THE eco-BALANCE™ APPROACH
TO TRANSECT-BASED PLANNING:
EFFORTS TAKEN AT VERANO, A NEW COMMUNITY AND UNIVERSITY IN SAN ANTONIO, TEXAS

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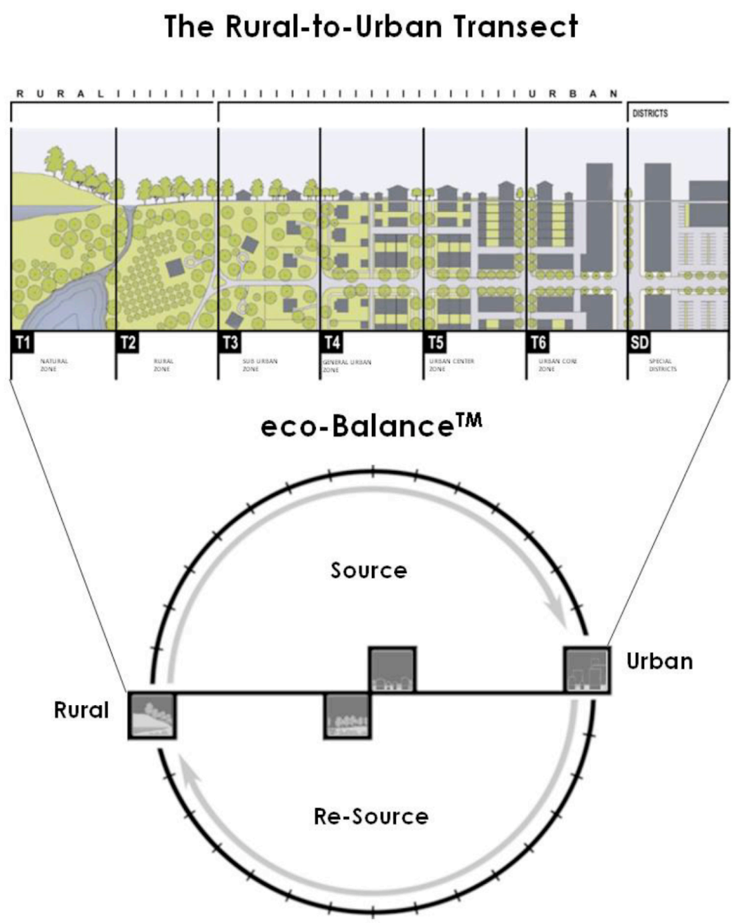

Figure 1

No existing green building certification procedure or environmental impact evaluation tool presently goes beyond a linear approach toward conserving resources. Current certification programs, including LEED (U.S.), BREEAM (Canada/U.K.), CASBEE (Japan), Green Star (Australia), or the indexing systems of Ecological Footprint and the Living Planet Index, fail to preserve resources through a conscious cyclical process of regeneration. Recent efforts such as the Living Building Challenge and Integrative Design hint at balance, but none function to preserve resources through a specific procedure for establishing a cyclical process of regeneration. In contrast, by incorporating eco-Balance™ Planning *and Design into Transect-based planning, we can actually determine success through the balancing, or completion, of life cycles.*

At Verano, a 2,500-acre, mixed-use development in San Antonio, Texas, the life cycles of water, building, materials, and energy become meaningful to us on- and off-site. So meaningful that the balancing of resources has been incorporated within the SmartCode, and the completion of these cycles marks our primary criterion for success.[*] The SmartCode is a "model transect-based development code available for all scales of planning, from the region to the community to the block and building."[1] The Transect approach of New Urbanism (in which elements of the built environment are categorized from rural to urban) helps us to understand performance both within a Transect Zone and when considering individual processes throughout the entire community.

By building upon the Transect approach and assessing the performance requirements within the each transect, we enable the entire community (from household to, eventually, an entire campus) to benefit from a replenished resource future.

What is eco-Balance™ Planning and Design?

Eco-Balance™ planning and design is the principle of balancing life support systems (**air, water, food, energy,** and **materials**) across life cycle phases (**source, process, use** and **re-source**). In essence, it is the balancing of resource flows by adroitly managing nature in ways that continually supply our basic needs in a regenerative manner. It is rooted in the life cycle – where things come from and where they go – so that the sourcing and re-sourcing process occurs within a spatial context that is manageable either by the individual or the community. Additionally, eco-Balance™ planning considers industrial processes as inextricable from truly holistic performance assessments. Life support cycles occur at many scales, from the backyard to the village or campus, and they occur as part of almost all life as we know it: from air, water, food, and energy cycles to the building materials we use. While these nature-based examples become our model, we manage and augment them through green technology and a consciousness of the ways design can engage the user/participant as part of these cycles. In this way, we can use nature to do our work for us without destroying the potential for other generations to enjoy the same benefits.

[*] Note: Throughout this paper the term "completion of cycles" acknowledges the difficultly or impossibility of creating a truly closed loop for certain life support systems including material and energy.

Balance Within Allied Professions

PROFESSION	BALANCE LANGUAGE
Accountant	Balances Credit with Debit
Mathematician	Balances Algebraic Equations
Mechanical Engineer	Balances Heat gain to Heat loss
Civil Engineer	Balances Retention to Release of Stormwater
Life Cycle Analyst	Analyzes data for Upstream and Downstream

Figure 2: Balancing is inherent in a variety of disciplines

While most green-building rating systems do not support life cycle balancing per se, many of them can be applied in such a way as to support a balanced approach. The completion of cycles and regeneration is the primary determinant of a sustainable system; in fact, if balancing of a cycle is accomplished well, the end result is "plus ultra" – a surplus that can be used at other transect scales or bartered in some manner outside the community. Life cycle-based planning and design provides the impetus for all development professions to imagine their roles as *contributors* to the completion of cycles rather than just implementers of one-way conservation procedures or professionals who check off items on a list.

Although we tend to concentrate on two primary human life-support functions – the cycles of water and energy – it is important that we understand what "completing" or "balancing the life cycle" really means. It is the matching of source methods with resource or replenishment methods. An example would be collecting water (which is based on the solar-driven hydrologic cycle and therefore renewable) and treating water (using non-invasive plant species, therefore also solar-driven) within a given footprint as efficiently as is economically feasible. Both methods incorporate what we refer to as "nature-based technologies," which satisfy our life-support needs by managing highly available physical, chemical, and biophysical means in a non-invasive and non-destructive manner. In recent years, land management experts, sustainable technologists, landscape architects, site planners, and engineers have developed an encyclopedia of techniques that fit these criteria, all putting nature to work on our behalf – more often than not augmenting nature's capacities as well.

eco-Balance^{TM} Planning Definitions:

eco-Balance^{TM} Footprint: Eco-Balance^{TM} phases are identified by using land-based eco-technologies; each of these technologies has a quantifiable land area required for its functioning. The eco-Balance^{TM} footprint corresponds to the immediate physical land/space that contributes to human life-support activities. These life-support activities can be given a range of approximate physical dimensions or footprint areas, for both the Source and Re-source phases of the life cycle to show balancing as demonstrated for T-3 and T-6 later in the paper. We use the Source and Re-source lexicon herein as a matter of convenience (it actually represents the

Source and Process in one part of the cycle and the Use and Re-source in the other – see figure 3.) The actual transport function and linkages between phases (pipes, roads, wires etc) is looked at more carefully at a second level of investigation.

Hierarchy of Scales refers to the varying generic boundaries within which life cycles must transpire to achieve balance: i.e. building, landscape, streetscape, open spaces, transects, or town, up to the metropolitan region, bioregion, or country if needed.

Integration is the overlapping or multi-use potential of a single footprint. For example, roof-mounted solar photovoltaic panels can generate electric power and harvest rainwater within the same spatial footprint. This integration is based on a knowledge set of multiple uses (i.e. a mesquite tree in Texas can provide fuel, flooring materials, shade, biofuel, food, and liquors from its beans). Integrating multiple life-support needs in a single footprint not only saves precious land area, but at times also delivers more than the sum of the parts. For example, integrating wastewater treatment with air-producing forests can increase the carbon sequestering capability of the forest. According to Daniel Wickham's *Wastewater Forests and a Carbon Sequestration Plan*, the United States could reduce its CO_2 emissions by 15 percent by adopting this technology, and wastewater plantations on a worldwide basis may have the potential to offset current CO_2 emissions entirely.

Life Cycle Balancing (Figure 3) refers to the actual process or physical accounting of both the sourcing from and re-sourcing to land areas necessary to support each life support system. The process of balancing can be graphically explained by either the eco-Balance™ square or eco-Balance™ circle. The life support systems are represented by five different colors and the life cycle phases are represented by the four sides of the square or four quadrants of the circle. The Life cycle technologies are represented by either icons or numbers respectively.

The physical eco-Balance™ mapping can be done using one of two criteria: number of people or land area. When the number of people on a given site is known (as in the case of an already developed or planned site), the land area required to support that population is calculated. The result is then divided into different hierarchies of scale, based on suitability. For example, depending on the transect, water can be sourced at the building scale, but can more effectively be re-sourced at the site scale. In other words, a high density transect dictates more occurring within-building treatment (i.e. living machine), verses a wetland, or open space forest wastewater treatment in more rural transects. Since all site areas are limited, those sustainable technologies are chosen which can integrate more than one life support need. When the site area is exhausted, the deficit area is calculated for the life support needs that must be balanced off-site (i.e. the next transect zone or in an eco-industrial development as discussed below). Sustainable technologies that create a synergy in a footprint area (think: intensive farming and megaflora plantation) can be used off-site to balance all the needs of people within the site in as minimal an area as possible. Thus, eco-Balance™ identifies and capitalizes on linkages within *and* across scales to optimize the resource balance potential of a site.

Although a comprehensive eco-Balance™ procedure assesses the life support deficits of each of the six established transects to determine the net gain or deficit at each life cycle phase, the eco-Balance™ process is demonstrated only for T-3 and T-6 in the examples below. In the case of undeveloped land where the land area is known, the site's carrying capacity is calculated to determine how many people can be sustainably balanced within the site, and the program is developed accordingly.

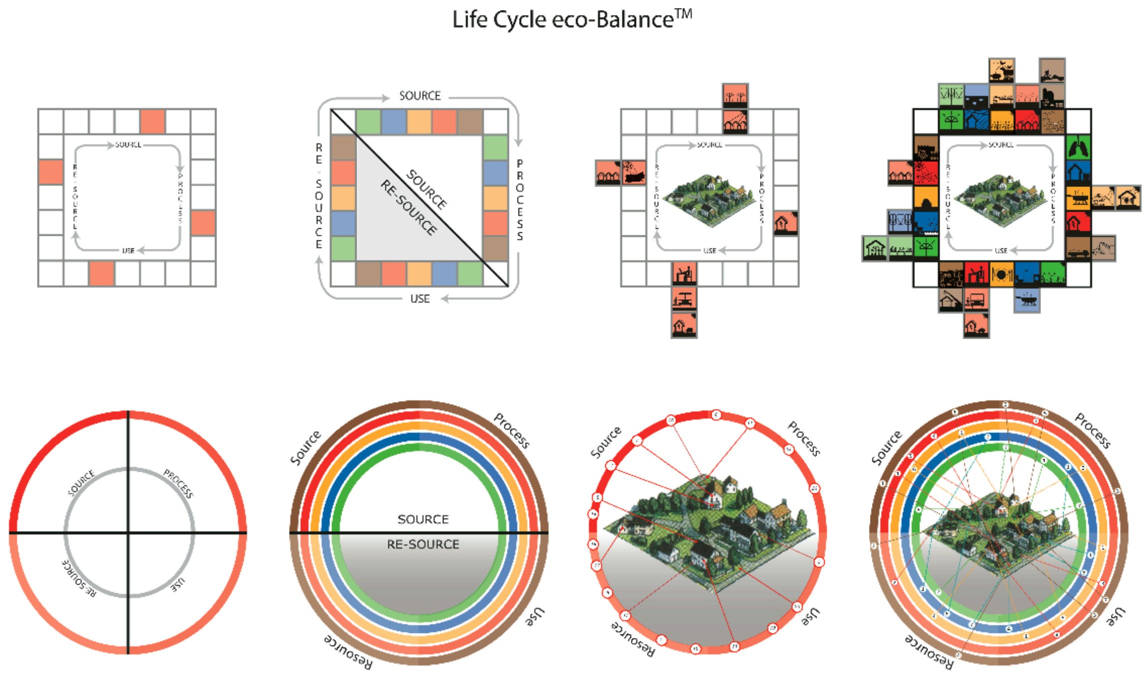

Figure 3

Eco-Industrial Development: One of the more important aspects of eco-Balance™ planning is the inclusion of an eco-industrial development as means of overall resource balancing. Industry can no longer be thought of a necessary evil in the sustainable planning of community instead it must consider part of, eco-Balance™ integrating this opportunity as revenue generating emplyoment producing and in this case, the final step in resource balancing the entire community. The eco-industrial development is an adjunct space in a community that houses highly efficient eco-industrial technologies (i.e. Mega-Flora plantation, limited combustion biochar gasifiers as power plants, carbon neutral brine based cement factory, etc) that contribute to the overall balance of the community. The collocation of these highly efficient processes results in a magnifying effect that compensates and at times surpasses deficits of the transects. The eco-industrial development is planned, designed and engineered therefore to be a part of the assessment process within the transects in order to ensure the greatest potential for community balancing. Figure 4 represents the role of the eco-industrial development in balancing other transects.

eco-Balance™ at Transect, Eco-Industrial Development and Community Level

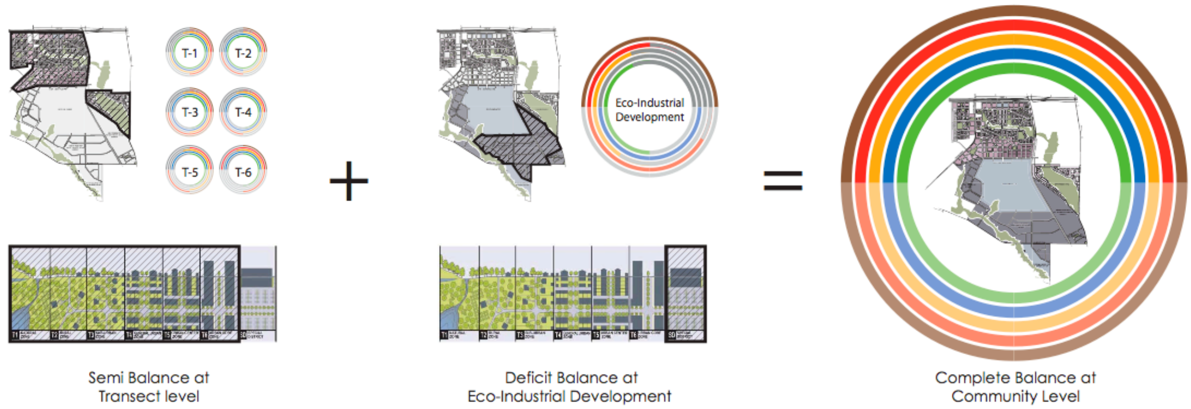

Figure 4

<u>eco-Balance™ footprinting examples†:</u>

T-3 Example:

Approximately 162 acres of the Verano development fall into the T-3, or Sub-Urban, Zone. This zone is divided into a hierarchy of land-use types: buildings, landscape (land around structures), streetscape, and open areas. Eco-Balance™ attempts to balance the air, water, food, and energy needs of the Transect Zone within the physical footprint of that zone. The building, followed by the landscape, is the primary and most efficient scale at which to attempt eco-Balance™ strategies. The streetscape offers fewer opportunities for balancing strategies, and open space is the final scale at which to propose intervention. If the Source and Re-source needs of the T-3 population cannot be met within the 162-acre area of the T-3 Zone, the proposed eco-industrial development bridges the footprint gap. Source and Re-source footprints of T-3 are determined using standard figures for per-person footprint in each life-support category. Sourcing and Re-sourcing techniques are identified for each of these categories.

An overlay of needed footprint to available footprint in the T-3 Zone of the site reveals gains or deficits in each life support system. At present, Verano's T-3 land area is 162 acres with required integrated footprint of 648 acres, resulting in a 486-acre deficit. This figure represents the total additional area needed to balance the basic needs of Verano's suburban population which needs to be balanced by the eco-industrial development discusses below.

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† The given examples are meant for demonstration purposes only. Land area values are approximations.

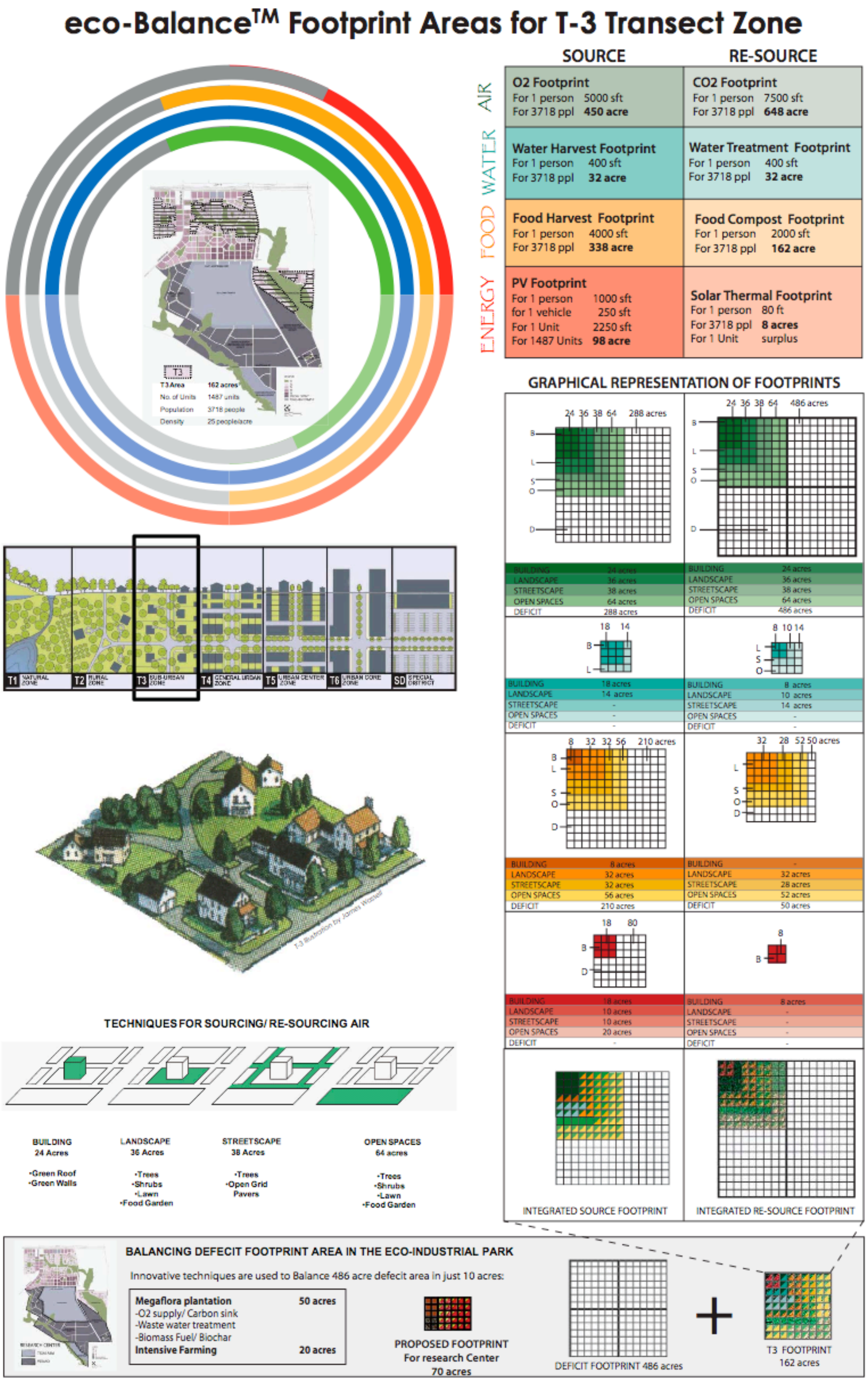

eco-Balance™ Footprint Areas for T-3 Transect Zone
SOURCE
RE-SOURCE
AIR
WATER
FOOD
ENERGY
O2 Footprint
For 1 person 5000 sft
For 3718 ppl 450 acre
CO2 Footprint
For 1 person 7500 sft
For 3718 ppl 648 acre
Water Harvest Footprint
For 1 person 400 sft
For 3718 ppl 32 acre
Water Treatment Footprint
For 1 person 400 sft
For 3718 ppl 32 acre
Food Harvest Footprint
For 1 person 4000 sft
For 3718 ppl 338 acre
Food Compost Footprint
For 1 person 2000 sft
For 3718 ppl 162 acre
PV Footprint
For 1 person 1000 sft
for 1 vehicle 250 sft
For 1 Unit 2250 sft
For 1487 Units 98 acre
Solar Thermal Footprint
For 1 person 80 ft
For 3718 ppl 8 acres
For 1 Unit surplus
GRAPHICAL REPRESENTATION OF FOOTPRINTS
T3 Area 162 acres
No. of Units 1487 units
Population 3718 people
Density 25 people/acre
T1 NATURAL ZONE
T2 RURAL ZONE
T3 SUB-URBAN ZONE
T4 GENERAL URBAN ZONE
T5 URBAN CENTER ZONE
T6 URBAN CORE ZONE
SD SPECIAL DISTRICT
TECHNIQUES FOR SOURCING/ RE-SOURCING AIR
BUILDING
24 Acres
•Green Roof
•Green Walls
LANDSCAPE
36 Acres
•Trees
•Shrubs
•Lawn
•Food Garden
STREETSCAPE
38 Acres
•Trees
•Open Grid Pavers
OPEN SPACES
64 acres
•Trees
•Shrubs
•Lawn
•Food Garden
BUILDING 24 acres
LANDSCAPE 36 acres
STREETSCAPE 38 acres
OPEN SPACES 64 acres
DEFICIT 288 acres
BUILDING 24 acres
LANDSCAPE 36 acres
STREETSCAPE 38 acres
OPEN SPACES 64 acres
DEFICIT 486 acres
BUILDING 18 acres
LANDSCAPE 14 acres
BUILDING 8 acres
LANDSCAPE 10 acres
STREETSCAPE 14 acres
BUILDING 8 acres
LANDSCAPE 32 acres
STREETSCAPE 32 acres
OPEN SPACES 56 acres
DEFICIT 210 acres
LANDSCAPE 32 acres
STREETSCAPE 28 acres
OPEN SPACES 52 acres
DEFICIT 50 acres
BUILDING 18 acres
LANDSCAPE 10 acres
STREETSCAPE 10 acres
OPEN SPACES 20 acres
BUILDING 8 acres
INTEGRATED SOURCE FOOTPRINT
INTEGRATED RE-SOURCE FOOTPRINT
BALANCING DEFICIT FOOTPRINT AREA IN THE ECO-INDUSTRIAL PARK
Innovative techniques are used to Balance 486 acre deficit area in just 10 acres:
Megaflora plantation 50 acres
-O2 supply/ Carbon sink
-Waste water treatment
-Biomass Fuel/ Biochar
Intensive Farming 20 acres
PROPOSED FOOTPRINT
For research Center
70 acres
DEFICIT FOOTPRINT 486 acres
T3 FOOTPRINT
162 acres
In the GRID 1 square equals 2 acres

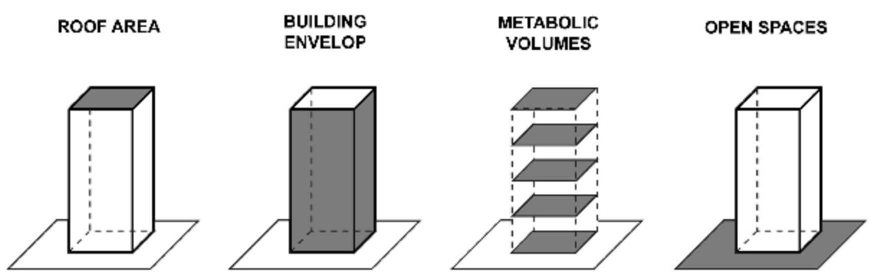
Figure 5

T-6 Example:

Eco-Balance™ footprinting occurs in all seven transect zones of the Verano Development. At the T-6, or Urban Core, Zone, the hierarchy of land-use types considers the three-dimensional nature of the zone. Intervention can occur on the roof with strategies such as green roofs that link air, water and food balancing. Similarly, the building envelope and the metabolic volumes of the buildings themselves become nested. Although they are still somewhat helpful, other intervention scales and the limited open spaces between buildings offer the fewest opportunities for eco-Balance™ strategies in the T-6 Zone. Perhaps the most important aspect of T-6 balance interventions is the recognition that we must start to create systems throughout the cityscape instead of focusing on a single building. This strategy affords us many cooperative opportunities between and within mixed-use development that has, as yet, hardly been investigated.

An approach similar to the one used for T-3 is used for Verano's T-6 Zone. Even though its land area is only 76 acres, the effective footprint is 240 acres as a result of adding vertical areas and metabolic volumes. The required integrated footprint is 800 acres, resulting in a 560-acre deficit that must be balanced by the eco-industrial development.

Techniques for Sourcing/ Re-sourcing for T-6



Green Roof	Green Wall	Vertical Greenhouse	Air Treating Landscape
Water collecting/ Treatment Roof	Water collecting/ Treatment Wall	Vertical Grey Water treatment	Water Treating Landscape
Edible Roof Garden	Vertical Edible Gardens	Vertical Greenhouse / composter	Edible Landscape
Roof PV's / Wind turbine arrays	Building Integrated PV's/ Wind turbines	Biochar Gassifier	Heat Island Reduction

Figure 6

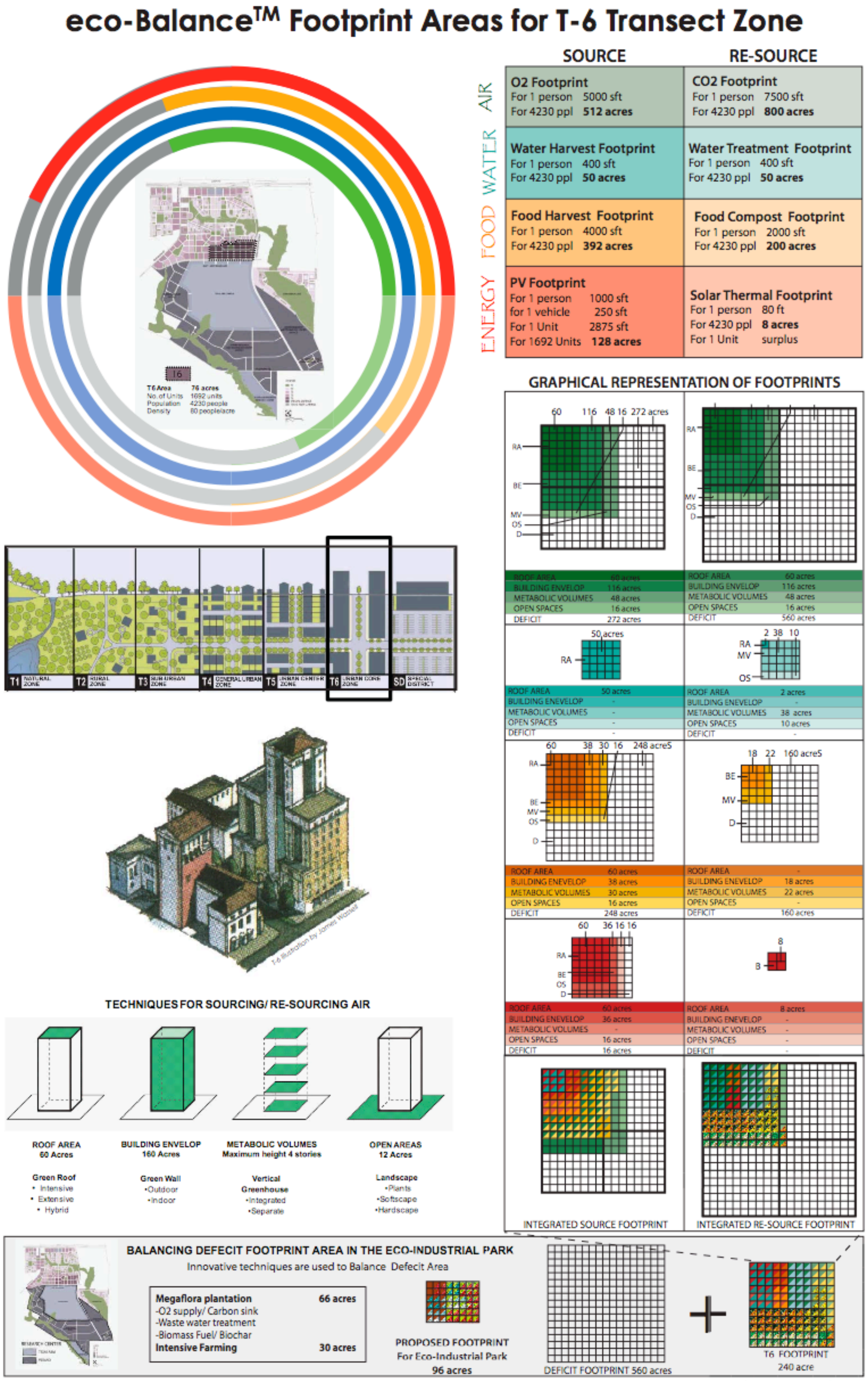

eco-BalanceTM Footprint Areas for T-6 Transect Zone
SOURCE
RE-SOURCE
AIR
WATER
FOOD
ENERGY
O2 Footprint
For 1 person 5000 sft
For 4230 ppl 512 acres
CO2 Footprint
For 1 person 7500 sft
For 4230 ppl 800 acres
Water Harvest Footprint
For 1 person 400 sft
For 4230 ppl 50 acres
Water Treatment Footprint
For 1 person 400 sft
For 4230 ppl 50 acres
Food Harvest Footprint
For 1 person 4000 sft
For 4230 ppl 392 acres
Food Compost Footprint
For 1 person 2000 sft
For 4230 ppl 200 acres
PV Footprint
For 1 person 1000 sft
for 1 vehicle 250 sft
For 1 Unit 2875 sft
For 1692 Units 128 acres
Solar Thermal Footprint
For 1 person 80 ft
For 4230 ppl 8 acres
For 1 Unit surplus
GRAPHICAL REPRESENTATION OF FOOTPRINTS
T6 Area 76 acres
No. of Units 1692 units
Population 4230 people
Density 80 people/acre
T1 NATURAL ZONE
T2 RURAL ZONE
T3 SUB-URBAN ZONE
T4 GENERAL URBAN ZONE
T5 URBAN CENTER ZONE
T6 URBAN CORE ZONE
SD SPECIAL DISTRICT
TECHNIQUES FOR SOURCING/ RE-SOURCING AIR
ROOF AREA
60 Acres
Green Roof
• Intensive
• Extensive
• Hybrid
BUILDING ENVELOP
160 Acres
Green Wall
•Outdoor
•Indoor
METABOLIC VOLUMES
Maximum height 4 stories
Vertical
Greenhouse
•Integrated
•Separate
OPEN AREAS
12 Acres
Landscape
•Plants
•Softscape
•Hardscape
INTEGRATED SOURCE FOOTPRINT
INTEGRATED RE-SOURCE FOOTPRINT
BALANCING DEFECIT FOOTPRINT AREA IN THE ECO-INDUSTRIAL PARK
Innovative techniques are used to Balance Deficit Area
Megaflora plantation 66 acres
-O2 supply/ Carbon sink
-Waste water treatment
-Biomass Fuel/ Biochar
Intensive Farming 30 acres
PROPOSED FOOTPRINT
For Eco-Industrial Park
96 acres
DEFICIT FOOTPRINT 560 acres
T6 FOOTPRINT
240 acre
In the GRID 1 square equals 2 acres

Figure 7

Eco-Industrial Development Example:

The Verano plan has set aside an area for industrial development. This project decision created an opportunity to test the potential of the eco-industrial development facet of eco-Balance™. The T-3 and T-6 Zones of Verano contribute 488-acre and 560-acre deficits respectively to the overall balance of the development. The eco-industrial development must make up for the 1,048-acre cumulative deficit. Using innovative industrial ecology strategies and highly efficient technologies creates a synergy in the eco-industrial development. It collocates highly efficient balancing strategies such as a megaflora planted within an intensive plantation setting in order to provide a Source for oxygen and Re-source for CO_2 as air balance and waste water treatment for the Re-sourcing of water and a limited combustion biochar gasifier power plant as an energy source. In turn the biochar power plant helps fire a mineral-based, carbon-neutral cement plant. As a result the eco-industrial development can begin to effectively balance the 1,048-acre deficits created by the T-3 and T-6 Zones in 166-acres (70 acres for T-3 deficit and 96 for T-6).[‡]

eco-Balanced™ SmartCode:

Like many other procedures, the SmartCode simply lists criteria to be implemented instead of conceiving of the list as actually providing for a cycle of activities that help resource balancing. An eco-Balanced™ SmartCode, on the other hand, shares the basic provision of demonstrating and providing for the full life cycle accountability of a variety of human life-support flows. The addition of the word "eco-Balance™" establishes the essential constituent of matching need with replenishment and total or partial cycle completion.

The fundamental principles for an eco-Balanced™ SmartCode and its application to the Verano development are graphically explained in Figure 8 in general and a specific water example in Figure 9.

The addition of eco-Balance™ to Smart Code accomplishes the following:

> Completes Cycles: adds the necessary steps to the existing SmartCode list to complete life cycles (i.e. "Water Cycle" "Added to Smart Code" columns).
>
> Integrates one cycle with another (see "Other Cycles" column)
>
> Realizes economic opportunities: many cyclical activities are potential sustainable businesses fitting three economic roles: production, sales, or maintenance revealing the economic opportunities that this type of program offers within the community and/or region verses procedures that are simply not conscious of this aspect (See "SB" column).

‡ A detailed analysis diagram can be obtained from the author.

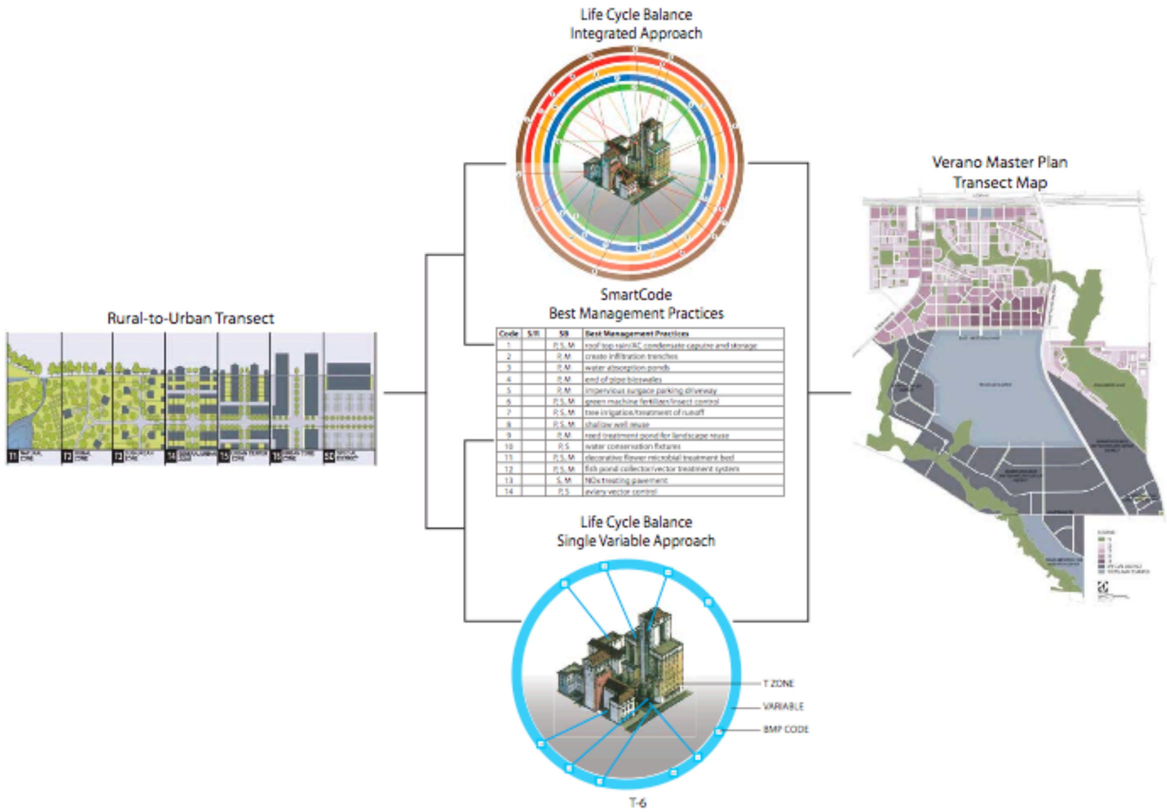
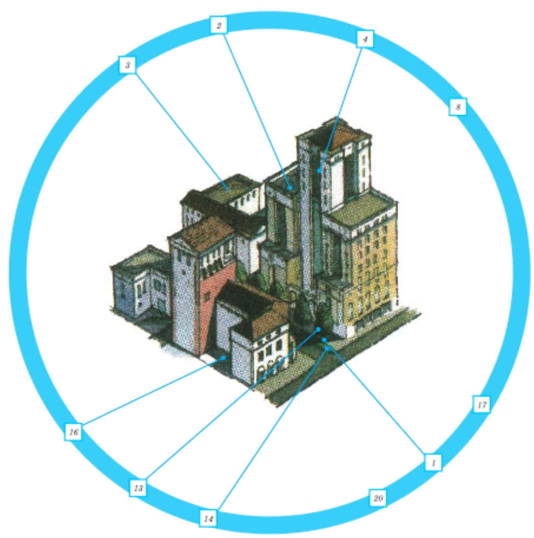


Figure 8

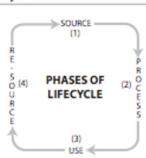
WATER BALANCE - Best Management Practices in T-6 Transect Zone

ECO-BALANCE WATER CHART FOR T-6						
Code	S/R	SB	Best Management Practices	Water Cycle	Other Cycles	Added to SC
1	◒ ◓	P, S, M	site grading & high-performing landscaping, greater infiltration	(2)	Air, Material	
2	◓	P, S, M	create landscaped roofs	(1)	Air	x
3	◓	P, S, M	roof top rain/AC condesante capture and storage	(1) (2)	Energy	x
4	◓ ◓	M	disconnect downspouts from sewer systems with end of pipe treatments	(1)		x
5	◒	P, S, M	provide pollution control prior to entering storm inlet	(2)		x
6	◓	P, M	repair and expansion of existing pipes	(2)	Material	
7	◓ ◓	P, M	micro-detention in parking lots, remediation before water leaves lot	(2)		x
8	◓ ◓	M	regional stormwater management-fund stream restoration & buffers	(1)		
9	◒	P, M	impervious surface limits with curbing	(1)	Air	
10	◒	P, M	landscape sites within parking areas below grade	(1)		
11	◒	P, M	onsite detention	(2)		
12	◒	--	minimize fertilizers/insecticides	(1)	Food	x
13	◒	M	tree irrigation/treatment of runoff	(4)	Air	
14	◒	P, M	crushed stone acequia aeration	(2)		x
15	◒	P, M	seepage well recirculation	(2)		x
16	◒	P, M	reed treatment pond for landscape reuse	(4)	Air	x
17	◒	M	water conservation fixtures	(3)		
18	◓	P, M	subsurface tank containment	(2)		x
19	◓	M	forest soil mantle treatment (landscape)	(4)	Air	x
20	◒	M	decorative flower microbial tratment bed (landscape)	(2)	Air	x
21	◒	M	fish pond collective/ vector treatment (off shelf & landscape)	(4)	Air, Food	x
22	◓	P, M	NOx treating pavement (off shelf)	(1)	Air, Material	x
23	◓	M	aviary vector control	(1)		x



◓ *Source*
◒ *Re-Source*

Sustainable Businesses at level & transect zones
P - *Produce*
S - *Sell*
M - *Maintain*



2. Landscaped roofs

4. Disconnected downspouts

5. Pollution control prior to entering storm inlet

7. Micro-detention in parking lots

16. Reed treatment pond

Figure 9

Principles of eco-Balance^{TM} planning:

Incorporating the new language of balance: Simple and complex multi-attribute procedures are used to measure life cycle completeness within specified Transect Zones or smaller boundaries. The terms “zero water” (total balance between need for water and the ability to re-source that need on-site), “zero energy,” “zero waste,” and “zero material” are no longer hypothetical concepts. When given a performance boundary, they demonstrate *total*, and more importantly, *degrees of measurable*, balance. The use of a wide variety of sustainable practices, technologies, and both public and private enterprises enable varying degrees of life cycle balance to occur at the community level.

Conceptualization Design-oriented tools: These are incorporated to enable an understanding of “the life of water,” “the life of energy,” and “the life of materials” on- and off-site through conscientious design and a symbolic process that identifies the special qualities of the community as having achieved some or all of these objectives.

Completeness and rigor: The planner must subject all Transect Zones (in conditions where New Urbanism is the underlying spatial planning method) to their own balance procedures from a) the most nature-dominated to the densest urban conditions. The net effect becomes an entire community of balanced on-site life cycles (Figure 10). System relationships may include nature-to-nature (balancing the ideal members of a regional flora, a Sourcing function, to the necessary fauna, a Re-sourcing function); building-to-nature (matching residential metabolic needs to ambient Source and Re-source capacities); and, finally, building-to-building (in which each building type has requirements that can be balanced by neighboring buildings that have different needs and subsequent surpluses. In the latter scenario, a carwash might supply a renewable water function to a neighboring big box store.

Transforming from linear to cyclical thinking: In an eco-Balance^{TM} SmartCode, practices that are normally presented in a linear form are demonstrated as interconnected steps in cycles that together create a balanced process. All the procedures and technologies of sourcing and conserving are included at the Source end, while all the use and re-sourcing is encapsulated at the other. If LEED or any other linear performance metrics are incorporated, they too must be reorganized to demonstrate cyclical balance.

Economics penetrates all steps and approaches: Within eco-Balanced^{TM} SmartCode or eco-Balance^{TM}/LEED, economics should be reflected within a spreadsheet that balances credits and debits in a typical accounting system. The cost-benefit of the credits (employment of Source procedures) should balance the debits (the Re-sourcing techniques) All federal, state, and local incentives should benefit the owner, the developer, and the user from the standpoint of better economic gains compared to a business-as-usual approach to development.

Don’t forget we are designers: Design with the intent to engage every community member in the cycle of balance so that life cycle phases become events that connect (through ritual and play, among other means) participants to an active understanding of their roles in keeping system flow operational and maintained. Through this process, the owner, developer, and public entities more fully comprehend the role and economic integration of operational maintenance as a function of a balanced community.

Life cycle intensity: Plan for various levels and intensities of the flow of goods and people so that life cycle phases are clearly placed according to these flow frequencies. The increments of pedestrian events, for instance, are fundamentally different from those of auto, truck, and rail transport life cycle phases. Transportation and buildings are the largest contributors to carbon release; this principle is therefore important for the eventual carbon balance of the community as a whole.

Plan for the unplanable: Use open, flexible systems whenever and wherever possible so that continued life cycle innovations may occur over time (some refer to this as resilient planning and design).

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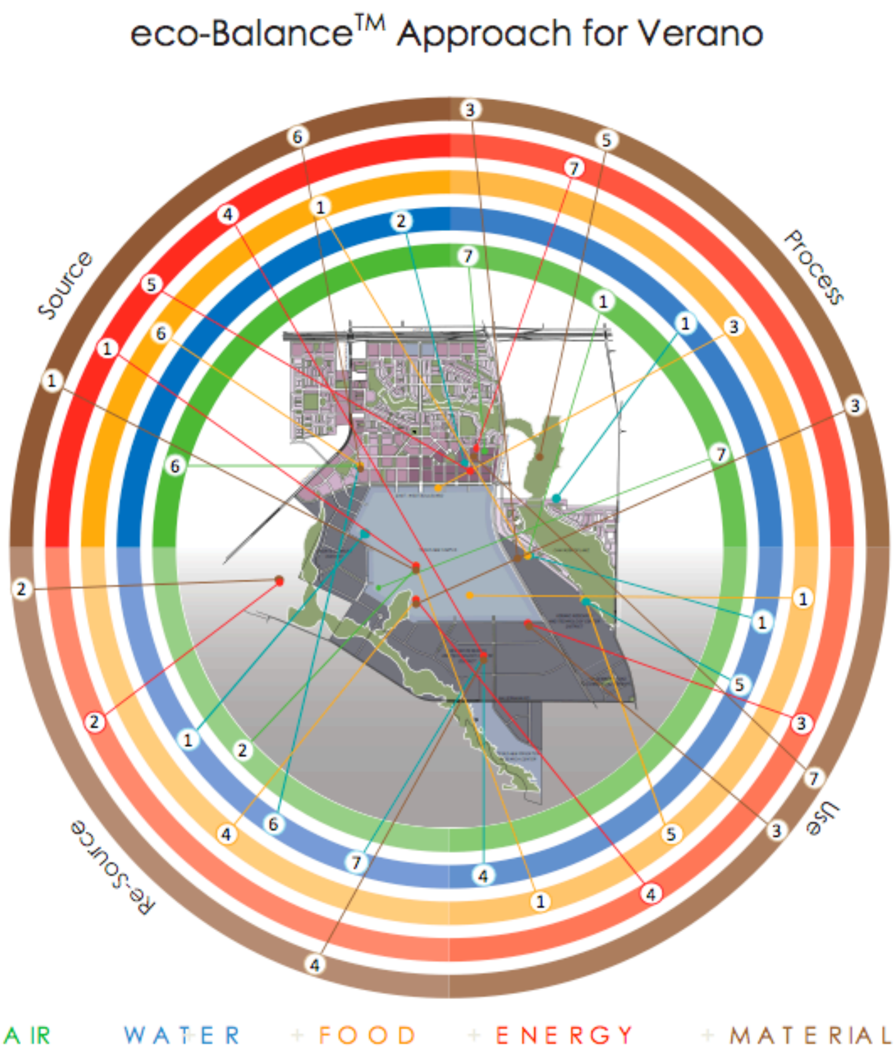

Figure 10

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1 SmartCode Central. www.smartcodecentral.com (Accessed 23 July 2009).