bioretention areas, vegetated swales, infiltration trenches and/or level spreaders.

T3 Surface Drainage with Low Infiltration Potential

In this lower-density area where little to no underground stormwater infrastructure exists and soil conditions do not promote significant infiltration, BMPs can be used to slow down runoff flows using on-site detention while also providing water quality treatment. Appropriate practices may include biodetention facilities, vegetated swales for conveyance, flow-through planters and detention parks.

T3 Surface Drainage with Special Condition

In this lower-density area where little to no underground stormwater infrastructure exists, soil conditions do not promote significant infiltration and steep slopes exist, BMPs can be used to slow down stormwater runoff flows. In addition to special considerations, appropriate practices may include level spreaders, check dams, riffle pools and free draining permeable paving for hardscape surfaces.

T4 Surface Drainage with Low Infiltration Potential

In this medium-density, mixed-use area where little to no underground stormwater infrastructure exists, BMPs are focused on using the available green space to slow down stormwater runoff flows using on-site detention while also providing water quality treatment. Given the slightly higher density over the T3 zones, appropriate practices may include flow-through planters, biodetention areas, pocket stormwater parks and channelized community swales.

T4 Existing Storm Drain

In this medium-density, mixed-use area where underground stormwater infrastructure exists, BMPs are focused on working with the existing infrastructure by capturing stormwater and slowly releasing it to the existing stormdrain network. These hybrid best-management practices use the available green space to slow down stormwater runoff flows using on-site detention before it is discharged into pipes. Given the slightly higher density over the T3 zones, appropriate practices may include plumbed detention planters, biodetention areas, pocket stormwater parks and plumbed community swales.

T5/T6 Existing Storm Drain

In these higher-density locations where underground stormwater infrastructure exists, BMPs are focused on relying on the existing infrastructure and using the few landscaped and hardscaped areas as a way to ease strain on the storm drain networks. These hybrid best-management practices utilize parking areas and sidewalks to collect stormwater runoff using curb cuts and grading. The planters and permeable concrete or asphalt incorporate underdrain systems that connect into existing infrastructure. These strategies reduce the peak flows from storm events and provide benefits for flood control and water quality.

T5/T6 Surface or Subsurface Drainage with High Infiltration Potential

In these higher-density locations where underground stormwater infrastructure may or may not exist and soils have high permeability, BMPs are focused on optimizing the infiltration potential of the soil by using permeable surfaces that allow water to percolate in the ground. These systems can also connect to the existing infrastructure and use planters, parking areas and sidewalks to collect stormwater runoff from streets and buildings. These strategies reduce the peak flows from storm events and provide benefits for flood control and water quality.

T5/T6 Subsurface Drainage with Low Infiltration Potential

In these higher-density locations where underground stormwater infrastructure does not exist and soil conditions provide for low infiltration rates, BMPs are limited and focus on reducing flows. Green roofs are a good way to reduce impermeable surfaces and provide for a reduction in stormwater runoff. Permeable paving also can be used to mitigate stormwater flows if site conditions allow for the surfaces to ultimately gravity drain.

The Flagstaff Zoning Code Update

1. Public Review Draft released
2. Web site: http://www.flagstaff.az.gov/index.aspx?NID=1416

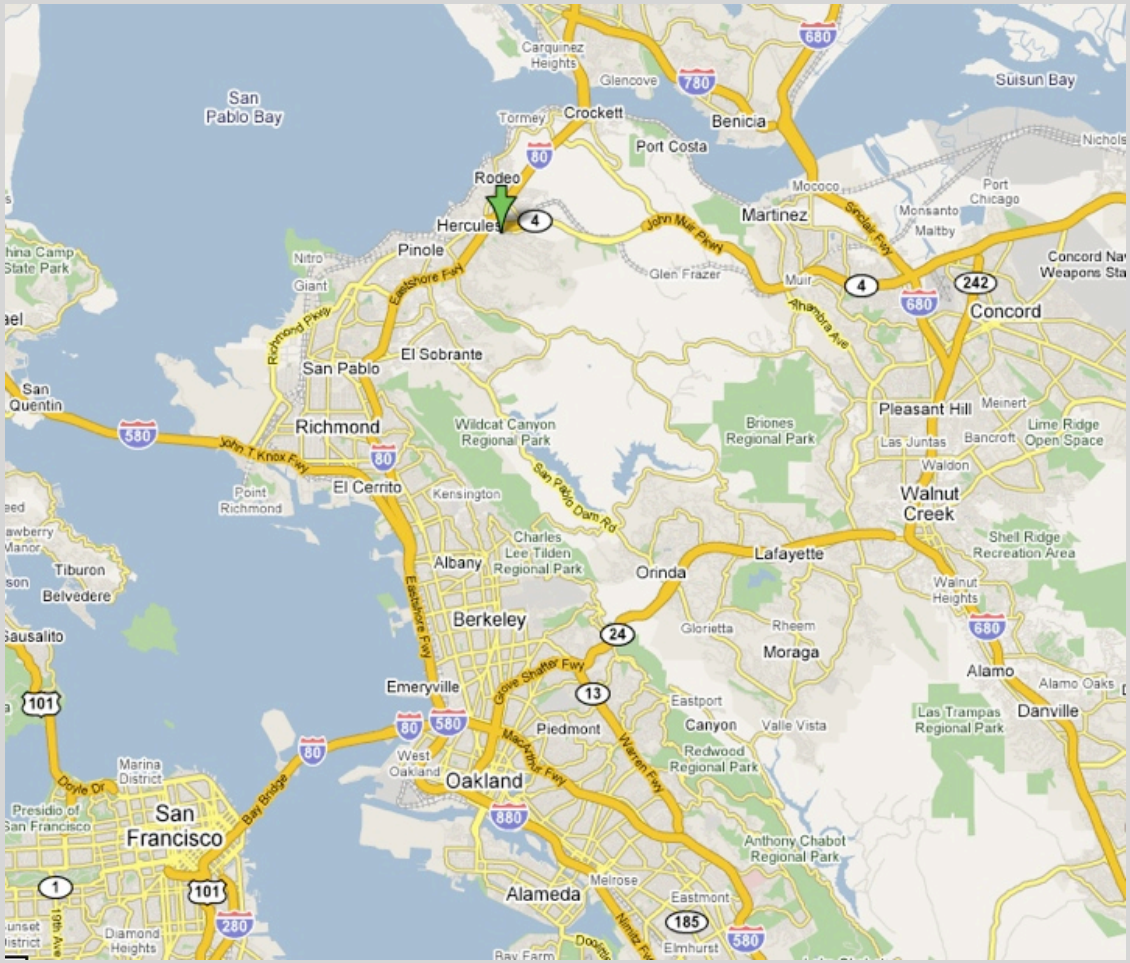
B. Case Study II: Hercules, California

A New Town Center for a Bedroom Community

Reducing Greenhouse Gas Emissions

Central Hercules District Case Study: Hercule, CA

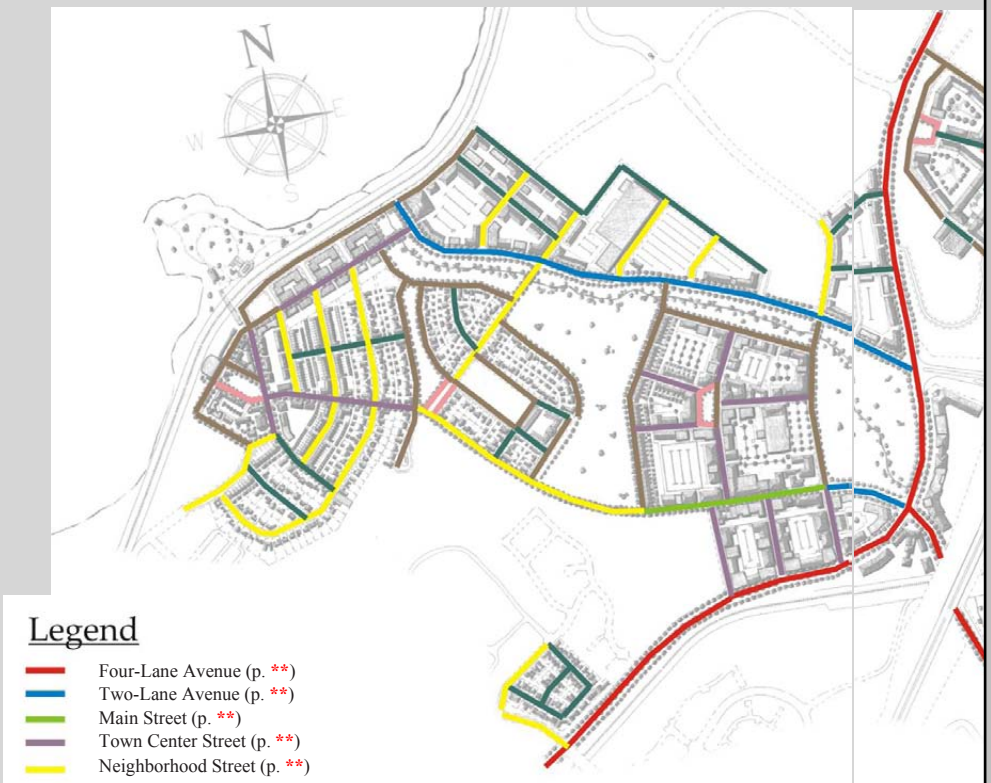
Case Study II: Hercules, California



- San Francisco Bay Area
- Population: 19,488
- Contra Costa County
- Established as company housing by the California Powder Works in 1881
- 427 acre opportunity site along the San Francisco Bay

To Find google “Central Hercules Plan”

Regulating Plan and Building Form Standards



3. Main Street

Main Street is lined with mixed-use shopfront buildings that are positioned at the front of each lot. It features angled parking or parallel parking and wide sidewalks. Trees in the right-of-way are optional. Colonnades are encouraged, to help give the street narrower proportions and better spatial definition.

Notes:

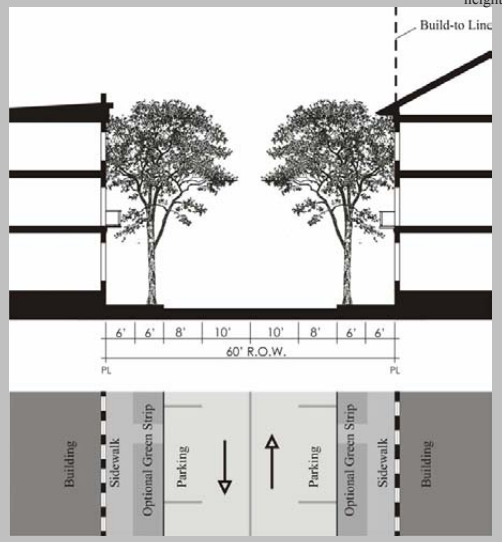
1. Appurtenances may extend beyond the height limit.
2. Building fronts are required to provide shelter to the sidewalk by means of at least one of the following: arcade, colonnade, marquee, awning, or second-floor balcony.
3. The alignment of floor-to-floor heights of abutting buildings is encouraged to allow for shared use of elevators.

A. Building Placement:

Build-to-line location:	0 ft. from property line
Space Between Buildings:	0 ft. if attached 6–10 ft. if detached

B. Building Volume:

Bldg. Width:	16 ft. minimum 160 ft. maximum
Bldg. Depth:	125 ft. maximum
Bldg. Height:	3 stories minimum 5 stories maximum 55 ft. maximum The first floor shall be a minimum of twelve (12) feet in height



Central Hercules Plan and FBC (Dover, Kohl & Partners)

Several New Walkable Neighborhood Built

OPTICOS

Sustainability and Form-Based Codes | Flagstaff, Arizona Code Update

OPTICOS

Sustainability and Form-Based Codes

Flagstaff, Arizona Code Update

Thursday, March 3, 2011

VMT Reduction and The Central Hercules Plan

-The Hercules New Town Center will result in **VMT reductions of 50 to 70 million miles annually** from the business as usual scenario for 2035 (2035 is the project build-out date). Business as usual scenario means not having a town center in Hercules.

-The long-term effect of the New Town Center will be to **reduce VMT by 50% from an average of 50 miles per household per day to 25 miles per household per day** within the New Town Center's catchment area (catchment area is a 7-minute drive to the New Town Center).

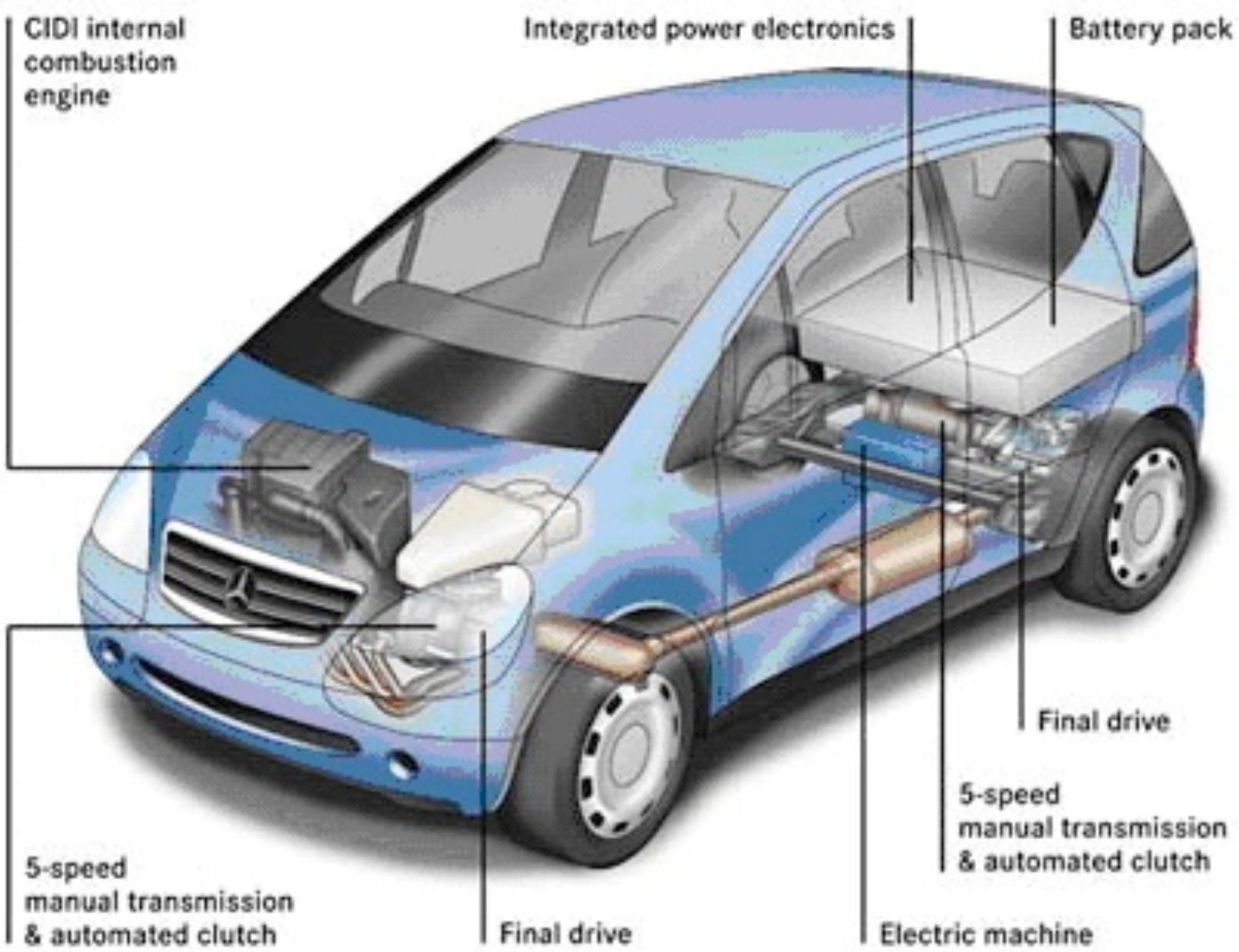
-Over thirty years, reducing average daily household VMT by 25 miles will **save consumers nearly half a billion dollars in gasoline**. This is approximately $850 a year per household not spent on gas (assuming a real price of $4/gallon)

Data provided by Joanna Malaczynski

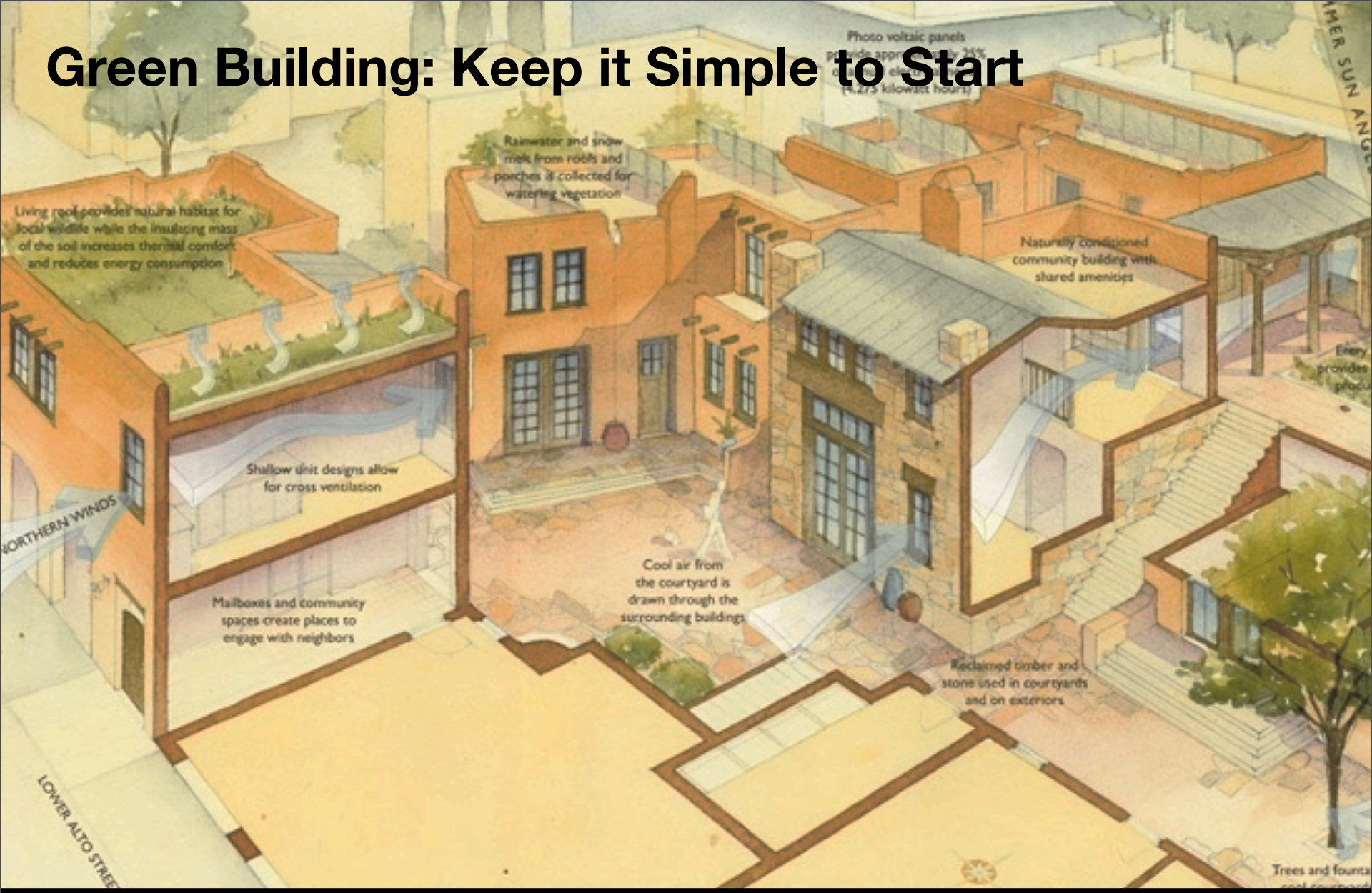
A Few Final Thoughts

Local Food Production, Hybrid Codes, Etc.

Hybrid Code vs. Hybrid Form-Based Code



Green Building: Keep it Simple to Start



OPTICOS

Sustainability and Form-Based Codes

New Partners for Smart Growth
2011

Two Completely Different Types of Zones: Do Not Try to Regulate the same!

Form-Based Zones/ Transect	Special Districts/Auto Dependent
Walkable Urban Low-carbon zones	Drivable Suburuban High-carbon zones
Lower parking requirements (More walking, access to transit)	Higher parking requirements (Less walking and access to transit)
Public realm = Public space	Larger public and private open space required due to isolation
Blended density (variety of types)	“Podded” densities and uses
Mixed use environments	Specific Uses allowed

Supporting Local Food Production and Economies

OPTICOS

Sustainability and Form-Based Codes

New Partners for Smart Growth
2011

Form-Based Codes and Sustainability:
Two Case Studies

Daniel Parolek
Principal, Opticos Design, Inc.
New Partners for Smart Growth Workshop
Charlotte, NC
February 3, 2011

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