Choices for Growing Communities

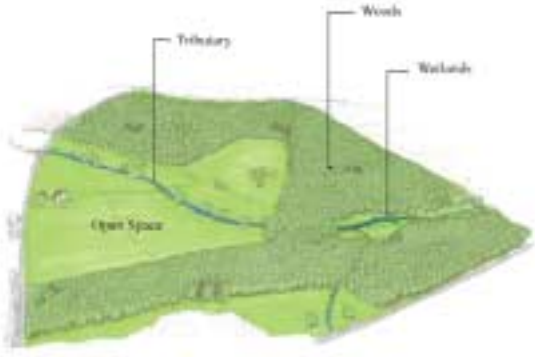
Differences, Downfalls and Dividends of Low-Impact Development

Overall Site Design

It's called many things – low-impact development, conservation development, better site design, environmentally sensitive design or sustainable living. One thing is certain, more developers and homeowners are considering the benefits of retaining some of the land's natural characteristics. They are realizing that the effort involved in creating a low-impact neighborhood can be paid back many times over – in financial, aesthetic and environmental benefits.

Photo courtesy of USDA NRCS and MIT

Land is often developed for residential use because of its availability, its proximity to other amenities, and its attractive natural features. With low-impact site design, many of the site features such as slopes and natural vegetation are retained. House lots may be clustered in one section of the site instead of being spread evenly over the entire parcel. Individual lots may be small, but homeowners usually have access to common areas within the neighborhood, such as trail systems or ponds. Low-impact site plans require inventories of natural areas and may require special variances, but these hurdles can usually be overcome.



Undeveloped sites often have valuable natural elements such as tributaries, woodlands, and wetlands.

Illustrations by Roger Hunt, Trees Forever

	Conventional Site Design	Low-Impact Site Design
		
Developer Pros and Cons	+ Design clearly meets existing standards and approval occurs in a timely manner + Profit margins and market demand are predictable and positive + Oversight of development process is routine, with standard practices well known by all parties - More infrastructure required, including extensive pavement and storm sewers	+ Less infrastructure required, less expensive + May be able to "trade" on traditional planning and zoning requirements + Homebuyers are willing to pay a premium for less environmental impact and more natural features + Alternative development is often seen by developers as a legacy - Increased time and potential expense for project development (site inventories, approval process) - Profit margins and markets are unknown, assuming additional risk - May require more direct monitoring of on-site activities
Homeowner Pros and Cons	+ Can maximize size of dwelling and lot for given cost to homebuyer + Subdivision has appearance similar to others - Costs of site alterations and infrastructure installation is applied to all lots/homes - Homeowner pays for cost of larger lot	+ Subdivision has unique look and feel + Home resale value is greater + Smaller lots require less maintenance for individual homeowners - Pro-rated to offset "undeveloped" land, so unit costs per sq. ft. of lot and home are higher - Neighborhood associations may be required to perform maintenance in common areas (may require "dues")

Soils and Topography

Low-impact development protects the natural benefits of a site by leaving soil undisturbed in many areas. Grading occurs only on building sites for roads and homes and the entire site is not "leveled." When soil areas are exposed, it is usually for a shorter period of time during construction. Because heavy machinery is limited to the construction envelope, there is less compaction of the subsoil. Less soil is covered by impervious surfaces (roads are narrower, sidewalks are limited and pervious pavement may be used).

Undisturbed soil is a porous medium that allows infiltration of rainwater, stores moisture and nutrients on a site, and supports a variety of plant and animal life.

Preserving the original site topography can add charm and interest to a neighborhood, while also preserving natural landscape functions.

	Conventional Soil Considerations	Low-Impact Soil Considerations
		
Developer Pros and Cons	+ A standard approach can be applied to all sites + Process includes accepted standards for erosion control + Regulatory review process is routine and predictable - Strongly affected by the amount of earthmoving that must be done - Increasing amounts of infrastructure (e.g. storm sewers) must be installed - Requires installation of silt fences, seeding of cover crops, and planning and installation of engineered solutions to control erosion and sedimentation	+ Limited earthmoving makes site prep less expensive and time consuming + Fewer requirements for temporary on-site erosion control structures + Less requirement for engineered permanent erosion control structures - Costs are increased during planning phase to customize approach to each site
Homeowner Pros and Cons	+ Uniform appearance of home sites + Concrete is low maintenance "groundcover" + Concrete provides ample space for parking cars - Home price includes costs associated with earthmoving and other requirements for installation of infrastructure on site - Difficulties with establishing post-construction vegetation due to poor soil properties (thin topsoil, compacted soil, lateral discontinuity due to mass grading)	+ Site includes undisturbed areas interspersed among homes + Natural topography is more attractive + Natural vegetation may be left on some lots - Less uniform appearance of site both during and after development - Pockets of undisturbed areas may look "messy" to some homeowners - Pervious pavement requires more maintenance than solid concrete

Hydrology

Site hydrology refers to the movement and quality of water in a landscape – into, over, or through soil and ultimately into streams and rivers. Changes to soil and topography during development also lead to changes in hydrologic response.

Photo courtesy of USDA NRCS

By minimizing disturbance to original site hydrology, developers can limit the total runoff volume. Low-impact development uses a combination of natural features and designed systems to retain and manage stormwater on-site, at both the subdivision and individual lot level. It limits total runoff and prevents "flash flood" situations. Nearby stream channels are also protected from high water flows that can cause downcutting, channel widening and stream bank erosion. Natural systems also protect water quality by filtering the water.

Detention basins address flooding problems by slowing storm water runoff and can be designed to enhance the aesthetics of a development.

	Conventional Hydrology Considerations	Low-Impact Hydrology Considerations
		
Developer Pros and Cons	+ Engineered water management fits existing standards, regulatory review is expedited + Infrastructure costs are predictable and can be passed to homebuyer + Less contractor oversight is required - Increased planning and installation of engineered structures to control water and sediment movement - Planning for hydrologic response must be done on a site-specific basis - Negative public image when precipitation causes post-development runoff	+ Less need for engineered solutions to prevent water movement across and off-site + Water is captured, processed, and used on-site (only 10-25% of precipitation becomes runoff) + Helps address regulatory requirements for stormwater management - Diverts space on-site to uses other than housing - More difficult to gain approval of site plans - Uncertain market appeal
Homeowner Pros and Cons	+ Considered "safe" solution to water issues + Moves excess water off-site rapidly - Potential difficulties with post-construction hydrology (e.g. flashier systems tend to flood) - Engineering costs pro-rated and included in home price	+ Maintenance of infiltration on-site diminishes need to supplement rainfall (e.g. irrigation systems may not be necessary) + Hydrologic response is less prone to flash floods and more predictable + Bioretention areas such as raingardens can be very attractive - Costs may be increased to support site planning - Lot-level improvements may cost more for individual homeowners

Landcover/Plant Communities

Prairies, forests and wetlands play a functional role in the landscape. With low-impact development, natural vegetation areas are preserved in strategic locations or across the site. Less disturbance to the site results in a healthier, more functional landscape. Connections to other natural areas or significant reserves may also preserve species diversity. With conventional development, mass grading diminishes or eliminates most native plant species. Trees not cut down during construction often decline and die within 5 to 8 years.

Plant communities are groups of species that coexist under certain conditions. As more land is used for residential development, native plant communities are displaced.

Preserving vegetation on a site adds character to the design, while also helping address erosion by stabilizing soil and intercepting rain water.

	Conventional Landcover Considerations	Low-Impact Landcover Considerations
		
Developer Pros and Cons	+ Create site with "clean slate" + Can achieve uniformity in appearance + Easier to meet existing standards for slope, etc. - Natural vegetation removed, causing costs for "grubbing out" the site - Previous vegetation must be replaced with temporary cover crop to protect site from erosion - Loss of other function associated with natural plants – absorption, evaporation of water, pollution absorption, streambank protection, etc. - Exposed sites are unattractive during development process (unhappy neighbors)	+ Natural vegetation provides low tech and inexpensive water treatment on-site + Can market and sell "green" development + End product has biological integrity - Less "developable" space if land reserved for natural areas - Harder to pass on costs associated with protecting landcover - Unique development may require extra marketing and promotional effort
Homeowner Pros and Cons	+ Landscape is neat and tidy + Landscape maintenance techniques are well known + Plant materials are well understood and easy to maintain - Homeowner usually installs high-maintenance landscaping and plant material - Focus is on ornamental rather than functional characteristics of vegetation - Unattractive appearance during additions to subdivision with exposed soil and little vegetation - Expensive to "retrofit" natural plant species or to restore natural plant community	+ Reserved natural areas also provide recreational opportunities + Natural vegetation generally requires less intensive maintenance than non-native species + Provides wildlife habitat - Cost per square foot of lot may be increased to cover undeveloped land - Maintenance techniques for natural areas are not well understood - Natural areas may appear "unkempt" to some homeowners

Regulatory Requirements

Land development is governed by regulations and sets of standards that are implemented at the local level by municipal or other governmental entities.

Conventional design standards are very specific and intended to protect public safety and welfare (e.g. minimum road width for fire truck access, sanitary and storm sewer requirements, sidewalks, rights-of way). Solutions for transportation, hydrologic modification, erosion control, and other issues rely heavily on standardized and tested engineered systems.

The design standards for low-impact design are specific, but are not well known among developers, designers, engineers or municipal officials. It often requires a variance from typical ordinances and may be handled as a Planned Unit Development (PUD). The design standards for low-impact development emphasize environmental integrity, particularly by minimizing hydrological disturbance to the site.

Photo courtesy of Wayne Petersen, NRCS

Pervious pavers such as these allow rain to filter through the soil, which slows run off and lessens the impact of chemicals on water quality.

	Conventional Requirements	Low-Impact Requirements
		 Photo courtesy of Univ. of Connecticut Cooperative Extension
Developer Pros and Cons	+ Approval procedures set up to accommodate conventional design + Supports level playing field among development enterprises - Little flexibility in design standards to allow developer to use site characteristics to their advantage or to implement innovative practices	+ Examples of successful implementation of low-impact practices and conservation design have been very profitable + Addresses regulatory requirements by minimizing site disturbance and maximizing benefits from site characteristics - Designers/engineers are less experienced with low-impact approach so it is more difficult and costly to develop a plan - Review process is lengthened and may not result in approval of the project - Unclear criteria for bearing the risk associated with less-tested systems - Case-by-case review may produce inconsistent results
Homeowner Pros and Cons	+ Design, approval, and development procedures are efficient - Maintenance of infrastructure may be paid for by property taxes and/or user fees - System doesn't address larger scale ecological integrity/health/quality of life components - Fewer choices in subdivision characteristics and amenities	+ Higher probability of adjacent subdivisions built as low-impact developments, leading to greater continuity of design and natural areas + Typically results in higher home values and more sustainable infrastructure because of less engineering - Greater cost to developer may be passed to homebuyer - Development proceeds more slowly

Typical Costs of Construction for Conventional vs. Low-Impact Development

While some costs can be higher for low-impact development, the savings in reduced grading and water management more than make up the difference.

Photo courtesy of USDA NRCS

Many of the planning costs involved with designing a conservation subdivision can be offset by lower infrastructure costs.

Hard Costs

Although development costs vary greatly between sites, the low-impact approach may reduce the cost of residential developments, particularly for installation of infrastructure on a site. Clustering homes on a smaller portion of the site reduces the amount of road surface and extension of utilities necessary to provide service to all residents. Other low-impact practices, such as minimizing grading and reducing the need for expensive concrete or asphalt surfaces (narrower roads and driveways, limited sidewalks) also generate cost savings. In addition, utilization of natural site features to retain water can greatly reduce costs of storm water management (i.e. less need for storm sewers).

Photo courtesy of USDA NRCS

Construction Cost Comparison*

	Conventional Development	Low-Impact Development
Grading/road	$569,698	$426,575
Storm drains	$225,771	$132,558
Stormwater ponds, fees	$260,858	$10,530
Bioretention features	NA	$175,000
Total	$1,086,277	$744,663
Unit cost	$14,679	$9,193
Lot yield	74	81

*From the Low Impact Development and Integrated Management Practices Toolbox, IECA, 2002

There may be additional up-front costs associated with site inventory and analysis for site planning as well as monitoring implementation of low impact approaches, but those costs are less significant than those associated with physical site alterations.

Soft Benefits

This example reflects only the cost side of the balance sheet. The benefits in terms of aesthetics and environmental function associated with low-impact development are significant, but difficult to calculate in dollars and cents. There is growing evidence, however, that homebuyers are willing to pay more for features included in low-impact design.

Photo courtesy of USDA NRCS

Low-Impact Development Practices

Once you decide to implement low-impact development in your construction process, you can choose from several accepted Integrated Management Practices. Many of these practices can also be used to retrofit existing neighborhoods or lots.

Photo courtesy of Stacie Johnson

Site Planning

Initial site inventories and general layout decisions affect:

- conservation of natural resource areas
- preservation of natural depressions
- clustering of homes
- ability to minimize unnecessary disturbance
- road placement, reducing length and width
- driveway placement, reducing length and width
- strategic grading rather than mass grading
- limited use of sidewalks

Planting native vegetation builds the soil and provides wildlife habitat.

Photo courtesy of USDA NRCS

Rain gardens capture rain water on-site, reducing the amount of run-off and enhancing the attractiveness of a home.

Implementation of Low-Impact Development (LID) Integrated Management Practices

Integrated management practices (IMPs) are designed to protect natural features and distribute constructed or natural retention features to manage post-development hydrology over an entire site, rather than focusing primarily on the downstream point of the site.

Here are some examples of IMPs for six general categories of low-impact development practices:

1. Soil protection/restoration
- Soil aeration
- Strategic grading
- Deep tillage in selected areas
- Preservation of high-infiltration or natural depression soils
- Use of native plants to enhance soil organic matter content
- Strive for post-construction organic matter of at least 5%

2. Bioretention
- Shallow vegetated retention areas – e.g. raingardens
- Landscape islands distributed across sites
- Maintenance of predevelopment flow patterns
- Streetscape applications – e.g. open vegetated swales, tree box filters, stormwater planters
- Existing forest areas preserved
- Under-drainage applicable to some systems

3. Infiltration
- Strategic grading
- Flattened slopes on impacted areas
- Long flow paths
- Reduced impervious surfaces
- Pervious pavers
- Swales (vegetated)

4. Filtration
- Surface and underground sand filters
- Perimeter filters – e.g. parking areas
- Organic filters
- Sediment chambers

5. Storage and use of water
- Cisterns (above or underground)
- Rainbarrels
- Raingardens
- Drywells
- Flattened slopes to disperse stormflow

6. Open channels
- Rip-rap, geo-textile, or bio-engineered bank stabilization
- Vegetative buffers

Using roadside swales instead of curbs and gutters helps rainwater infiltrate and reduces the need for storm sewer infrastructure.

Extension Urban Agriculture

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ISU Dept. of Natural Resource Ecology & Management
www.nrem.iastate.edu
Trees Forever
www.treesforever.org
Iowa Dept. of Natural Resources
www.iowadnr.com

More Information about Low-Impact Development Practices

Iowa Resources
www.ia.nrcs.usda.gov/news/brochures/urban.html
www.iamu.org
www.urbanwaterquality.org

National Resources
www.lowimpactdevelopment.org
www.cwp.org
www.stormwatercenter.net
www.epa.gov
www.greeninfrastructure.net
www.uli.org

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