ECONOMIC & PLANNING SYSTEMS

▪ *Land Economics* ▪ *Real Estate* ▪ *Public Finance*

CHAPTER 5 EXCERPT - FINAL REPORT

STAPLETON DISTRICT I RESIDENTIAL DEVELOPMENT STRATEGY AND PROGRAM

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5. TAXONOMY OF ENVIRONMENTALLY-SOUND DEVELOPMENT PRACTICES

INTRODUCTION

One of the most unique underpinnings of the Stapleton Development Plan is the stated commitment to redevelop the former airport site with a sustainable form of development. Sustainable, or environmentally-sensitive development is generally defined in the Plan as a vibrant, mixed-use community with diverse, walkable scale neighborhoods that reduce dependence on automobile use and consumption of natural resources. The pursuit of a more progressive development program at Stapleton is anticipated to result in economic, social and environmental innovation that will serve as a new community model for the region.

This chapter provides an operational definition of sustainable development specifically as it applies to residential development. The goal is to provide an overview of those elements of development design and construction which can be modified to improve the conventional house and residential neighborhood without challenging its broader marketability. The taxonomy of environmentally-sound development practices described below are used as the basis for market testing described in more detail in Chapter 6. In that chapter, the range of environmentally-sensitive development options anticipated for further consideration are narrowed, based on their relevance and compatibility with the economic and market realities facing Stapleton.

It should be underscored that the compendium of environmentally-sensitive development options highlighted below are illustrative in nature, rather than exhaustive. There is an extensive and constantly evolving universe of environmentally-sensitive development features, particularly in the areas of building materials and system technologies. Furthermore, while there will likely be opportunities to include highly innovative small-scale developments within Stapleton's various Districts, the focus of this analysis is on environmental approaches that are adaptable to production housing. As such, the analysis excludes development options that are cost prohibitive for production housing, as well as the more radically different approaches to home development such as straw-bale and rammed-earth construction.

ENVIRONMENTALLY-SOUND DEVELOPMENT PRACTICES

Innovation in the areas of environmentally-sensitive project design and development can be generally classified in the following four categories:

(1) community design and land planning
(2) building materials and systems
(3) architectural and building design treatments
(4) infrastructure alternatives.

An overview of development options within each of these four categories follows. The discussion of community land planning and building materials is more detailed than the outline of architectural and infrastructure options. These two areas have the greatest impact on the physical or functional aspects of the home that are perceptible to the home buyer, and are thus more pertinent to this market assessment.

COMMUNITY DESIGN AND LAND USE PLANNING

INTRODUCTION

How a community is laid out, including the interaction between land uses, access and proximity to public transit, the relationship between buildings, open spaces, pedestrians and automobiles all have a significant impact on the character and quality of neighborhood life. In general, the typical post World War II subdivision is considered a design solution which offers little in terms of sustainability or environmental sensitivity. These residential communities generally require automobile trips from home to work, to services and to play, adding to high transportation costs and energy consumption. Further, building design in the typical tract subdivision is oriented toward the preservation of each home's privacy, thus minimizing the greater role of neighborhood and community.

In recent years, a group of planners and architects has moved away from the suburban sprawl that has dominated the landscape for the last several decades, toward a more sustainable form of development. Many of the design elements embraced by this relatively new planning movement are reflected in much of the housing developed prior to 1940. Features such as access to public transit, mixed-densities and mixed-land uses and walkable streets are visible in the pre-World War II neighborhoods throughout Denver and other metropolitan communities around the country.

Variously referred to as "neo-traditional" or "traditional neighborhood development", "new urbanist" or "transit-oriented development", these new communities are purported to result in reduced automobile use and a concomitant decline in energy consumption and congestion. It is also espoused that alternative approaches to community design can promote social and economic vitality which will be reflected in an improved quality of life and the preservation of long-term neighborhood values. A more complete discussion of the definition of sustainability as it applies to urban planning and a literature review of the new urbanist movement are outlined in EPS' Working Paper #1 prepared for the Stapleton Redevelopment Foundation in January, 1994. Relevant sections of that paper are summarized herein.

The following section of the Report describes the key attributes associated with new Traditional Neighborhood Developments (TNDs)[1]. A summary of TNDs currently under development is provided, as is a more in-depth profile of several representative projects.

[1]For purposes of ease and economy of words, TND will be used to encompass the range of projects which include new planning concepts.

The success of these communities, as well as their appropriateness for Stapleton, was assessed through discussions with project sponsors, marketing representatives, builders, and local public officials. The market responses to these communities are described in Chapter 6. Recommended attributes for Stapleton are highlighted in Chapter 7.

COMMON FEATURES OF TRADITIONAL NEIGHBORHOOD DEVELOPMENTS

There are several planning features which are generally considered to differentiate TNDs from conventional master-planned communities. The practical application of these principals vary in emphasis and execution with each project. Further, the design concepts applied to specific projects are being tested and modified as the first significant number of residential units are developed. Nonetheless, there are several key ingredients common to most of these innovative communities which are succinctly described by Lloyd W. Bookout in "Neotraditional Planning - A New Vision for the Suburbs?" (*Urban Land*, January 1992).

1. Balanced well-integrated land use mixes that put residential, commercial and public uses within easy walking distance of each other;
2. A mix of densities with an overall higher density and smaller yards than in most suburban communities and all uses within a five to ten minute walk from the town center;
3. More formal grid-like street patterns with no cul-de-sacs;
4. A circulation pattern that is pedestrian friendly and includes such features as narrow tree-lined streets, attractive sidewalks and street-scapes often with garages placed at the back of the home in alleys and usable front porches;
5. Many public open spaces and more usable common areas such as village greens, town squares, formal parks;
6. Architectural character that reflects local history and uses local building materials where possible;
7. A sense of community that is fostered by socioeconomic diversity, which in turn is encouraged by the mix and integration of housing types and prices.

CASE STUDIES

The development of Traditional Neighborhood Developments is still in its inception. Few communities embodying the range of concepts articulated above have been completed for an extended period of time. In the last several years, however, an increasing number of projects are being introduced. By way of example, New Urban News identified 102 current projects throughout the US. (A summary of these communities is shown in Table 5-1) In addition, several of the first large-scale TND projects are initiating second and third phases of development, with new phases being modified to reflect consumer preferences and responses.

Table 5-1
Inventory of Traditional Neighborhood Developments in Process (1996)
Stapleton Market Feasibility Analysis

State/ Name	Location	Status	Completed	Acres	Characteristics	Developer/Sponsor	Designers
Alabama							
Blount Springs	Blount Springs	Construction	25% Phase I	5,000	128 homes (phase1)	Blount Springs Recolonization Partners	DPZ
Gorham's Buff	Pisgah	Construction	2-3%	186	Town on hill, 350 homes	McGriff Family	Lloyd Vogt
Tannin	Orange Beach	Construction	33%	60	172 homes	George Gounares	DPZ
Arizona							
Civano	Tuscon	Advanced Planning	n/a	820	2,300 homes	Trust for Sustainable Development, City	Moule/Polyzoides DPZ
RosaVista	Mesa	Advanced Planning	n/a	80	Manufactured homes	Homefree Village Resorts	DPZ
Arkansas							
Brodie Creek	Little Rock	Construction	1%	700	1,000 units, commercial	Wilson Development	Nelessen Associates
Har-Ber Meadows	Spring Dale	Construction	1-2%	425	600 units, retail, civic	Jones Development	EDI Architecture
California							
Bay Meadows Specific Plan	San Mateo	Planning	n/a	75	775 units, village center	Bay Meadows Jockey Club	Calthorpe
Capital River Park	Sacramento	Designed	n/a	52	Transit Oriented	Goodell & Associates; Lodi Mission Partners	Calthorpe
Colma Station Plan	Daly City	Designed	n/a	65	Transit Oriented	Daly City, San Mateo County transit agency	Calthorpe
Communications Hill	San Jose	Planning	n/a	500	Network of neighborhoods on hill	City, Barry Swenson Builders (Phase I)	Solomon
Courtside Village	Santa Rosa	Advanced Planning	n/a	68	500 units, retail, school	Courtside Partners	Alan B. Cohen
The Crossings	Mountain View	Construction	45%	16	360 homes	TPG Development	Calthorpe
Curtis Park West	Sacramento	Planning	n/a	96	Redevelopment of former railyard	Union Pacific	Lionakis-Beaumont
East Elk Grove Specific Plan	Sacramento County	Planning	n/a	1,400		EEG Property Owners	Calthorpe
Hughes-Fullerton Reuse Plan	Fullerton	Planning	n/a	270	Mixed use neighborhood	Hughes Corp.	Calthorpe
Jackson-Taylor	San Jose	Designed	n/a	75	Urban Redevelopment	City of San Jose	Calthorpe
Laguna West	Sacramento County	Construction	25%	1,033	3,300 units	River West Investments	Calthorpe

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State/ Name	Location	Status	Completed	Acres	Characteristics	Developer/Sponsor	Designers
Loomis Town Center	Loomis	Designed	n/a	490	750 res. units	Town of Loomis	Calthorpe
Malibu Civic Center	Malibu	Planning	n/a	100		Malibu Village Assoc.,	Calthorpe
Mountain Village Action Plan	Ontario	Planning	n/a		Redevelopment of commercial strip into neighborhood	City of Ontario	Calthorpe
North Lake Village	Fairfield	Planning	n/a		Transit oriented	Loube & Loube Inc.	Calthorpe
Otay Ranch	Chula Vista	Advanced Planning	n/a	1,000	Two villages, 5,600 units	Village Development	Village Development
Playa Vista	Los Angeles	Advanced Planning	n/a	1,087	New city district, 13,000 residential units	Maguire Thomas Partners	Moule/Polyzoides, DPZ
Rio Vista West	San Diego	Construction	Commercial built, residential planned	95	Urban development	Calmat Properties	Calthorpe
Suisun City Redevelopment	SuisunCity	Construction	n/a	100	Urban Redevelopment new neighborhood, plaza	Suisun Redevelopelopment Agency	Roma Design Group
Varnhagen Ranch	Petaluma	Planning	n/a	123	200-240 dwelling units, retail, community center	Steve and Tony Varnhagen	Calthorpe
Colorado							
Elitch Gardens	Denver	Planning	n/a	30	616 units, retail, civic	Perry/Affordable Housing Development Co.	Calthorpe
Dakota Ridge	Boulder	Planning	n/a	50	New neighborhood	Richard McCabe	Calthorpe
Lowry AFB Redevelopment	Denver	Planning	n/a	1,366	Redevelopment of base	Lowry Redevelop. Auth.	Sasaki, HOH
Mill Village	Longmont	Groundbreaking	n/a	80	300 homes	Swift and Associates	CBA
Prospect	Longmont	Construction	1%	80	320 homes	Kiki Wallace, Dale Bruns	DPZ
Stapleton Redevelopment	Denver	Planning	n/a	500 (phase I)	Redevelop closed airport into neighborhoods	Stapleton Dev. Corp.	Cooper/Robertson
Florida							
Abacoa	Jupiter	Groundbreaking	n/a	2,100	University, 6,073 res. units baseball park	de Guardiola Dev.	DPZ Calthorpe, Mouie/Polyzoides
Amelia Park	Fernandina Beach	Advanced Planning	n/a	100	421 residential units	Embry Development	DPZ
Avalon Park	Orlando	Planning	n/a	1,860	4,150 homes	Avalon Associates	DPZ
Celebration	Osceola County	Construction	60% of Phase 1; 5% of Total	4,900	8,000 homes total, downtown, office park	Disney	Cooper Robertson, Robert A.M. Stern

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Stapleton Market Feasibility Analysis

State/ Name	Location	Status	Completed	Acres	Characteristics	Developer/Sponsor	Designers
Hail Plantation North	Gainesville	Planning	n/a	545	800 homes, four neighborhoods	HG Joint Venture	Robert Kramer and Matthew Kaskel
Hail Village Center	Gainesville	Construction	20-30%	50	200 homes, 200,000 sq. ft. retail		Robert Kramer and Matthew Kaskel
Jordan Commons	Princeton	Groundbreaking	n/a	40	188 homes, mod. income	Habitat for Humanity	DPZ, others
New Village	Kendall	Designed	n/a	100		Aura Group	Dover/Kohl
Ravened	Sarasota County	Construction	n/a	380	600 homes, village center.	Robert Elliot	Folsom Group
Rosemary Beach	Walton County	Construction	2%	100	230 homes, 2nd phase	Leucadia National	DPZ
Seaside	Walton County	Construction	85%	80	350 homes, village center	Robert Davis	DPZ
Silver Oaks Village	Zephyr hills	Planning	n/a	40	Residential retail civic	Silver Oaks Development Co.	Community Planning & Research
South lake	Orlando	Construction	Phase I Complete	617		Southlake Development	DPZ
Town of Tioga	Gainesville	Construction	1-2%	280	537 homes, town center	Dibros Corp.	Orjan Wetterqvist
Windsor	Vero Beach	Construction	60%	400		Westnor Ltd., Abercrombie & Kent	DPZ
Georgia							
Post Properties	Atlanta	Planning	n/a	70	Urban village, office campus	Post Properties	DPZ
Hawaii							
l Haseko		Planning	n/a	350	three neighborhoods, oceanfront town center		DPZ
Illinois							
Fox Mill	Campen Twp.	Groundbreaking	n/a		Trad. neighborhoods in larger development	B&B Enterprises	Land Planning Services
Historic Kirkwood	Kirkland	Construction	n/a		Traditional extension to village	Phil Pearson	Land Planning Services
Mill Creek	Blackberry Twp.	Advanced Planning	n/a		Prairie style	Shodeen Development	Dave Yocca, Design Workshop
Oswego Village Sq	Oswego	Groundbreaking	n/a			Inland Real Estate	Bucher-Willis
Vernon Hills	Vernon Hills	Groundbreaking	n/a	110	200 homes, transit station proposed	Town & Country Homes	Land Planning Services

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State/ Name	Location	Status	Completed	Acres	Characteristics	Developer/Sponsor	Designers
Indiana							
Beachwalk	Michigan City	Construction	10%	106	Beach front town	Tom Moss	Allegretti Architects
Maryland							
Sandy Spring	Sandy Spring	Designed	n/a	400		Joseph Alfandre	DPZ
Clarksburg Town Center	Montgomery	Planning	n/a	275	1,350 res. units	Sumner Development	CHK
Kentlands	Gaithersburg	Construction	n/a	352	1,700 homes, school, retail planned	Chevy Chase Savings Bank, Colony Capital	DPZ
King Farm	Montgomery City.	Groundbreaking	n/a	440	3,200 dwelling units	Helios/Towle	CHK
Lafayette Courts	Baltimore	Groundbreaking	n/a	21	Public housing redevelopment into neighborhood	Baltimore Housing Authority	CHK
Lakeland	Gaithersburg	Planning	n/a	343	Adjacent to Kentlands	Natelli Communities	DPZ
Lexington Terrace	Baltimore	Advanced Planning	n/a	8	Public housing redevelopment into neighborhood, 300 town homes, commercial	Baltimore Housing Auth., Struever Bros., Eccles & Rouse	CHK
St James	Prince George's Co.	Advanced Planning	n/a	430	Two villages and three hamlets	Ryco Development	Nelessen Associates
Massachusetts							
Mashpee Commons	Mashpee	Construction	Commercial Complete	294	New village connected to existing shopping center	Fields Point Ltd.	DPZ
Michigan							
Stonelea	Highland Twp.	Planning	n/a	850	New town on reclaimed mine land	Real Estate Interests, American Aggregate	DPZ
Mayfield Park	Mayfield Twp.	Groundbreaking	n/a	105	505 homes, retail	A-Plex Management	Gibbs Planning Group
Shelby Town Center	Shelby Twp.	Advanced Planning	n/a	120	1,500 townhomes, 200,000 so. ft. retail	DiLorenzo Dev.	Gibbs Planning Group
Mississippi							
Cotton District	Starkville	Construction	n/a		Urban Redevelopment into new neighborhood	Dan Camp	Dan Camp
Missouri							
Wildwood Town Center	Wildwood	Planning	n/a	1,200	Plan for new town center in sprawling suburb	City of Wildwood	DPZ
New Jersey							
Kinnelon	Kinnelon	Planning	n/a	19	Town center surrounded by residential	David Prol, Alan Obstler	Nelessen Associates

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Stapleton Market Feasibility Analysis

State/ Name	Location	Status	Completed	Acres	Characteristics	Developer/Sponsor	Designers
Town Center Plan	Washington Twp.	Planning	n/a	700	Radial grid, mixed use core, 2,000 units	Township (7 major landowners)	Nelessen Associates
New Mexico							
Frijoles	Santa Fe	Planning	n/a	344	433 units commercial two-thirds open space	Alan Hoffman	DPZ
Sierra Contenta	Santa Fe	Construction	3-4%	1,400	Affordable, 5,500 units, village centers	Tierra Contenta Corp.	Calthorpe
North Carolina							
Arbor Creek	Holly Springs	Construction	10%	221	850 res. units, 32 acres commercial	Tillett Development	Community Planning & Research
New Village	Huntersville	Planning	n/a	239	Transit-oriented	Robert Bowman	DPZ
Ramah	Huntersville	Planning	n/a	70		Robert Bowman	DPZ
Southern Village	Chapel Hill	Construction	10%	350	1,200 units, 200,000 sq. ft. office retail	DR. Bryan	Doug Stimmel
Trillium	Cashiers	Planning	n/a	650	Three villages, lakefront town center	Rusty Culbreth	DPZ
Vermilion	Huntersville	Advanced Planning	n/a	300		Robert Bowman	DPZ
Village of Woodsong	Shallotte	Advanced Planning	n/a	22	164 dwellings, retail	The Milliken Co.	Thomas Low
Ohio							
Central Neighborhood Plan	Cleveland	Construction	Phase I 75% complete	60	Urban Redevelopment 80 units phase 1	City Neighborhood Progress Inc.	DPZ
Firestone Woods	Cleveland	Planning	n/a	1,500	Village clusters with 50% open space	Biskind Development	Calthorpe
Oregon							
Canyon Rim Neighborhood	Redound	Planning	n/a	95	Extension to town, 570 units	Mike Tenant, City of Redmond, State DLCD	Lennertz Coyle
Fairview Village	Fairview	Construction	5%	88	600 residential units	Holt & Haugh	Lennertz Coyle, William Dennis
LeGrande Neighbor	LeGrande	Planning	n/a	20	Manufactured homes retail, 120 units	State DLCD	Lennertz Coyle
McKenzie	Springfield	Planning	n/a	100	New neighborhood w/ Main Street, 600 units	Banfield Properties, State DLCD	Lennertz Coyle

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State/ Name	Location	Status	Completed	Acres	Characteristics	Developer/Sponsor	Designers
North Mountain Neighborhood	Ashland	Planning	n/a	58	188 units coordinating nine land owners	City of Ashland state DLCD	Lennertz Coyle
Shevlin Riverfront	Bend	Planning	n/a	19	56 units	Brooks Resources	Lennertz Coyle
Sunnyside Village	Clackamas Co.	Construction	n/a	278	1,730 units, retail, civic	Clackamas County, private developers	Calthorpe
Charmbury	Hanover	Planning	n/a	315		Charmbury Partners	Thomas Comitta
Eagleview	Uwchlan Twp.	Construction	50% Phase 1; 10% of total	150	82 homes phase 1	Hankin Group	Hankin Group
Hill District (Crawford Sq & Bedford Additions)	Pittsburgh	Construction	Crawford Square 80%	80	Urban Redevelopment in multiple phases (1,160 units) Main St. revitalization	McCormack Baron, city Hill Com. Dev. Corp.	UDA Architects
Penn wood	Morgantown	Designed	n/a	173	275 homes	Stoltzfus family	Thomas Comitta
Town's End Farm	Unionville	Planning	n/a	25	Village extension 55 homes	Russ Richardson	John Caulk
South Carolina							
Cane Island Retreat	Beaufort County	Planning	n/a	164	Island village w/central lake	Fred Trask	DPZ
Close Family Preservation & Development Plan	Fort Mill	Planning	n/a	5,500	Six villages	The Springs Co.	LandDesign Inc.
Daniel Island	Charleston	Construction	1-2%	3,800	4,000 to 7,000 homes	Guggenheim Found.	DPZ, J. Barnett, Cooper Robertson
Gleason Place	Beaufort County	Planning	n/a	98	Infill neighborhood	Fred Trask	DPZ
Habersham Village	Beaufort County	Planning	n/a	275	1,100 units	Turner/Davis	DPZ
Jordan Tract	Mount Pleasant	Designed	n/a	243	850 units, commercial	Graham Development	DPZ, Dover/Kohl
New Market	Greenwood	Planning	n/a	30	Manufactured home neighborhood	Strephen Davis	DPZ
Newpoint	Beaufort	Construction	50%	54	125 homes, small retail	Graham/Turner	
Port Royal	Beaufort County	Construction	n/a		Extension of town in traditional grid system	Town of Port Royal Village Renaissance, Inc.	Dover/Kohl
Upper Cane Island	Beaufort County	Planning	n/a	218	Island village	Fred Trask	DPZ
Tennessee							
Cordovan, the Town	East Memphis	Construction	10%		220 homes, retail	Gill Properties	Looney Ricks Kiss

Table 5-1
Inventory of Traditional Neighborhood Developments in Process (1996)
Stapleton Market Feasibility Analysis

State/ Name	Location	Status	Completed	Acres	Characteristics	Developer/Sponsor	Designers
Harbor Town	Memphis	Construction	70%	110	550 homes, 345 apts.	Henry Turley Co.	RTKL Associates
Mid-Town Corridor	Memphis	Construction	50%	56	229 units	City of Memphis	Looney Ricks Kiss
Schilling Farms	Collierville	Advanced Planning	n/a	446	434 homes, 750 apts.	Boyle Development	Looney Ricks Kiss
South Bluffs	Memphis	Construction	75%	35	371 dwelling units	Henry Turley Co.	Looney Ricks Kiss
Texas							
Addison Circle	Addison	Groundbreaking	n/a	80	3,000 units high density urban neighborhood	Columbus Realty. Trust Gaylord Properties	RTKL Associates
Virginia							
Belmont Forest	Loudoun County	Construction	10-15%	273	752 homes	Joseph Alfandre	DPZ
Boulder	Stafford County	Designed	n/a	950	2,300 units in four neighborhoods	North Stafford Assoc.	WHA
Brambleton	Loudoun county	Planning	n/a	2,500	6,000 dwellings, retail	Brambleton Land Corp.	CHK
East Ocean View	Norfolk	Planning	n/a	100	Urban Redevelopment	Norfolk Redevelop. and Housing Auth.	DPZ
Haymount	Caroline County	Advanced Planning	n/a	1,682	4,000 res. units, farm	John A. Clark	DPZ
Spring Valley	Blacksburg	Advanced Planning	n/a	100	200 homes, limited commercial	Spring Valley Associates	UDA Architects
Washington							
Northwest Landing	Dupont	Construction	3%	3,000	4,500 residences, stores, industrial	Weyerhaeuser Real Estate	Calthorpe
Wisconsin							
Middleton Hills	Madison	Construction	3-4%	149	400 residences	Marshall Erdman Assoc.	DPZ

Source: New Urban News, December 1996

A selected number of neotraditional residential communities were profiled as part of this study. The purpose of the survey was to illustrate the range and scope of projects being proposed and developed using the TND concepts. In addition, information regarding the success and failings of those projects provides valuable input into the development of an environmentally-sensitive development program for Stapleton.

The survey was limited to new, year-round rather than resort communities, as well as those communities which are located within or near a larger metropolitan area rather than in a remote setting. In addition, while the TNDs are innovative in land planning concepts, many do not address ecological or environmental concerns outside of a goal toward reduced automobile usage. Several of the projects have been selected because they combine elements of a TND with some "Green" building techniques. A summary of the 10 profiled communities is included in Table 5-2.

CIVANO, CITY OF TUCSON, ARIZONA (IN PLANNING)

This 820-acre traditional neighborhood development is planned to include 2,500 residential units, neighborhood-serving retail uses and light industrial and office space. The goal of the project is to demonstrate the marketability of a large-scale sustainable development at affordable prices. In addition, while most of the TNDs incorporate a limited number of "Green" features, Civano plans to combine a significant level of environmental building and infrastructure techniques within a TND land plan. Housing prices are proposed to vary from $70,000 for a small townhome to $200,000 for a custom home on the development's edge.

The plan itself calls for extensive open space which will remain undeveloped. Parks, walking paths, and bicycle paths will be integrated throughout the development. Streets are planned to be narrower and lined with shade trees to create a cooler "micro climate". The residential neighborhoods include smaller lots, with other amenities including public pools and small retail concentrations. Employment opportunities are proposed, to allow for reduced commute time and a reduction in automobile use.

Development of the Civano Plan involved extensive community and City involvement. The City provided ongoing support and has a full-time dedicated staff person working on the project. In addition, the City will be providing $7 million in financial support for on-site infrastructure. The property was purchased from the State Land Trust by a local private developer, Case Enterprises, working in cooperation with the Trust for Sustainable Development, an environmentally-responsible developer from Canada. The development team was selected due to its level of sensitivity to environmental issues. The Trust for Sustainable Development had recently completed the planning of a large TND called Bamberton in British Colombia, Canada. The environmental features proposed for Civano include:

Table 5-2
Traditional Neighborhood Developments Profiled
Stapleton Residential Market Analysis

Community/ Location	Developer/ Architect	Size (acres)	Total Units/ Commercial SqFt	Residential Sales Price (Current/Proposed)	Current Status	Includes Green Features
Celebration Celebration, FL	Disney / Cooper Robertson	4,900	8,000 units; traditional retail and business district; 109-acre office park	n / a	Project under construction. Downtown just opened.	Limited
Civano Tucson, AZ	Case Development / Trust for Sustainable Development	820	2,500 units; light industrial space, office & retail	n / a	Construction of homes to begin in mid-1997	Yes
Harbor Town Memphis, TN	Henry Turley Co. / Looney Hicks Kiss	110	550 single family 345 apartments; 43,000 sqft village commercial center; 120-room inn; 24,000 sqft office	$147,900 to $315,000	Project under construction, about 70% complete.	No
Haymount Caroline Co., VA	John Clark / DPZ Architects	1,600	4,000 units; 250,000 sqft retail; 500,000 sqft office / commercial	n / a	Construction to begin in early 1997.	Yes
Kentlands Gaithersburg, MD	Great Seneca Development Corp. / DPZ Architects	352; 343 being planned for future expansion to be called Lakeland	467 single-family 508 townhomes 292 condominiums 240 apartments; 350,000 sqft shopping center; neighborhood commercial	$239,900 to $1,000,000 Apt. Rent: $850-$1,420	First Project under construction (about 63% complete). 70 lots remain to be sold to developers. Kentlands shopping center completed. Second project in planning	Yes

Table 5-2
Traditional Neighborhood Developments Profiled
Stapleton Residential Market Analysis

Community/ Location	Developer/ Architect	Size (acres)	Total Units/ Commercial SqFt	Residential Sales Price (Current/Proposed)	Current Status	Green Development
Laguna West Sacramento, CA	Phil Angelides/ Peter Calthorpe	1,045	2,100 single-family 1,200 multi-family; 95 acres for office; 17 acres for commercial; 36 acres for travel commercial; 237 acres for lt. industrial	$112,900 to $234,990	About 25% of single family units complete; 33,000 sqft retail to open in December; Multi-family to start next year	No
New Windsor Windsor, CO	Kiki Wallace/ DPZ Architects	n/a	650 units (sf detached, townhomes, apts); small shopping center	$100,000 to $200,000	Site development under construction	No
Prairie Crossing Grayslake, IL	Shaw Company	667	317 units	$194,000 to $409,900	Project under construction. Approximately 75 homes sold.	Yes
Prospect Longmont, CO	Palmer Investment/ In-house	250	505 residential units, 5 product types (sf detached, attached row-houses, studios, live/work). Small retail/service; Some residential/retail	$150,000 to $400,000	Site work complete. First houses under construction.	No
Village Homes Davis, CA	Michael Corbett	68	220 single-family 20 multi-family	$139,000 to $280,000	Project completed in 1982	No

- Civano's buildings will use passive solar design to reduce energy demand
- Buildings will be adaptable for future conversion to photovoltaic (PV) electric generation and similar technologies when they become economical
- Harvested and reclaimed water will be used for irrigation
- Homes will be highly energy efficient
- Residents will have access to on-site recycling and composting
- Solar hot water heaters will be standard

KENTLANDS, NEAR GAITHERSBURG, MARYLAND (UNDER DEVELOPMENT)

A 352-acre traditional neighborhood development (TND) was designed in June 1988 by Andres Duany and Elizabeth Plater-Zyberk (DPZ) and developed by Joseph Alfrandre & Company, Inc. Kentlands features a mix of densities and housing types and will have 1,500 units at buildout and a 350,000 square foot shopping center. Current planning efforts are underway to expand the project onto an adjacent 343-acre property.

Kentlands has been widely considered as the first true test of a traditional neighborhood development. Unfortunate timing initially caused Kentlands to have financial problems due to the general downturn in the real estate market in early 1990. In September, 1991, Kentlands was taken over by its lender, Chevy Chase Federal Savings Bank. The bank remained committed to the original development plans and they were rewarded by brisk sales beginning in early 1992. As of December, 1996, about 63 percent of the units were completed.

At buildout, Kentlands will have a total of about 1,500 units, of which about 470 will be single family detached units, 510 will be townhomes, 290 will be condominiums, and 240 will be apartments. All homes are rear-loaded and accessed of alleys assuming the site permits the development of alleys. All townhomes and detached single family units have some backyard capacity. The lot size for townhomes ranges from 16' to 24' by 100'. For the smaller single-family units, the "cottage units", the average lot sizes are 30' to 40' by 100'. There are several shallower lots which are only 80'deep. For the larger single family detached units the lots range from 50' to 80' by 100'. Homes that are front loaded need to be a minimum of about 70' wide. For both the cottage units and the larger single family detached units, the backyard is generally about 20' to 30' deep by the width of the lot. At Kentlands there is a requirement specifying that there must be at least 16' between the rear of the home and the front of the garage for single family units.

Kentlands has completed a 350,000 square foot commercial shopping plaza on 34 acres. However, the commercial uses are not exactly pedestrian scale old fashioned "main street" retail. The tenants include a K-Mart, a supermarket, a home improvement center, and smaller stores typical of strip shopping centers. Mid-town, a more locally-serving commercial district is to break ground this spring.

Kentlands offers the following neotraditional development features:

- It promotes a pedestrian orientation with narrow tree-lined streets;
- It utilizes natural features in the land use plans including three picturesque lakes and other mature vegetation;
- It offers a diversity of product type and mixes ranging in price from $800 month apartments to $550,000 or more for the largest three story houses;
- It mixes different types of land use together (commercial, public and residential);
- It preserves and adapts for community use a stately mansion and farm buildings dating from the 1850s.

HARBOR TOWN, MEMPHIS, TENNESSEE (UNDER DEVELOPMENT)

Having grown up in Memphis and New Orleans respectively, Henry Turley and his partner, Tony Bologna of the Henry Turley Company had a joint vision to recreate the positive attributes they both associate with the traditional neighborhoods of their childhood. Positive features of the older neighborhoods they sought to replicate included the vibrancy associated with having mansions located near cottages, socializing with neighbors on big front porches, limited front yard setbacks, narrow streets and rear-loaded garages. They are currently developing their vision as Harbor Town.

Harbor Town is located on Mud Island in the middle of the Mississippi River, within very close proximity to downtown Memphis. Begun in mid-1989, the project is expected to have 891 units of mixed residential development and to feature a town square, a school, a shopping plaza anchored by a marina and inn at one end and a carefully tailored mix of shops, restaurants, apartments, and offices at the other. Developing a traditional community at Harbor Town was a high risk endeavor due to the innovation of the project design as well as the site location. Nearby Memphis suffers from a poor image and economic decline, in large part as a result of suburban flight. Initial financing was achieved on the strength of the partners and not the real estate, although Mr. Bologna indicated that financial returns to the initial investors are expected to be very strong.

Approximately 80 percent of the residential units were complete as of December 1996, as were the on-site parks and on-site Montessori School. The average lot size for the single family detached residential units built to date is 50' by 100'. There are also zero-lot line single family detached units on lots averaging about 25' by 90'. A 4,300 square foot grocery store is currently under construction. Due to the size of the store (too small for a chain and too large for small, independent operator), the grocery store will be owned and operated by the development company. While absorption levels are slower than that achieved in the surrounding suburban communities, Harbor Town is achieving some of the highest values in Memphis. Furthermore, according to a survey of residents compiled by Market Profiles, people love living there. The on-site Montessori school doubled in size and the 350 apartments leased so fast that additional rental units are now being added.

LAGUNA WEST, NEAR SACRAMENTO, CALIFORNIA (UNDER DEVELOPMENT)

In California, "the pedestrian pocket," or TOD (Transit Oriented Development) concept developed by Peter Calthorpe made its appearance in the market place as Laguna West, a new development south of the City of Sacramento. The plan includes 2,100 single-family units; 1,200 multi-family units, a 73-acre lake and parks, a town hall, schools, offices and retail shops, all on 1,045 acres.

Many homes are built with usable front porches, and at least 24 percent of the homes must have recessed garages behind the front entryway. As of October 1996, about 550 homes had been built and sold. The majority of single-family homes are currently selling for between $113,000 and $235,000. The first multifamily project for seniors is expected to break ground next spring.

A key project goal is to reduce traffic congestion and reliance on the automobile by concentrating commercial, recreational and high density uses in a town center that is an easy walking or bicycling distance from surrounding neighborhoods and jobs. Community facilities at the Town Hall are managed by the local Recreation and Parks District. The larger Laguna Creek community uses the facility for adult classes, recreation, and day care services. The community is served by an express bus and may eventually be served by a future extension of the Sacramento light rail system.

Commercial development has been slow in coming to Laguna West. However, in late 1996, the first 33,000 square feet of neighborhood commercial space opened. Tenants include small shops, restaurants and offices. Meanwhile, Apple Computer has located at Laguna West with 450,000 square feet, and JVC Corp. will join Apple in developing a manufacturing facility at Laguna West to open in late 1996.

VILLAGE HOMES, DAVIS, CALIFORNIA (COMPLETED)

Designed in 1973 by architect / developer Michael Corbett on a 68-acre site in Davis, California, Village Homes fits into a broader definition of what has been coined "Green development." Since its completion in 1982, Village Homes has become a model community with energy efficient designs, use of passive solar energy; and many neotraditional planning concepts.

A study done in 1990, found that Village Homes residents use 36 percent less energy for vehicular driving than a conventional neighborhood control group, largely the result of the extensive bike path system throughout the community. It was also found that residents used 47 percent less electricity and 31 percent less natural gas per household than the conventional neighborhood control group. The homes in Village Homes are 50 percent more energy efficient than surrounding homes and the tree-lined street keep the temperature about 10 degrees cooler than the surrounding communities.

The project includes 220 single-family units and 20 apartments. There is also a nine-bedroom housing cooperative which houses 12 people. The only commercial use in the

development is a small office building. The development includes 12 acres of open space used for community agriculture and two large playing fields. In addition, homes are backed up to 1/3-acre common areas. No rear fencing is allowed to separate the back of the homes from the common area.

Village Homes has attracted buyers of all age groups including young professionals, retirees and families. The majority of buyers are middle-income, although the rental units and smaller single-family units provide opportunities for lower income residents. In general, the buyers that are attracted to Village Homes are more environmentally aware and are seeking an alternative to the standard suburban tract home. Residents are attracted to the sense of community, the common space, and the available open space. While the environmental qualities of the development are important to new buyers, it is the sense of community that appears to be the biggest draw. The primary criticisms of the community are the small lots and the lack of private yards.

Village Homes incorporates several of the neo-traditional planning concepts, including:

- Narrow, tree lined streets which absorb less heat;
- A variety of house styles, including New Mexican, California Modern and a few earth-sheltered homes;
- A sense of neighborliness is encouraged by arranging the houses around the common green space (not unlike the traditional English village greens or commons) and each "village" is linked together by a system of footpaths and bike trails;
- There is a community center with a solar heated pool, a day-care center, a meeting hall and a small commercial building where some residents rent space;
- Common areas between the houses are landscaped and designed collectively by the residents and include a mix of grass, shrubbery, sand boxes, fire pits and gardens.

The key "Green development" features incorporated in the development include:

- Streets run east to west to maximize solar exposure;
- Homes are well-insulated and incorporate passive solar construction;
- Homes have rooftop solar water heaters that meet 100 percent of the home's hot water needs in the summer and 50 percent in the winter;
- All common areas include fruit and nut-bearing trees, some of which are harvested commercially and the proceeds contribute to the annual maintenance funds;
- A network of drainage swales replace conventional storm drains and run through the common areas;
- Residential lots are graded away from the street and towards shallow landscaped swales;
- The landscaping requires just two-thirds the amount of irrigation compared to other Davis developments due to the natural drainage systems and denser plantings;

HAYMOUNT, NEW TOWN, CAROLINE COUNTY, VIRGINIA (IN PLANNING)

Haymount is being planned as a traditional American small town (TND) on 1,600 acres along the Rappahannock River in Caroline County. John A. Clark is project developer, and Andres Duany and Elizabeth Plater-Zyberk are the architects and planners. Like many of the initial TNDs, Mr. Clark provided the inspiration and perseverance to press the project through the approvals process. At buildout, Haymount will have 4,000 residential units, including townhouses, apartments and single-family detached houses, with homes projected to range from $58,000 to $400,000. The project also includes 500,000 square feet of flexible office space and 250,000 square feet of retail space. Project planning began in 1991, with construction scheduled to start in early 1997.

William Browning of the Rocky Mountain Institute calls Haymount the best example of a fully sustainable project that he has seen. Browning says that Haymount aims to be a completely sustainable community -- it will create jobs for its residents by generating a demand for sustainable building materials and other construction inputs. The community will have rigorous energy and material codes that will encourage the use of environmentally sensitive materials and promote businesses that manufacture and use recycled products. The goal is to have 1.3 jobs per household, with a range of job types provided.

Neo-traditional Planning and Environmental Features

- Six villages will be small enough to walk from the center to the periphery in five minutes.
- Streets will be a traditional grid pattern with sidewalks that connect the whole town.
- Each village will have a mix of residential and commercial uses and public spaces.
- Streets and landscape designed to encourage people to walk rather than drive to their destinations.
- Haymount proposes to protect up to 50 percent of the 1,600 acres including all wetlands, steep slopes and 85 percent of the river front and American bald eagle habitat.
- Landscaping will emphasize native plants and woodlands destruction will be limited.
- Storm water will be recharged naturally using swales and porous paving.
- Wastewater will be treated by on-site biofiltration.
- Recycling is promoted by designing houses and yards to encourage separation of materials and pickup.

Other Unusual Features:

- Haymount developer John A. Clark has promised to provide a full-time environmental manager who will administer the recycling program and oversee a reforestation program.

- An archaeological manager has been proposed to supervise the parks and archaeological sites.

- One in every 20 houses will be "affordable."

- Development of a Community Land Trust will support the development of affordable housing countywide.

PROSPECT, LONGMONT, COLORADO (UNDER DEVELOPMENT)

Prospect is a smaller traditional neighborhood development currently under construction in Longmont, Colorado. The 80-acre property is being developed by Kiki Wallace and Dale Brun, with DPZ as the project planners and architects. The project calls for a total of 335 lots and 505 units, including houses, offices, townhomes and carriage units as well as support services and retail. The two-block main street is anticipated to serve on-site uses, but be supported by surrounding residential units as well. Home prices are anticipated to range from $150,000 for a townhome unit to $400,000 for a single-family detached home.

The land use plan incorporates the majority of features articulated by the TND architects and planners including narrow, grid streets with small lots. In the first phase of development there are basically two lot sizes. The attached row houses are on 24' by 100' lots and the single family detached units are on 48' by 100' lots. With the larger lots, a maximum of 50 percent lot coverage is allowed. The front setback ranges from 8' to 16' and backyards are about 20' deep. In future phases of development, there will be a greater range of lot sizes. About 5 percent of the homes are attached courtyard units on lots about 45' by 80'. There will also be attached mixed use units on 36' by 100' lots and attached workplace units on 27' by 125' lots. Homes will include usable porches in the front and almost all units will have detached garages accessed from alleyways.

The project was originally formulated through a six-day charter lead by Andres Duany in January 1994. Mr. Wallace, whose farming family has held the property for a long time, is an atypical developer. This is his first real estate project, and he is impassioned about executing a project true to the ideals of TND. He also expressed confidence that the project will perform well financially.

The City initially attempted to permit the project using existing zoning regulations. However, atypical lot sizes, street widths and other anomalies resulted in long delays. Mr. Wallace persevered on most items and received approvals for the project virtually as initially planned.

With site work still underway, 48 of the 62 lots in Phase I have been sold to local builders. Average prices for a 5,000 square foot lot have increased from $42,000 to $50,000 since

initial marketing. This is about $10,000 less than the price paid for 10,000 to 12,000 square foot lots at an adjacent conventional project where average home prices are anticipated to be higher. The majority of builders attracted to the project have been smaller and more local or regional rather than national firms. Mr. Wallace has found the smaller firms to be more willing to work with the design guidelines established for the project.

CELEBRATION, CELEBRATION, FLORIDA (UNDER DEVELOPMENT)

Celebration is a new town being developed by the Walt Disney Company and designed by Master Plan architects Cooper, Robertson & Partners (the firm that assisted on the Stapleton Development Plan and is currently working on a land plan for District 1. The 4,900-acre site is near Orlando, Florida adjacent to the Walt Disney Resort. Celebration is proposed to include up to 8,000 residential units, as well as on-site public school, health, commercial, retail and recreational facilities. The town is being developed as a pedestrian-friendly place to live, work and play. On-site amenities include an 18-hole golf course, miles of walking paths, village parks and a lake.

A broad mix of residential units are proposed for Celebration including apartments, townhomes, cottage, village and estate homes. Lot sizes for these units range from 22' and 25' by 100' for the attached townhomes, 45' by 130' for the cottage units, 70' by 130' for the village homes, and 90' by 130' for the estate units. Celebration homes will be designed in one of six traditional types, lending a sense of cohesiveness and history to the new neighborhoods. Architectural rendering, building proportions and siting requirements are laid out for prospective builders in a Pattern Book. Homes will be oriented toward the front yard with front porches. Cars are to be de-emphasized, with garage access off rear alleyways, although future phases of development may include alternative garage orientations.

The downtown is a traditional retail and business district. Downtown Celebration includes a bank, sales office, town hall, post office, cinema, offices, and apartments. The majority of these buildings were designed by internationally renowned architects, affording the project significant publicity. An adjacent 109-acre office park is being developed as part of Celebration. The proposed buildout totals one million square feet. The first residents moved into Celebration in the summer of 1996, and the downtown was completed November of the same year.

Celebration's history and development pattern are greatly influenced by the largess of the developer/owner. Disney proceeded by developing many of the on-site amenities and commercial uses prior to the initiation of the residential development. This has added significantly to the overall marketability of the housing. Although this approach is difficult to orchestrate without a highly capitalized developer, many of the other surveyed TNDs are attempting to put in some level of retail or other amenities in advance of initial market support. Access to nearby retail outlets and public open space are perceived as key elements in differentiating the projects from more typical suburbs.

Specific traditional and environmental features include:

- Only a third of the overall land area will be developed;
- A tree-preservation program aims at saving many native, mature trees;
- Environmentally friendly building materials will be used;
- Energy efficiency requirements are established by the EPA Energy Star Program;
- Irrigation-quality water will be used for irrigation;
- Environmental management programs will include recycling and wildlife education.

PRAIRIE CROSSING, GRAYSLAKE, ILLINOIS (UNDER DEVELOPMENT)

Prairie Crossing is a 317-home project on 667 acres of land located in a farming setting 40 miles north of Chicago. While the project setting is much more rural area than Stapleton, the project is highlighted for its combination of new planning concepts and "Green" development techniques. The property was initially acquired by a wealthy neighbor who was concerned about the encroachment of a proposed 2,400-unit development. The Shaw Company, a Chicago-based developer was retained to undertake the planning and development of a project that would retain agricultural uses and provide a tighter housing plan to preserve a significant amount of open space. The Shaw Company is a Chicago-based innovative development company. Mr. Shaw has been President of the Urban Land Institute (ULI), and Mr. Frank Martin, President of Shaw leads a standing committee of ULI on environmentally responsible development practices.

The project took seven years to receive final approvals and the endorsement of the local community. The current project preserves 535 acres for agriculture, restored prairies, a 22-acre lake and other open spaces. Home sites and roads are developed on the remaining 132 acres. An existing dairy barn was converted into a fitness center and charter school. Homes are selling for between about $200,000 and $400,000. Since project marketing began in February 1995, 75 homes have been sold.

Environmental and TND features include the following:

- Village area homes have attached garages off alleyways;
- Most homes have large, usable front porches;
- Narrower streets;
- Ten miles of interior trails;
- Natural grassland swales for storm water collection;
- Two train stations opening in southern perimeter of the site;
- Indigenous landscaping in the common areas;
- Energy Efficient Units selected as national model through the Building America Project;
- Toxic-free or low toxic paints and cabinets;

- Built in recycling bins installed in all kitchens;
- Control ventilation system for passive cooling;
- Habitat conservation.

WINDSOR OLD TOWN, WINDSOR, COLORADO (UNDER DEVELOPMENT)

The Palmer Investment Company is undertaking a TND in Windsor. Plans for the 250-acre property include 512 residential units, with single-family, multifamily apartments, townhome units, and a small commercial center for a grocery store, restaurants and other local-serving uses. On-site amenities include pocket parks and green belts. In addition, the project sponsors anticipate contributing land for an elementary school serving about 450 students. The goal of the development team was to recreate a residential community with some of the positive elements of older neighborhoods in Fort Collins, Boulder and Denver. The development plan incorporates a grid street pattern, narrower lots, functional porches and other traditional design elements.

Site development for the first 129 lots will break ground in February, 1997. The average lot size for the single family units will be 55' by 115' deep, although larger lots (up to 80' wide) are available. Demand for lots by builders has been tremendous, with 300 written offers in hand. Lot prices are in the $26,000 to $40,000 range which is comparable to that achieved by the competition on lots that are 60 percent larger in size. Houses are anticipated to sell from the low $100,000 to $200,000, with annual absorption forecasted at 100 units per year. Builders are afforded a reasonable latitude to differentiate their homes from others, particularly in the interior space. Rather strict covenants have been established regarding siting, vertical proportions of the home, architecture, garage location, landscape materials and other external attributes.

Key TND land planning features include:

- A wide median with trees;
- Hollywood driveways with a median grassy strip;
- Side loaded, detached garages;
- Attached garages must be notched back from entryway;
- Narrower lot widths at 55 feet, compared with 70 feet in the market area;
- Driveways fan out from one to two car width at garage;
- Front yard porches;
- Setback lines are specified;
- Mandatory front yard landscaping;
- Required fencing, but must be distinct from adjacent houses;
- Architectural review and approval of all units by development team.

"GREEN" BUILDING MATERIALS AND SYSTEMS

INTRODUCTION

In addition to new approaches to community land planning, there are a significant array of building materials, systems and technologies available which can improve a building's energy efficiency, reduce resource consumption and improve health impacts relative to conventional production housing. This section addresses the range of substitute products and features currently available that satisfy one of these three major environmental goals. Included is an overview of the environmental impacts associated with conventional building practices and a representative compendium of substitute products and materials that are available.

While attempts to increase a building's energy efficiency, or to develop alternative sources of energy through solar, thermal or wind-power have been evident over the past several decades, in the recent past there been an increasing awareness of the vulnerability of our overall ecological environment. The increased sensitivity to the delicate and potentially precarious nature of our ecology is evidenced by factors such as an increase in recycling programs, public outcry regarding the depletion of the rain forest, acknowledgment of the relationship between good health and worker productivity, and the affects of indoor air quality.

Recent concerns over the environment have resulted in new approaches to building construction. Commonly referred to as Green Building, new approach to construction seeks to minimize the environmental impacts associated with conventional real estate development. In general, Green Building encompasses the areas of resource efficiency and energy efficiency. In addition, studies linking respiratory disease, allergies and other diseases to indoor air quality have spawned an array of non/less toxic products and improved indoor ventilation.

ENERGY EFFICIENCY

Improvements to a home's energy efficiency reduce the depletion of petroleum reserves and also produce an investment benefit for the buyer through reduced heating and air conditioning costs. The energy efficiency of Colorado's typical new home could be improved significantly at a nominal cost per home. Colorado State energy codes are among the lowest in the country. Improvements to State codes are detailed through a variety of energy efficient State and local programs, although only a few counties have adopted these programs. Two new programs provide incentives to the builder community to adopt more energy efficient standards. Energy Rated Homes of Colorado and the HBA of Metro Denver's Green Building Program (GBP) provide benefits such as ongoing marketing and

access to Energy-Efficient Mortgages[2]. A summary of builder standards and energy options associated with the Energy Rated Homes Program is provided in **Appendix 5-A.** Improved energy efficiency can be achieved by modifying virtually all aspects of the building. Inexpensive alternatives exist to dramatically affect energy performance. The following illustrates the range of construction options available that improve a home's energy efficiency:

- Passive solar design orients the house to the south taking advantage of winter sunlight to help heat the home. Often this no cost option can save 20-35 percent on heating bills.
- Rigid foam-forming systems for concrete foundations increase R value to 20+
- Optimum Value Engineering framing can reduce shell heat losses by 15 percent. Increased R value of walls from R=11 to R=19 can be achieved with little additional framing cost.
- New insulation technologies such as spray cellulose and spray Icynene, reduce infiltration and resultant air changes for a small incremental cost. The payback is less than 5 years in energy savings.
- New California standards have fostered the production of hot water heaters with R=16 jacket insulation to replace typical R=8 for a small incremental cost.
- High efficiency furnaces and boilers are becoming more cost competitive.

RESOURCE EFFICIENCY

Buildings in the United States use 40 percent of the nation's resources every year[3]. Many building products today use raw materials more efficiently and incorporate recycled content constituents. Water efficient fixtures can reduce water consumption and gray water recycling can dramatically reduce exterior water demands. Examples of approaches to reduce the consumption of natural resources include the following:

- Concrete foundations can use recycled fly ash from coal fired power plants to increase strength and divert the fly ash from landfills
- Engineered lumber uses up to 50 percent less wood fiber[4] to perform the same structural functions as solid sawed lumber which requires old growth trees.
- Siding can be made from recycled wood fiber and sawdust.
- Cellulose Insulation is made from recycled newsprint.
- Carpet can be made from recycled PET (pop-bottles) and wears longer.

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[2]Buyers of homes that meet the energy efficiency requirements of the Energy Rated Homes of Colorado can qualify for an energy-efficient mortgage. This program allows buyers to stretch the ratio of the mortgage to total gross income by 2 percent because the lenders recognize that lower utility payments allow the buyer to afford a slightly higher mortgage.
[3]American Institute of Architects.
[4]Truss Joist MacMillan.

- Latex paint can be recycled and made into new paint.
- Water saving appliances save water, energy used to heat water and sewerage processing.
- Hot water circulation pumps reduce water wasted while consumer waits for hot water to reach distant showers and sinks.

INDOOR AIR QUALITY

The EPA has indicated that indoor air can be 10 times more polluted than our city air on smoggy days. The health impacts, such as respiratory disease, have risen 48 percent[5] in the last decade, often attributed to bad indoor air quality. Green homes address air quality by reducing toxins and ventilating the home. Selected approaches to improving indoor air quality include:

- Adhesives used in construction contain many known carcinogens. Safe adhesives are now on the market at competitive prices.
- Some of the same adhesives are used in building products and off-gas formaldehyde into the environment. Formaldehyde free products are good substitutions.
- Solvent based paints and finishes can impact indoor air quality for months. VOC free paints and finishes are cost effective substitutions.
- Heat recovery ventilation systems exhaust indoor air, recover the heat, and transfer it to an incoming outdoor air stream eliminating pollutants and saving energy.

COMPENDIUM OF ENVIRONMENTAL PRODUCT SUBSTITUTES

This section of the report provides a summary of the range of environmental product substitutes to be considered for inclusion at Stapleton. The specification and use of building materials is a complex process involving cost, durability, ease of installation, familiarity, availability and service. To be environmentally appropriate adds other layers of complexity to the process. Nonetheless, there is an abundant and growing range of Green products which can be successfully substituted for conventional materials. In fact, the development, distribution and pricing of Green products is rapidly changing. As the implementation of the Stapleton Plan nears, it is quite likely that an even broader range of cost-competitive products will be available.

Products included in the analysis were found to be cost effective, locally available, may be substituted without dramatically changing the appearance, structural integrity or function of a conventional house, and can be substituted by merchant builders using conventional subcontractors. Further, many aspects of construction practices make structural, economic and market sense. Product substitutes were only considered if they could potentially retain or enhance the home's marketability and retain affordability.

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[5]The New England Journal of Medicine.

A summary of the 20 major building components for which there are environmental substitutes is included in Table 5-3. A discussion of each category follows. Due to the extensive range of building material options and the wide variation associated with building in general, it was not possible to create a detailed cost breakdown for all the Green features. A comparison of the unit costs associated with Green features and conventional products is provided in Appendix 5-B. A breakout comparing costs for developing a conventional and Green home prototype is provided in Chapter 6. In general, the inclusion of Green features was found to have a relatively small impact on total project costs. The added costs associated with compliance with the Denver HBA Green Building, for example, is approximately one to three percent. Unlike most upgrades, however, these modifications are associated with a direct economic payback and personal benefit to the buyer.

SUMMARY OF GREEN PRODUCTS AND MATERIALS

The following section provides a detailed, and somewhat technical overview of the Green building products included in Table 5-3. While some of the terminology is specific to the construction industry, it will hopefully be useful in communicating to builders the range of specific material options available.

Foundations

There are new strategies for the use of concrete which result in resource and economic savings while fulfilling the same structural function. Strategic placement is the use of concrete where it is most appropriate. For example, shallow foundation systems are successfully employed around the country, including in very cold climates, where deep foundations are typically required. Building code officials in Denver have recently approved the use of shallow foundations.
Some of the ingredients mixed with concrete can be toxic. How these ingredients are handled is key to minimizing the deleterious impacts on the environment either at the plant or on the job site. Further, adding fly ash to the mixture actually strengthens the concrete, reduces the amount of cement required and recycles waste from industrial and utility waste-streams.

Forming concrete is typically done with plywood and can account for 15-35 percent of the total cost of concrete installations. Essentially the foundation gets built twice, once in wood and again in concrete. Some companies have invested in aluminum forms which can be reused. This becomes a more resource efficient solution, yet still adds labor in building and dismantling forms. Currently, there are several alternatives available which use Polystyrene in a variety of shapes and sizes to form walls. The foam forms stay in place and serves as insulation for the foundation.

Framing Systems

Large dimension lumber, 2x10 and larger, often is milled from old growth trees for economical harvesting and processing. Engineered wood “I” joists are now cost competitive for most applications and use fast growing farm trees for cellulose fiber.

Table 5-3

GREEN BUILDING MATERIAL SUBSTITUTES

1. Foundations
- Recycled runway aggregate
- Flyash admixture
- Foam forming systems
- Shallow foundations
- Non-asphalt based water proofing

2. Framing systems/envelope
- Engineered lumber
- finger jointed studs and plates
- Structural insulated panels
- Optimum Value Engineered framing systems

3. Sheathing
- Recycled content sheathing
- Oriented Strand Board (OSB)
- Foam sheathing (HCFC free)

4. Floor systems
- No solid sawn 2x joists or headers larger than 2x8
- Formaldehyde free subfloor and underlayment
- Recycled content underlayment

5. Roofing
- Minimum 30 year roofing material
- Cement based roofing material
- Recycled content steel roofing
- Other recycled content roofing

6. Siding
- Recycled content hardboard siding and trim
- Locally produced brick and synthetic concrete stone
- Cementitious siding

7. Decking
- Recycled content deck material
- Locally produced brick and stone

8. Insulation
- Recycled content (minimum 25 percent) insulation
- Spray cellulose
- Non toxic foam spray insulation
- HCFC-free rigid foam
- Advanced foam sealing and caulking

Table 5-3 *(continued)*

GREEN BUILDING MATERIAL SUBSTITUTES

9. Windows
- Low E glazing
- Heat Mirror glazing
- NFRC rated windows U> .30

10. Doors
- Exterior doors insulated to R=5 or greater
- Exterior sliding glass doors R=3 or greater
- Reconstituted or recycled content hardwood interior doors

11. HVAC
- Heat recovery ventilation with elimination of furnace and Air Conditioning
- All ductwork joints sealed with low toxic mastic
- No ducts in outside walls unless insulated to R=13
- Sealed combustion boilers or furnace
- 90 percent or higher furnace efficiency

12. Domestic Hot Water
- Tank insulated to R=16
- Sealed combustion gas-heater
- Hot water pipes insulated to R=6
- Solar hot water

13. Interior Walls
- Recycled content drywall
- No urea-formaldehyde based wall finishes
- Natural plaster

14. Interior Floors
- Recycled content carpet
- Recycled content ceramic tile
- Natural linoleum
- Pigmented concrete
- Natural (wool, cotton) domestic carpet

15. Cabinets and trim
- No particle board cabinet boxes
- Formaldehyde free cabinets and counter top substrate
- Natural oil finishes on cabinets
- Water based finishes used on cabinets (on site)
- Laminated veneer trim

Table 5-3 *(continued)*

GREEN BUILDING MATERIAL SUBSTITUTES

16. Finishes
- VOC free paint
- Water based wood finishes
- Solvent free adhesives

17. Appliances
- High efficiency appliances
- Low water use appliances

18. Lighting
- Compact fluorescent fixtures and bulbs installed

19. Water use
- Xeriscape that is more than 60 percent of non-paved areas
- Grass planted that is water conserving, (blue gramma, turf type fescue)
- Rainwater catchment and storage
- Gray water recycling
- 1.5 GPM faucets in bathrooms
- 2.0 GPM faucets in kitchen
- On demand hot water circulation pumps

20. Solid Waste/Recycling
- Indoor recycling bins provided
- Garage recycling storage provided
- Composting bins provided

Finger-jointed studs use short pieces of 2x4 or 2x6 material glued together to form standard stud lengths. This results in straighter boards than solid sawn studs which warp and twist causing unusable material, or crooked walls.

Structural Insulated Panels are a sandwich with Oriented Strand Board (OSB) on either side of expanded polystyrene. They come in panel sizes of 4x8 to 8x26 or larger. When assembled properly, they can reduce labor costs and improve effective R value (the heat retention values) of the wall and roof envelope.

Optimum Value Engineering (OVE) was developed by the National Association of Home Builder's Research Center. The OVE method saves framing materials while providing for insulation in corners and wall intersections. This system can be used in tandem wit some of the material substitutes.

Sheathing

Recycled content sheathing is available in various types. A sandwich material of 100 percent recycled aluminum and wood fiber is available which meets wind load codes and is less expensive than OSB. Exterior drywall made from gypsum and recycled newsprint is often used on commercial buildings and is particularly good under stucco for houses.

Floor systems

OSB is made from a variety of sources of cellulose fiber and adhesive types. OSB can be manufactured from fast growing "weed" trees and uses a higher percentage of the tree than plywood. Plywood requires large diameter trees for effective veneering. OSB in conjunction with wood "I" joist floor framing can reduce cellulose fiber requirements by 50 percent with superior structural integrity. Most OSB (and plywood) uses phenol-formaldehyde adhesive which is less toxic that urea-formaldehyde used in interior particle board and some paneling. Some OSB uses an even less toxic MDI resin base for its adhesive.

Underlayment used on top of sub-floor and under ceramic tile or vinyl tile has been made from Luan, a rapidly disappearing tropical hardwood plywood. A recycled content, gypsum based underlayment is available and is recommended by major manufacturers of tile as a substitute.

Roofs

Petrochemical products are still the base for most residential roofing products. The 15 or 25 year life-span of the product makes them resource intensive since shingles are rarely recycled. Alternatives are available in steel, plastic, and cement which use recycled content materials and come in shake or shingle looking styles. Weight is an issue with some of the cement based products. All have longer life spans than asphalt or fiberglass shingles and can be recycled themselves.

Siding

Recycled wood fiber siding and trim is more stable than natural wood, holds paint better and is a cost saving feature. Cementitious siding looks like wood and is reinforced with fiberglass and provides a fire resistant surface.

Locally produced brick and stone are long lasting, low maintenance finishes that reduce transportation costs and environmental impacts.

Synthetic stucco is an energy efficient finish which, when installed properly, will be durable for the life of the home. Recent problems have surfaced concerning improper installation which leads to water problems behind the finish.

Decks

Exterior applications of lumber have several controversial variables. Clear Heart Redwood is generally clear-cut from old growth forests. Redwood grows slowly and existing stands in California are endangered. Some second growth lumber is available from sustainable harvested sources; however, it is less resistant to rot and insects than heartwood. Pressure treated wood has potential health consequences to installers and inhabitants.

For exterior applications, recycled content plastic lumber, especially when combined with wood fiber or other strengthening agents, is an alternative.

Insulation

The level of insulation and the quality of installation makes a major difference in how much energy the house requires for heating and cooling. Fiberglass insulation is the standard in the industry today. High density fiberglass makes the same wall cavity 15-20 percent more effective in reducing heat loss. The manufacture of fiberglass can incorporate 10-30 percent recycled material. The problem of micro particulate shedding has begun to be controversial, with loose fill a greater risk than batts. Fiberglass batts also use formaldehyde as a binder.

A more environmentally sensitive alternative to fiberglass is cellulose. Cellulose is primarily made out of recycled wood fiber from manufacturing waste and from newsprint. When it is sprayed it forms a good infiltration barrier adding to the tightness of the house. It is less contractor dependent for quality control in filling voids. It can be blown dry, or mixed with a binder and sprayed.

Rigid foam insulation applied to framing yields added infiltration resistance, reduced frame conduction losses, added effective total wall R-value. Most rigid foams now are Chloro-fluoro carbon (CFC) free. They have generally been replaced with a less active blowing agent, HCFC. Although much better than CFCs, HCFCs still contribute to ozone depletion and slowly out-gas from the insulation over time. As a Greenhouse gas, HCFCs are 150-500 times worse that CO2 in contributing to global warming. Rigid polystyrene insulation uses pentane as a blowing agent and is a better environmental option.

Windows

Windows energy efficiency is rated based on R-values. The higher the R-value the greater the insulation value. Windows are one of the most high-tech products in residential construction. Over the last 15 years the effective R-value of windows has increased by 50 percent. This is the result of both improvements in glazing and in frame construction.

Although a standard for many years, aluminum windows are phasing out of most cold climate market areas. This void is being filled by vinyl frames. Vinyl is available in a wide variety of quality, however. Many still have weather sealing problems over the life of the window due to the expansion and contraction of the plastic. Most energy efficient windows are made out of wood. Vinyl cladding adds value in its low maintenance qualities. Wood window manufacturers are facing the same problem of finding affordable clear material with which to manufacture their product. Some are using finger-jointed material with an interior coating and exterior cladding.

Low E glass coating (a film which reflects heat) which increases glass R-value from R 2.6 to R 3.0 is increasing in market share each year. The premium of 10-15 percent for low-E easily pays for itself in a few years. The added benefit is that the window is warmer and therefore more comfortable to be near in cold weather. Double low-E and HeatMirror are available in premium windows which can increase the R value of the center of the glass to 8.

The National Fenestration Rating Council rates overall window energy performance and publishes a book listing test results on all major window products. This rating is like the EPA mileage rating on cars ranking windows on overall U Value and R Value.

Doors

Exterior doors are typically solid wood or foam wrapped in metal or some other weather resistant material. Most insulated doors are relatively similar in energy efficiency since the market is so competitive. The key component is good weather-stripping and an effective threshold. R values of 5-7 are common.

Interior doors are usually wood, molded hardboard, or hollow core. Molded hardboard is often made with some recycled content and pressed into shape. Some hardboard is made with urea-formaldehyde and should also be avoided. Solid wood is beautiful and is a value added product. Clear stock is becoming harder to get and often comes from old growth forests.

Heating Ventilation and Air Conditioning/Indoor Air Quality

Many products and materials contribute to indoor air quality problems. Combustion by-products from furnaces, boilers and hot water heaters can be a major source of problems. Sealed combustion units alleviate the potential of backdrafting into the living space.

In high concentrations, Radon, a naturally occurring radio-active gas, can potentially lead to lung cancer. Preventative rough-in for future radon mitigation is a simple and cost-effective procedure.

A significant source of potential health hazards associated with car exhaust can be found in potentially hazards concentrations in attached garages. Car exhaust contains many known carcinogens and can migrate into the living space and when house doors are opened to the garage. An exhaust fan in the garage reduces the potential for car exhaust to accumulate and reach the house.

Heat recovery ventilation is a good insurance policy against build-up of indoor air problems. It exhausts stale indoor air while providing fresh air with only a small energy penalty. Many of these units help to pressurize the house slightly reducing infiltration and resisting radon and car exhaust intrusion.

Domestic Hot Water

New gas heaters can save 30 percent compared to 15-20 year old equipment. In addition, electric heaters are significantly less energy efficient. According to the Rocky Mountain Institute, a high-efficiency gas unit will cost $2385 to operate over 13 years compared to $5337 for an electric unit over the same period.

California has adopted a new standard for energy efficient hot water heaters which has increased jacket insulation from R=8 to R=16 for a modest cost increase. The basic builder model designed for California is available in Colorado

While rarely used, solar water heating is more durable and reliable than in the past. Solar can reduce hot water bills by over 50 percent with paybacks in 7-10 years.

Interior Walls

Typical "fake wood" wall paneling is made using urea-formaldehyde, a known human carcinogen. Until the manufacturing process is changed to using a less toxic binder, paneling is discouraged.

Alternatives to typical drywall that use recycled materials are available. Recycled newsprint and synthetic gypsum (a by- product from scrubbers in coal fired power plants) is combined to make drywall. Other variations are available in the market. These products are stronger and more durable than conventional sheet rock.

Interior Floors

Vinyl tile and other sheet flooring products made of mostly polyvinyl chloride (PVC) are already banned in some European countries because of VOC off-gassing. Toxic by-products are generally produced in their manufacture. Natural linoleum is made primarily from cork and linseed oil is an excellent substitute and is one of the most environmentally friendly products available.

Ceramic and porcelain tile are highly durable, and are environmentally sound in the long run. Some high quality ceramic tile incorporates recycled windshields and fluorescent light tubes.

Carpet has been identified by the EPA as a potential source of indoor air pollution. Testing and monitoring are on going. There is now a wide variety of high quality carpet made from recycled pop bottles, (PET) and has the performance and feel comparable to conventional carpet. The EPA has instituted the Green Label program which assures lower levels of toxic out-gassing. Natural domestic fiber carpet with jute backing is a good alternative to synthetic fibers.

Cabinetry and Trim

Particle board is one of the largest sources of formaldehyde, a human carcinogen. It can off gas for 5 years into the living environment. It is typically used for cabinet boxes, substrates in counter tops, shelving and stair treads. Alternatives to particle board are available that are formaldehyde free. Any use of particle board should be sealed with a low permeability coating.

Cabinets are available which are made from non-toxic materials and finishes or solid wood. Clear wood trim materials are harder to get and place a high demand on virgin timber. Finger jointed trim for painted applications and veneer covered finger jointed trim for stain applications are good substitutes.

Tropical hardwoods like Luan should be avoided (unless they come from certified sustainable sources) as they cause irreparable damage to tropical rain forests due to primitive harvesting practices.

Finishes and Adhesives

More than any other category, these products adversely affect indoor air quality, especially immediately after installation. The health hazard is particularly acute for installers. Most conventional products off-gas VOCs, formaldehyde, and other chemicals which are generally used to enhance the performance and shelf-life of the product. Questions have been raised by the medical research community concerning the toxicity of combined chemicals on human health. Quality substitutions which are lower in toxicity or are non-toxic are now available for all of these products.

There are many good low / no VOC paint alternatives. For adhesives, solvent free adhesives are less toxic and some products are non-toxic with good to superior adhesive characteristics.

For wood floor finishes, water-based urethane is suggested. It contains no crosslinker, a variety of chemicals which adds hardness but is very toxic. The new generation of water-based finishes have been tested for durability and wear comparably to standard solvent-based finishes.

Appliances

The energy efficiency of kitchen appliances vary widely due to the wide range of styles and features available in the market. All appliances have energy use labels which show typical use energy consumption. Refrigerators have the widest span of energy consumption. New, very low energy use models are on the market with a 50 percent cost premium attached. Dish washers can affect both energy and water use and have a 100 percent spread in costs.

Lighting

Compact fluorescent use 1/4 to 1/3 of the energy of incandescent fixtures and can last ten times as long. There are many on the market which provide balanced, color corrected light. Temperature (the color of the light) can be specified to approach that of incandescent bulbs or more of a full spectrum daylight in bulbs. Fluorescent bulbs are still quite costly, resulting in a very long payback on the energy savings feature.

Water Use

Conserving water saves both energy and reduces our need for water and waste treatment as well. By installing water efficient faucets and shower heads, a typical family can save $60-$120 per year. That translates into roughly 17,000 gallons of water saved. Typical shower heads use 3.5-6 gal/min. A water efficient head reduces the flow to under 2.5 without sacrificing water pressure.

In California and Arizona, pilot programs are separating toilet waste from shower, sink, dishwasher and clothes washer waste. The gray water is used for flushing toilets, exterior irrigation and lawn watering. Total water use can be reduces from 50-75 percent by appropriate design and plumbing of gray water systems.

Solid Waste

In addition to recycling construction debris, by making recycling easy for the home occupants, household waste is more likely to be recycled. Built in sorting bins in cabinets or in designed pantries stimulates recycling behavior. Providing bins is a low cost, high public relations option.

ENVIRONMENTALLY SENSITIVE INFRASTRUCTURE OPTIONS

There are a significant number of environmental options for infrastructure systems. Only a few visionary developers in the U.S. have included re-engineering the infrastructure into their designs. The development plans for Haymount in Virginia and Village Homes in California are examples of extending environmental thinking to water use, pollution reduction, habitat protection, habitat creation, and street networks. The central idea is that reduction of water use and waste production are not only good environmental concepts, they are also sound economic concepts.

A brief overview of modifications to the infrastructure systems that warrant more detailed study are addressed below as they relate to systems for water supply, storm water, wastewater, streets, and site drainage. The information was compiled by the team architect and engineer. A more complete discussion of engineering options is included in the J.F. Sato Associates November, 1996 report, "Infrastructure Report for Stapleton Housing Study.

It should be noted that some of the modifications to typical infrastructure systems and associated cost savings will require approval by the Denver Water Department and the Denver Wastewater Department. Furthermore, potential downsizing of mains and pipes indicated by reduced water consumption are below the current minimum sizes allowed by Denver Water and Wastewater. The potential to receive approvals for these potential modifications will need to be assessed.

WATER SYSTEM

- A minimum 60 percent reduction in typical residential water use is feasible using new water conserving systems. This could be accomplished through use of low-water use landscaping, efficient sprinkler or drip systems, and water conserving appliances.

- Denver Water has formed a Task Force, on their own initiative, to look at Stapleton water use. There is an opportunity to work with them to reduce the main sizes, even though their standards would not now allow the reduction.

- The use of greywater (reused water) from sinks, showers, washers and dishwashers for vegetated areas. Greywater is not currently allowed by code in Colorado, but Denver Water has begun to study the possibility of creating regulations. Greywater systems could be installed for each individual house, or on a neighborhood scale. It is likely that regulations will be in place for its use, at least for the public ways, parks, commercial Greens, and other larger areas of landscape.

- Reduction of water consumption by 60 percent could result in reducing the size of the water mains. The net reduction for construction could be $330 / acre.

- Reduction in water consumption could also result in reducing the size of the sanitary sewer mains. The net reduction for construction could be $792 / acre.

- Incorporate the maximum number of water conservation features in homes. Consider requiring water use be under a maximum amount (gallons per minute for shower heads, gallons per flush for toilet fixtures, etc.). This translates directly into savings for the sanitary sewer system, if planned ahead of time.

STORM WATER SYSTEMS

- Use of Westerly Creek and / or constructed wetlands to handle at least 50 percent of the storm water from District I. Compared to the cost of the wetlands, there may be a net reduction in cost due to reduced storm mains and associated sewage treatment capacity. Parkways could be designed to drain to their vegetated area, and not be served by storm sewers.

- Covenants for maximum storm water infiltration can, for example, control how much impermeable surface can be constructed on site. There are other features such as in-gutter detention systems and other provisions that have little or no cost but can greatly reduce the size and thus the cost of the storm water system.

- Assume the street width of typical residential streets to be consistent with older Denver neighborhoods (such as Emerson Street), and not the same width as the typical suburban street. Village Homes streets averaged 10-15 feet less than the typical suburban street, and developers found a savings of 20 percent in construction and maintenance of the street system.

- Investigate constructed wetlands for the Westerly Creek area. This could help protect water quality, reduce the costs of municipal sewage treatment, and add to the environmental theme of Stapleton.

REUSE EXISTING INFRASTRUCTURE

- Reuse the existing infrastructure wherever possible. In some areas, renovation of the infrastructure may be necessary.

MINIMIZE GRADING

- Minimize the earth-moving done to the site. Work with the natural drainage patterns of the land where possible. When earth-moving is required, balance the cut and fill so that no net importation or exportation of fill is needed. This concepts should reduce pollution and costs caused by truck transport of fill.

- Fill will be needed to make the surface drainage system work, and excavation will be needed to accomplish the restoration of Westerly Creek. Balancing of the cut and fill on the site appears to be feasible.

ENVIRONMENTALLY-SOUND ARCHITECTURAL TECHNIQUES

Another important area for improving the environmental sensitivity of a project is in the area of architectural design, orientation and siting. The following architectural and siting features may be appropriate at Stapleton. They are based on case studies of other Green developments built locally and nationally, and the experience of the consultants.

- Diversity, discussed as a goal of many of the TNDs, extends to the architectural style and use of materials. Denver's existing neighborhoods have a large variation in style, and use many different materials. There is, by way of comparison, more diversity than the current suburban model.

- An ecological model encourages using resources that are close at hand to minimize transportation costs. This includes considering the use of locally-produced materials such as brick and masonry for homes and commercial establishments. Use of a "vernacular" or regionally inspired design would also respond well to the ecological model.

- Orienting the homes with the long axis in the east-west direction allows maximal use of daylighting and sun tempering from the south. Keeping the home compact and orienting the home properly to the sun can cut the total energy use by up to 30 percent. This configuration is also compatible with the block orientation of Denver's neighborhoods.

- Through proper orientation and design, daylight can be enhanced as a source of light during the day. The result is lower energy use and a more comfortable and pleasing home environment.

- Avoid entries facing north and side driveways on the north sides of buildings. In our climate, north sides of homes are colder and icier than any other side. The winter winds also tend to come from the north, or north-west. This is not of prime concern in very mild climates such as southern California and Florida.

- Design to allow natural ventilation. The Denver climate can be quite comfortable in the summer without air conditioning if the home can be ventilated, especially at night. Window placement, room design, and building configuration are all features of a natural ventilation system.

- Front porches, desirable for community reasons, are also desirable for energy efficiency and comfort.

- Extend the eaves of the home. Eaves of approximately two feet, depending upon the application, protect the exterior from weather and sun-related deterioration and reduce summer energy costs by shading the building.

- Use trees or other buildings to shade the homes in the summer and to provide a wind break in winter and spring. Deciduous trees are most appropriate on the south side, shading in the summer and allowing sun in the home in winter. Coniferous trees to the north will protect the home from winds.

- Use tree lawns along the street. They provide shading on the east or west side of the home, and thus improve energy efficiency and comfort during warmer months.

- Design roof slopes and orientations that will allow future installation of photo voltaic or active solar systems in the future.

- Wire and configure homes to allow for telecommuting from the home. The environmental benefit is to more readily allow people to spend one or more days working at home. This saves on air pollution and gas consumption.

- Minimize job-site waste. Plan and construct homes to be resource efficient, which will reduce the amount of waste on the job site. Reuse extra materials on site if possible. Where waste is unavoidable, recycle it. Set up clearly marked bins for different types of waste, such as wood, metals, concrete, cardboard, etc.