An Ecological and Physical Investigation of Pittsburgh Hillsides
REPORT to the City of Pittsburgh Hillsides Committee

Final Report
November 30, 2004

Prepared in cooperation with Allegheny Land Trust for the City of Pittsburgh Hillsides Committee
Funded by The Heinz Endowments

Prepared by:
Stephen Farber, PhD
3 Rivers 2nd Nature
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Executive Summaries

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PREFACE TO EXECUTIVE SUMMARIES

This investigation of the ecological and physical environments of Pittsburgh's hillsides, with economic and legal support, is intended to assist the City of Pittsburgh Hillsides Committee with its deliberations and recommendations regarding the future of Pittsburgh's hillsides. While a number of opinions have been voiced about the regulation of hillside preservation, conservation or development, there has been little research on the character or function of the hillsides. One of the goals of this project has been to provide an informed framework for establishing coherent public policy.

The REPORT to the City of Pittsburgh Hillsides Committee is a compilation of four individual reports that together form that framework:

Economic Report
Ecological Report
Physical Report
Legal Report

Creating an appropriate policy toward hillsides involves an understanding of their many contributions to the viability of the city-functional, economic, form-giving, aesthetic, and social-as well as the liabilities they may impose on development-hazards and costs. This is a multi-discipled challenge. The investigation brings together expertise in the environment, ecology, geology, urban design, and landscape architecture. Legal and economic expertise provides firm grounding to the investigation's recommendations.

All recommendations and evaluations documented in this REPORT are conceptual in nature and do not suggest engineering solutions. The REPORT is not intended to contain recommendations for specific private property or properties, and not text or illustrations should be interpreted as such.

The Executive Summaries that follow highlight the salient points and arguments of the respective reports. Please refer, though, to the full reports for additional and more detailed information.

Executive Summary
Economics of Hillside Slope Development
Stephen Farber, PhD

The economic values of hillsides and the preservation of vegetative covers on hillsides arise in several ways. First, the topographic relief provided by Pittsburgh hillsides is a major landscape defining feature that is distinctive and provides a unique identity to the Pittsburgh region. This value is manifest in the visual image of Pittsburgh projected nationally and internationally with scenes of the Golden Triangle and associated riverine/hillside landscapes. This value is inestimable as a distinctive feature, keeping the image of Pittsburgh in the public eye as a pleasant place to live and visit; an economic development value that would be difficult to quantify but is likely substantial. A second value of the unique topographic relief is its role in defining neighborhoods and communities. The hills and valleys afford a sense of place and community identity that is inestimable, yet clearly apparent from the settlement patterns and strong identities with local communities. A third value is a more estimable economic value; the economic value of the topographic and associated land cover landscape amenities. As noted below, these values are most often evidenced in enhanced property values in proximity to those amenities. Finally, a very important and estimable set of economic values of the land cover associated with the typical topographic relief in Pittsburgh is attributable to the natural system services of those ecosystems. These values are discussed below.

A considerable number of reputable economic studies illustrate the economic values of various urban environmental amenities. The most reliable of these studies estimate the enhanced property values attributable to those amenities. These studies have been undertaken in a variety of urban areas: Boulder, CO; Columbus, OH; Portland, OR; England; Baltimore, MD; Washington, DC; Fairfield, CT; Grand Rapids, MI; Los Angeles, CA. They all demonstrate that proximity to green spaces and/or open spaces enhances property values. These premiums for proximity can range up to 25% of the value of a property; but are most likely to augment property values by around 5%.

The vegetative cover typically accompanying hillsides defines ecological types that provide a variety of natural system services. Vegetative cover in watersheds reduces stream pollution, as shown by several studies. Reduced pollution has economic value in terms of increased recreational values, reductions in health related costs, and reductions in water treatment costs downstream. The ecological values of tree cover can be considerable; for example, in the management of runoff. A study of Los Angeles illustrates this: increased tree cover would reduce stormwater and flood control costs by nearly $4 per tree. The pollution and heating/cooling values of tree cover were shown to be considerable in a Chicago study.

It would be reasonable to expect that public infrastructure (roads, sewers, water, electricity, etc.) would be considerably more costly in the case of hillside developments than development in flatter relief. Similarly, development in areas not served by this infrastructure would be more costly than in "infill" areas. For example, a study in Australia illustrates that road costs were $2500 higher per dwelling unit in an undeveloped "Greenfield" than in an "Urban Infill" development.

Even when developers pay for the extraordinary infrastructure costs, and pass these costs on to buyers, there remain the public infrastructure maintenance costs, and public service costs (fire protection, police protection, waste collection, etc.). Impact fees are not typically assessed to cover these extraordinary recurring costs. To the extent that the full value of extraordinary costs of hillside development are not paid for, other taxpayers must end up subsiding these developments, and the less-than-full-costs simply encourage such developments. Costs of public services for residential developments generally compare unfavorably with the tax revenues from those developments. A summary of over 90 cost of services studies in the US showed that, on average, residential developments cost roughly 15% more than the revenues that could be expected from those developments on a per dwelling unit basis (property taxes, local sales and income taxes, etc.)

In addition to extraordinary infrastructure and public service costs, hillside developments, and associated alterations of ecosystems, result in the loss of natural systems services, which may have considerable economic value, especially in landslide, flood prone, high topographic relief areas such as Pittsburgh. The public bears the costs of these lost services in the form of increased pollution of streams, increased water treatment costs, increased flood conveyance and control costs, etc. These increased costs have an equity implication when it is poorer people who live downhill or in downstream floodplains.

An Ecological and Physical Investigation of Pittsburgh's Hillsides

EXECUTIVE SUMMARY - ECOLOGICAL REPORT
by Timothy M. Collins

I think I can safely say that our team would be first to argue that land within the city is best used for development. Dense urban environments can create efficient transportation, education and cultural infrastructure and enormous savings in terms of energy consumption. Dense urban environments also leave ex-urban lands open to agriculture, forestry or recreational uses. However, in instances when the development of urban land may create a threat to public safety, or when citizens decide to save land for its intrinsic values we must reconsider the suitability of development. What follows in this report are tools to help clarify the zoning and regulation of undeveloped City hillside lands. Ultimately, these tools will enable the development of a long-term set of policies that provide for systematic hillside land preservation, species conservation and, when warranted and affordable, ecological restoration.

One hundred years ago, preservation and conservation movements were born as a reaction to the perceived encroachment of the industrial economy upon land. For the first time there was a sense of the physical limits of resource extraction within the United States. Preservationists believed that wilderness was in a state of grace, beyond the limits of human habitation. Nature was something to be preserved and contained for future generations. Conservationists believed that wilderness was a resource bounty to be managed and controlled for long-term economic benefits. Both of these philosophical and political positions placed nature (in the form of wilderness and land-resource) well beyond the limits of cities or towns. The post-industrial reaction to impacts upon soil, water, land, air, climate, and our bodies is ecological Restoration. "Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed." (www.ser.org) Restoration ecology is a new way of thinking. It links citizens and experts, as well as cities and outlying lands, in a broad program of ecological awareness and action. It is a community of disciplines synthesizing a continuum of diverse knowledge and practices. In many ways the challenge of restoration ecology is to promote a community of environmental health, aesthetics (after Nassauer and Muelder Eaton) can be an indicator of that healthy vitality.

Through out time there has been a struggle between practical minded people that see utilitarian value in nature and those that see intrinsic value in nature. Utilitarian value is primarily external from the object of contemplation, while intrinsic value is internal. In other words, the utilitarian value of a tree in a forest can also be found in the value of the wood, when extracted, milled into lumber and brought to the mill workers shop where it can be cut and joined to create fine furniture. Trees in the forest provide jobs for the lumberjack that cuts the tree, the sawmill owner that processes it from tree trunk to usable lumber, the truck driver that hauls it, and the craftsman who makes wonderful objects from lumber. The tree as a raw material is a resource that supports life, enables the economy and is ultimately a renewable resource although one that regenerates slowly over time.

The intrinsic value of the tree is a more complicated question. Does a tree have a sense unto itself? Does it feel pleasure and pain? Does it act in its own self interest? Can humans act as advocates for the legal rights of tree's in much the same way that act as advocates for corporations, small babies, or other non-verbal entitites? Recent philosophical literatures raises the question of agency and self interest, moral authority and advocacy are subjects of intense study and conflicting argument. Recent forays in the literature of political ecology examine the idea that nature and tree's could have rights, or that the divided houses of culture and nature could reunite in a new concept of scientifically and metaphysically informed government. Are these thoughts appropriatefor a city like Pittsburgh, where the culture and economy has been constructed and sustained upon the ideology of resource use and the economies of extraction?

For our purposes we can leave behind the heady discussions of philosophy and instead discuss intrinsic value in terms of a tree's essential relationship to the land. We can also discuss the utilitarian services this tree provides to the human community during its tenure, which by the nature of the tree's self-replicating life-force can be quite substantial, The tree is part of a network of roots processing nutrients. The roots provide the structure that holds the soil from erosion. The tree has a role in the hydrologic cycle, processing water in the root zone, it draws water through the trunk and releases it from its leaves into the air in the form of gas. It has a role to play in air quality, it is a sink for carbon dioxide and a source of clean fresh air through the stomatal openings in the leaves. The structure of the tree provides shelter for wildlife, its fruits provide food, the shade cools the air. The tree when alive and part of a forest is a primary structural element of a larger ecological infrastructure that is all alive. A tree competes with other trees and plants in the forest for sunlight, Its bark reacts to nails and materials that pierce it, healing itself, not unlike our own flesh. It reacts to changes in the weather, it blooms in the spring, cloaks itself in colorful foliage each fall, and reveals its fundamental bare wood structure each winter. The tree is alive, it procreates, its value is unto itself and in relationship to the forest. Humans can share those values as members of the forest community, or impose a more utilitarian value upon the tree, and deny its life. Mans dominion over nature goes back to the Bible. Despite this history of dominion, the tree is a living entity that is part of the network of life. A living tree has a defensible role in the human economy based on the studies of the environmental economist Steve Farber, whether it has intrinsic value that can be imposed on others, is the meta-topic (but not the focus) of this study. The primary topic is utilitarian, steep wooded hillsides are green-infrastructure that bring significant services to human communities. Green infrastructure mitigates landslides, storm water impacts and air quality issues. Following the bias of Pennsylvania's courts, we will confine what by now should be a clearly perceived empathetic interest (on the part of this author) in the life of nature, to its subservient role in the support of public safety and as a "reasonable" alternative to land use development, on the basis of green-infrastructure values.

Tools to inform the discussion of City hillside zoning.

Our sense of the "nature, or ecology of this place" is colonized by the language of cultural spaces, and architectural design. This is a highly abstract ideology of enclosure, of private parcel ownership and municipal authority. Municipal zoning seeks to minimize the negative impact of private development. It is at its strongest when focused upon the protection of public health, safety, morals or the general welfare of the greater community. Despite a history of urban landscape theory that has roots in ancient city design, modern authority in the writings of Ian McHarg and contemporary validity in the discourse of landscape ecology, political ecology and restoration ecology - the issues of ecosystem services are primarily undermined or enabled by parcel by parcel regulation and decision making. We assembled a team of artists, natural scientists, an environmental planner, an urban designer and various computer mapping experts to develop tools that might enable natural systems in the city. The first question we struggled with was what component of the natural world could we target, that might -- provide the relevant argument that would allow the Hillsides Committee of the City of Pittsburgh to feel confident that a new hillside zoning regulation was equitable to landowners as well as legal and enforceable? The second question we struggled with was what issues could we identify that would enable the most robust democratic discourse within each neighborhood, about the value of open space, and the struggle over the meaning of the public realm, the public will, and larger social and environmental ideals in realtionship tot the rights and aspirations of individual property owners?

After much consideration, we decided to provide analysis of both quantitative and empirical data that can inform rational decision making on steep slope properties at the level of zoning policy, regulation and enforcement. The focus in this section is upon 25% slopes or steeper, this is an angle at which many soils become unfit for urban development, creating both on site and downslope threats to public safety. This is also a slope angle where the buildings in the city drop off significantly, and city services in terms of roads and sewers are inconsistent and often nonexistent. In turn, this also means that these are the places in the city where remnant forests have flourished, or where natural recovery has occurred to significant effect, in some cases creating interconnected forest patch-corridor matrices that result in emerald arcs, forests that are visually stunning and increasingly valuable to humans that value proximity to nature and the green-infrastructure services of nature, even at the urban core.

All materials in the Ecological Report have been developed with the express intention of reflecting the analysis and outcomes of Cyril Fox' study of the authority and jurisprudence of land-use controls. Following the Fox report, we were seeking an analytical methodology that would "identify potential danger from landslide and other development problems" as well as examine the cities current stock of "adequate public services and infrastructure" at each of these parcels. Finally we were seeking to minimize any "perception of arbitrary decision making" – through the rigorous application of accepted material data sets supported by the City of Pittsburgh, Allegheny County and the United State Agricultural Service. In the high ideals and ancient history of rational planning, we have decided that the best way to act in the interest of the public realm, was to let the data speak for itself.

Specific goals:
Tools for Democratic Discourse
- Contextual analysis at the watershed scale.
- Open space needs analysis at the neighborhood scale, and

Decision Tools
- Decisions analysis at the parcel scale.
- Field studies to inform land use guidelines.

Tools for Democratic Discourse.

• Contextual analysis at the watershed scale.

The ecological report focuses first on the watershed scale - maps that help us understand the urban relationship to topography, hydrology, woodlands, parks and interior forest. This is nothing more than a conceptual framework to help us understand the function and failure of natural ecosystems within the city. The final map in this series (map 1.7) gives us a sense of the significant forested areas of the city, and their relative interior forest, defined as the forest area approximately 100 meters from the edge of forest patch (Moyer 2003). Interior forest habitat is critical to maintaining populations of organisms which require stable sources of food and cover.

• Open space needs analysis at the neighborhood scale.

Secondly we looked at the city on the scale of neighborhoods. On a neighborhood by neighborhood basis, we mapped resident income, average value, population density and vacant parcels in relationship to parks and open space. In this section we argue that neighborhoods with low per capita income, low value, and high population density have a greater need for open spaces than those places with high income, high value and low population density. These maps provide the reader with a means to understand what neighborhoods have access to open space, to parks and forests and which do not. Arguably this can be used by citizens and officials alike to think about what these steep hillsides mean in terms of the social and ecological characteristics of each neighborhood, and where there are issues of equity and access or lack there of.

Decision Tools

• Decisions analysis at the parcel scale.

We were seeking to develop a decision matrix, that would allow each parcel in the city to be analyzed and then sorted into areas for preservation, conservation or development. We were seeking an analytical methodology that would allow us to identify potential danger from landslide as well as available public infrastructure that could service each parcel. Our method is based upon the best available knowledge of soils (in terms of erosion, foundation and roadbed safety) in the city. And upon each parcels relationship to adjacent buildings, or proximate (within 100-300 feet) roads and sewers. This is the most objective, rational manner that we could come up with to sort parcels into scientifically informed and legally defensible zoning categories. The data for this analysis is from the United States Agricultural Department Study of the Soils of Allegheny County, and existing City of Pittsburgh infrastructure studies. Based on this data and analysis we were able to arrive at the following standardized definitions.

Preservation: land deemed environmentally unfit for development due to erosive soils, and a lack of available City infrastructure.
Conservation: land with sensitive but not exclusionary soil characteristics for safe building practices, with some infrastructure necessary to support development.
Development: land with both the soil characteristics for safe building practices and available infrastructure to support development.

With the clear understanding that this exercise is intended to inform Pittsburgh City Zoning, we realized that the geo-referenced data sets would need to be effectively queried at the level of individual City parcels. We were able to develop a Microsoft Access database tool we call the "parcel identifier." This tool allows the casual user, or City planner to query the infrastructure and soils databases for each City parcel using the lot and block numbers. The results of that query are recommendations for preservation, conservation or development described above. Finally we added two "push" categories that inform the user of potential threats to development due to the proximity of the underlying coal seam, or potential benefits to preservation and conservation ideals in terms of adjacent woodlands.

The relative effects of the "parcel -identifier" database are mapped and charted for the total number of parcels on slopes >25% in the outline below. This data set provides the committee with an understanding of the affects of the analysis on the total number of developable parcels. All four categories include the infrastructure and soil safety information. The ecology team would argue that the soils and infrastructure decision should remain unchanged, however there is room for discussion and decision on the "push" factors.

Parcels Without Woodlands or Coal
This is the cleanest and simplest presentation of the relationship between existing infrastructure and soil conditions as analyzed by the "parcel identifier." Using just soils and infrastructure we have a very simple, clear and concise tool to inform decisions on zoning.

Preservation	3494 parcels (30%)
Conservation	3951 parcels (34%)
Development	4310 parcels (36%)

Parcels with Coal Only
If we were to only include the coal seam underlay as an additional -public safety- push factor, the categories increase or decrease by the following number of parcels/percentage:

Preservation	3806 parcels (33%)
Conservation	3937 parcels (33%)
Development	4012 parcels (34%)

Parcels with Woodlands Only
If we were to consider the parcel - woodlands condition as an additional -ecological systems- push factor the categories increase or decrease by the following number of parcels/percentage:

Preservation	5782 parcels (49%)

Conservation 2897 parcels (25%)
Development 3076 parcels (26%)

Parcels with Woodlands and Coal

With the addition of both the woodland and coal "push" categories the categories either increase or decrease by the following number of parcels/percentage:

Preservation 5992 parcels (51%)
Conservation 2860 parcels (24%)
Development 2903 parcels (25%)

• Field studies to inform land use guidelines.

Given our industrial history, it is sometimes hard to fathom the import and value of the remnant and recovering forests of Allegheny County. The botanist found a high diversity of woody species within each of the sites and evidence of four typical forest community types in the three areas sampled. They identified 84 woody species in total: 66 of which were native (=79%), and 13 of which are native hardwood trees (15%) (See Table 1). Many trees were greater than two meters in circumference and one tree at exceeded three meters in circumference. The steep hillsides of Pittsburgh indeed sustain a diverse assemblage of tree species with their attending shrubs and understory trees. Four hardwood forest native plant communities were identified on the hillsides studied. (See Appendix A for complete descriptions of these forest types):

Dry oak– mixed hardwood forest, typically occurs on slopes with dry soil

Red oak– mixed hardwood forest, occurs in mesic soils and found on lower slopes in our survey

Sugar maple– basswood forest, often occurs on rich soils with rocky slopes and supports a rich vernal flora .

Mixed mesophytic forest - typically found on lower slopes, which is unique to the Southwestern portion of Pennsylvania, and supports an extremely rich and diverse flora.

The Geologist comments on the three major site areas, was cautionary. Site studies illustrate the importance of field checking maps of geological hazards and soil types as part of the final decision on the suitability of hillside land for development. Section 4.2 "Understanding the Soil Survey for Planning goes into more detail on this topic.

In Conclusion

Our studies illustrate the fact that there is available data upon which a hillside zoning plan can be written. Given the authority of the United State Department of Agriculture and the City of Pittsburgh, the soil data and infrastructure data are legally defensible sources applicable and indeed intended for land-use decision making. The field studies provide potent tools for informed land use guidelines, and a rational overview of the value of our remnant and recovering forests. The contextual analysis and open space analysis help us see the current patterns and baseline condition today. This report provides the committee with authoritative work on ecology, our colleague have provide equally thoughtful input on design, economy and law. We believe that we have had some success clarifying

PHYSICAL REPORT EXECUTIVE SUMMARY

The hillsides of Pittsburgh are a remarkable natural resource, interlacing and complementing the densely constructed built fabric of Pittsburgh neighborhoods with dense woods. Steeply sloped land in Pittsburgh occupies approximately one-fifth of the area of the city. Most of it is covered by natural vegetation and some is exposed rock. For various reasons, very little of this land is "developed"-that is, occupied by buildings or other man-made features. However, the slopes are not preserved or protected in their natural state although they provide functional, aesthetic, environmental, recreational and other public benefits. How much of this land should be protected to maintain the many beneficial functions it provides? How can Pittsburgh capitalize on this unique natural asset in a sustainable way?

This investigation of the ecological and physical environments is intended to assist the City of Pittsburgh Hillsides Committee with its deliberations and recommendations regarding the future use of Pittsburgh's hillsides. This report focuses on the relationship between Pittsburgh's hillsides and its built form and how the natural characteristics inform and shape the built environment. The report also addresses implications and offers recommendations for future hillsides development. Utilizing a slope classification system contained in the Soil Survey of Allegheny County, Pennsylvania, the report defines "hillsides" as areas of 15% or greater slope and differentiates between two classifications in its recommendations: slopes of 15% up to 25% and slopes of 25% and greater.

At the city-wide scale, the physical setting is studied from its overall development impact on the city's settlement patterns, its spatial structure, the shaping of its neighborhoods, views and vistas, and urban texture. At the more localized hillsides scale, typical hillside development prototypes are identified that give Pittsburgh a unique identity. From these findings, two development strategies are recommended: redirecting development and restricting development. Three study sites, indicative of typical hillside conditions, are studied, and the use of the development prototypes is tested.

The report utilizes descriptive observations of the built form, identification and application of prototypical patterns, and development precedents from other hillside ordinances as the basis of the investigation and recommendations. GIS database material from the City of Pittsburgh and Allegheny County has been used to generate, document, or illustrate information.

Strategic Question

Pittsburgh is not facing growth pressure and has no shortage of vacant or underutilized land. High vacancy rates have been avoided only by demolishing housing, closing schools, and abandoning commercial property. Pittsburgh's shortage is in people and businesses to occupy the property already developed and to provide a healthier tax base for the city.

The strategic question for Pittsburgh is how to capitalize on Pittsburgh's hillsides as a means of attracting people and businesses while redeveloping and revitalizing its existing urbanized areas. For the purpose of Pittsburgh's revitalization, what is the "highest and best use" of hillsides? In a society where cities vie for people and businesses, how does Pittsburgh increase its competitive advantage? When and where does private construction distract from-rather than contribute to-the overall economic value of the city? What types and extent of construction should be permitted?

Historically, Pittsburgh's hillsides, because they were inaccessible and smoke-covered, were not highly valued development sites. Today, steep slopes can attract development because of good views or natural surroundings. But they do not lend themselves to development easily. They impose serious development constraints and exact added costs, both private and public.

The City of Pittsburgh has formally adopted in its Environmental Performance Standards of the Pittsburgh Zoning Code an affirmation of the benefits of the hillsides to the city, a commitment to preserving those benefits, and the need to develop the operational mechanisms to do so:

"The city's natural resources and sensitive environmental areas, steep forested hills, prominent ridges and rivers are major contributors to Pittsburgh's distinctive character and high quality of life. Provisions should be intended to protect sensitive environmental areas from adverse development impacts. Provisions should be developed that are intended to:

- Encourage the protection of steep slopes, riparian corridors, and other natural resources, while promoting economic development;
- Promote the public health, safety, and welfare of the residents of the city; encourage high quality development and orderly community growth; and
- Conserve and stabilize property values."

Pittsburgh's hillsides shape its public realm, contribute to the green and healthful character of the city and the identity of its neighborhoods, maintain the integrity of the natural ecology and the economic functioning of urban life, and provide aesthetic, historical and cultural continuity.

The goal of Pittsburgh's public policy regarding its physical form is to integrate the construction of built environments and the cultivation of natural environments into a single system that provides for a good and sustainable quality of life. Development on hillsides has greater potential to impact the health, safety, welfare, environmental, and aesthetic values of the Pittsburgh community than development on flatter land. Hillside preservation, conservation, and limited as-of-right development are an appropriate recognition of these values.

With this policy as its core principle, the Steering Committee articulated an expanded definition of the value of hillsides in Pittsburgh and a statement of the purposes that the recommendations in this study are to address. The principles described in the report are the basis for a common vision for the future of the hillsides.

In order to assess the appropriateness of developing hillsides, the conventional framework for considering the value of natural environments is reconsidered, as discussed in detail in Stephen Farber's paper, "Economics of Hillside Slope Development". The value of hillsides is not just to produce revenue for the city. They offer broader economic, functional and social benefits. More fundamentally, the conventional "non-organic" model of urban settlement is premised on a fundamental dichotomy between humanity and nature, embedded in our culture, our concept of "development", and our patterns of production. This model has led to an alienation of our urban society from nature and the misuse of our resources. A new and better model looks to re-integrate them, creating a holistic framework for improving and sustaining the quality of city life.

To understand the role of the hillsides in Pittsburgh's identity, it is necessary to understand Pittsburgh's urban form, especially the characteristics that make it unique. The major factors are its geomorphology (its natural land form), settlement patterns, its spatial structure and texture, its neighborhood identity, and its views and vistas.

Pittsburgh's Urban Form

Geomorphology: Geologically, Pittsburgh is sited on the Allegheny Plateau, once part of the bed of a huge inland lake. Its slopes and valleys were formed by an erosion process rather than by folding and uplifting. The slopes are not the gentle folds of New England towns or the dramatic tilted planes of the west. They are steep "walls" of river corridors incised into the flat plateau, more like the Palisades of the Hudson. Pittsburgh's geographical form creates large spaces or outdoor "rooms" connected by corridors or "hallways" with flat terrace floors and steeply sloped walls.

Except for some neighborhoods in the East End, almost all of Pittsburgh's residential development is on sloped land. The hillsides provide neighborhood boundaries, dictate our transportation systems, provide most of the open space within the city, and form the backdrops and frames for views and vistas. Other than the rivers, the slope-walls are the dominant natural features that create Pittsburgh's "sense of place."

Settlement Patterns: Early development was on the flattest areas of the city as well as the slopes that bordered these areas which were not too steep for residential development. The Hill District, Polish Hill, the Southside Slopes and areas of Lawrenceville were the earliest slopes to be developed. The flood plain "flats" were developed for mills and manufacturing, surrounded by dense residential development. In general, the slopes were impediments to access and high terraces remained largely undeveloped until mid-20th Century. Today, the slopes that are the most natural are those in areas developed after 1895, while the slopes that have densest traditional development were those developed before 1855.

Spatial Structure: The spatial structure of a city is what provides its perceptual legibility. At the scale of the city, the elements that provide continuity in Pittsburgh are the rivers, highways, and steep slopes. Major arterials, following the topography, generally parallel the slopes. The slopes also divide neighborhoods from each other, sometimes wrapping neighborhoods with a continuous band of wooded land. In sum, the hillside slopes, which parallel major paths, define edges, reinforce districts, and form portals, are arguably the most important single element in the legibility of the city.

Urban Texture: The "texture" of a city describes the effect of the buildings and open spaces as if seen from a great distance. The densely built fabric of the city contrasts to the natural open spaces and woodlands within the city. In Pittsburgh, local neighborhoods have their own texture and are easily distinguished from each other and from the natural areas that often separate them. In between the well-defined built and natural areas there sometimes exists sporadic development, which does not exhibit any orderly pattern. This occurs where new development at a larger scale has been inserted or where significant disinvestment has destroyed the historic urban texture.

None of the dense development of the city occurs on the slopes over 25%. Within the city there exist large continuous areas of steep slopes without development. Areas of development that have continuous urban fabric are primarily residential neighborhoods with buildings of small footprints. Dense industrial and commercial areas have tended to deteriorate or be replaced over time, leaving very little urban texture. A strategy of infill development would strengthen the coherence of urban texture where it has been weakened and create a stronger contrast to natural areas.

Neighborhood Identity: Pittsburgh has physically distinct neighborhoods and has frequently been described as a "city of neighborhoods". Their physical and social boundaries reinforce each other, resulting in "urban villages" that tend to be much more self-contained than in typical cities in the US. It is one of the distinctive characteristics that attract people to Pittsburgh. It also contributes to the social and economic sustainability of the neighborhoods, which offer small-scale pedestrian-oriented environments.

While the slopes can be perceived as barriers to movement and transition within the city, they reinforce the city's strong neighborhoods by creating distinct edges. In Pittsburgh, where neighborhoods tend to be densely built, natural wooded slopes provide an especially distinctive neighborhood edge. To insure that Pittsburgh's neighborhoods continue to offer a uniquely attractive way of life, the slopes which form the boundaries of the neighborhoods should be reinforced, as well.

Views and Vistas: Views are significant in urban environment not only for their aesthetic value, but also for orientation and identity. The scenic quality of landscape views is highly correlated with the "unspoiled" character of natural environments. The verticality of hillside slopes heightens their aesthetic impact because they occupy so much of the visual field. Solidly wooded slopes create Pittsburgh's "green walls", which terminate view corridors throughout the city as well as form backdrops for panoramic vistas. Natural slopes not only give visual relief but allow for more compact higher-density development. Higher urban densities, which are related directly to the efficient use of public resources as well as contributing to urban character, are considered more livable when access to natural open space is provided. The density of Pittsburgh's neighborhoods is not oppressive because they are surrounded by open space.

Slopes that are highly visible, due to exposure or to a relationship to a high-volume transportation corridor, are most critical to protect from development. Critical areas for protection include not only the face of the slope but also the crest and, to a lesser extent, the land at the foot of the slope.

Pittsburgh's Hillside Development Patterns

Whereas the geomorphic qualities of the hillsides formed city-wide development patterns, the intermediate scale of the hillsides presents a more complex relationship of topography, development and open space. There are distinct hillside development patterns caused by the steepness of the slopes that occur nowhere else in Pittsburgh. These patterns provide the fundamental basis for recommending future hillside development that will maintain the character of the city.

Four hillside development types (prototypes) were observed to have identifiable and distinctive development patterns:

- No Development
- Developed Edges
- Ribbon Development
- Grid Development

A fifth prototype, Scattered Development, where individual buildings are randomly located on hillsides, was also identified. However, it is either a remnant of disinvestment or an anomaly. This report's recommendations do not encourage scattered development.

Prototype A "No Development" encompasses those slopes and hilltops that remain wooded and not developed. They appear as landscaped open space often forming edges to the river valleys and provide a landscaped backdrop to the built environment. These hillsides are generally comprised of large parcels with few owners, most of it in public ownership. Due to their steepness, pedestrian paths and steps may be present. These undeveloped slopes are in the parts of the city settled after 1900. Examples: Hays, Lower Washington Boulevard, Highland Park near the VA Hospital, and areas west of the Parkway West beyond the Fort Pitt Tunnel.

Prototype B "Developed Edges" occurs when both the top and bottom edges of the slopes are developed and the slopes remain as open space between. The remaining undeveloped and landscaped slopes may be narrow, but discernable, as development extends down from the top and up from the bottom where the slopes transition to a steeper profile, however most slopes of this type have large, undeveloped and wooded open spaces. Examples: The northern face of Mt. Washington, the hillside along Bigelow Boulevard, the Duquesne/Mercy/SoHo slope, Troy Hill, and Fineview.

Prototype C "Ribbon Development" occurs when a center section of a slope is significantly developed as a building corridor dividing the vertical hillside into two or, possibly, three bands alternating between structures and landscape. There may or may not be edge development at the top or bottom of the slope. Green hillsides are interrupted by strong linear development along a street or streets that follow the slope contours. Development is concentrated along the road crossing the slope. Examples: Arlington Road on the South Side, 18th Street on the South Side, Sycamore Street in the Mt. Washington saddle, the edges of Polish Hill, and Spring Hill.

Prototype D "Grid Development": These slopes are basically developed from top to bottom. Limited interruptions, such as minor cliffs or small portions of 25% and greater slopes, are located within the prototype. Buildings tend to have limited or no setbacks and tend to be immediately next to sidewalks or streets. The building pattern is not always visible in the summer because the buildings are beneath the tree canopy height. Examples: The South Side Slopes at Mission Street, Upper Lawrenceville, Polish Hill, Herron Hill, Bloomfield, Lawrenceville, and Upper Oakland above Fifth Avenue.

Anomalies: Anomalies occur when development breaks the characteristic pattern. Usually in the form of single structures, they are undesired because they are significantly different from their context. They are intrusions and uncharacteristic of their context. Tall buildings on hillsides are anomalies. Most hillside buildings are no more than three or four stories in height and do not extend higher than the tree tops. They exist "within" the tree canopy. Wide buildings are a second type of anomaly. Wide buildings are a consequence of large-scaled, generally dense, development that tries to maintain a low building height. Typical examples are attached townhouses on hillsides or an occasional institutional building. Color and materials can also become anomalies when they significantly contrast with their natural setting or their neighbors. Anomalies are of more concern when they are highly visible by large numbers of people. Hillsides that form the walls defining the river valleys and the hillsides of heavily traveled valleys, where they are easily visible from major arterials are in prominent locations where controls are more necessary.

Redirecting Development

Pittsburgh's greatest challenge is to restore its economic viability. Having lost more than half of its population over the last sixty years and the major sources of economic production, the city struggles to maintain a tax base and an acceptable level of public services. The city may have "bottomed out" in the last ten years, but it has yet to escape the downward spiral. Its most recent strategy has been to sell off its public assets. This would likely mean, among other things, encouraging increased private development of open space, especially publicly-controlled property. Ultimately, as in business, this would be a self-defeating strategy.

A more promising strategy is to recognize the assets that make Pittsburgh unique and attractive, and enhance those features for the purpose of increasing population and private enterprise. This is a strategy that has been pursued successfully by a number of increasingly affluent cities, including Denver, CO, San Clemente, CA, and Burlington, VT. In the competitive environment of American cities today, Pittsburgh must make itself a city of choice.

Disinvestment has left significant vacant land within existing neighborhoods and other developed districts. Derelict vacant sites generally detract from the livability and economic value of the surrounding area. They must be maintained in order not to create a nuisance or a health hazard. They represent a lost opportunity in terms of neighborhood open space or public revenue, if developed, from property taxes.

The sites that are serviced with existing infrastructure are more economical in terms of public expenditures. New public infrastructure, such as streets, curbs, sidewalks, lighting, and sewers, do not have to be extended. Replacement or upgrading infrastructure is far more economical and may be the responsibility of the property developer. If improvements are made by the City for infill sites, they are more likely to benefit other property owners in the vicinity.

A policy of encouraging infill development over new "greenfield" development also saves the ongoing costs of extending the public infrastructure. The City is already unable to maintain its existing infrastructure, and any new revenue from property taxes should be applied to existing maintenance rather than to creating additional infrastructure that will require additional maintenance.

Pittsburgh will attract a new more affluent and educated population by strengthening its sense of place, its distinctive identity. Reinforcing the physical structure of the city, especially the "mosaic" quality of its neighborhood-based form, can be more economically advantageous than collecting taxes on a few new hillside buildings. Protecting and maintaining "unspoiled" green hillsides is as important as bringing new development to older deteriorated districts of the city.

A number of initiatives would come from a clear public policy that identifies the strategic importance of the hillsides and regulates their development to make them a more effective tool for economic development. Such actions would include, for example, removing paper streets and property subdivisions from hillsides that should not be developed. High visibility slopes should be protected from development. Other initiatives are presented for consideration in Section 9 of the Physical Report.

Recommended Guidelines for Hillside Development

This study recommends that hillside development regulations be adopted and mapped. The recommendations here are intended as guidance for the design of those regulations, to be developed later. They are not intended to serve as "design guidelines." Design guidelines, although helpful in defining good quality development on hillsides, are not enforceable or necessarily equitably applied. Pittsburgh's hillsides are too significant an asset not to be rigorously controlled.

<u>General Goals</u>
Maintain the essential natural characteristics of Pittsburgh such as major land forms, vegetation and wildlife communities, hydrologic features, scenic qualities and open space that contribute to a sense of place.

Reinforce the image of Pittsburgh as a city which is shaped largely by and integrated with its natural surroundings, particularly in areas where natural features help to define the urban edge.

Retain the integrity of predominant views of hillsides, both of and within, to maintain the identity, image and environmental quality of Pittsburgh.

Ensure that hillside development is designed to be sensitive to the existing terrain and other significant natural land forms or features.

Encourage compact and appropriately-scaled development, screened by trees where possible, in hillside areas where development is allowed to occur.

<u>Policies</u>
Significant natural systems and resources associated with hillside environ-

ments, including ridgelines, vegetation and wildlife habitat, special geological features, natural drainage watercourses, steep slopes, and important historic or cultural features shall be maintained.

The visual character of hillsides shall be maintained, recognizing the importance of the exposure of hillside development to public views and the importance of providing panoramic views from the hillsides.

The right to live in Pittsburgh's hillside areas goes concurrently with the responsibility to build in an environmentally sensitive manner.

<u>Hillside Development Patterns</u>
Maintain and create ecological landscape corridors into and around the built form, including "bridging over" development when necessary, to maintain Pittsburgh's landscape and reinforce the city's characteristic balance between the landscape and built environment.

Encourage the completion of existing development edges to strengthen the continuity of the built form, rather than build on new or formerly-developed parcels elsewhere on a slope. Streets that parallel the crest or foot of a slope make stronger edges than other streets, as well as provide public access to views and the natural environment. Buildings that face onto these parallel streets make strong edges.

Encourage infill development on existing and vacant parcels where possible to reinforce the built fabric and strengthen the differentiation from the natural open space. Seek to intensify existing neighborhoods and in the process minimize infrastructure construction and public maintenance.

<u>Visibility of Slopes</u>
Two degrees of hillside development visibility are recommended, Highly Visible and Less Visible. Hillsides should be mapped according to their visibility.
Preservation of Natural and Unique Features
Rather than a policy that encourages development to override the environment, development should respect and reinforce the natural features of Pittsburgh and preserve its unique qualities. Among these are:

- Its geological features: dramatic bluffs, river and stream valleys, flat terraces, and escarpments.
- The native trees and plants of Western Pennsylvania.
- The native habitat.

<u>Slope Crests</u>
Maintain the natural crest edges wherever possible. Prohibit clear cutting of trees at crest edges.

Where development occurs on crest edges, restrict building heights so that buildings appear to be "within" the tree line or tree canopy. Where development has already occurred, new development should match the existing in terms of scale and profile so long as the existing development conforms to the patterns and other development recommendations suggested.

If new streets are created at tops of slopes, locate them between development and the crest to create a public edge. Position buildings on the upland portion of the lot and away from the crest of a hill to maintain a clear sense of the hillside brow in a natural condition when viewed from major roadways and other off site public viewing places.

<u>Portals</u>

Prohibit development within 600 feet of designated tunnel portals. This seems to be the typical distance of private development from tunnel entrances. Land at the entrances is publicly owned and usually extends 600 to 800 feet horizontally from the actual entrance. A distance greater than 600 feet is desired, if achievable.

Prohibit development within 1,000 feet of a designated valley portal. Because these portals are larger in scale than tunnel entrances, the non-development distance should be larger. 1,000 feet is somewhat arbitrary, although it is the general distance most development now steps back from these valley portals. Further investigation of this distance requirement is recommended.

<u>Buildable Slopes</u>

Limit development on slopes with stable conditions as follows:

- No development restrictions, other than typical zoning regulations, on slopes of 0% to 15%.
- Restrict development on slopes of 15% to 40%.
- No development on slopes of 25% to 40% within High Visibility designated areas. Exceptions would be infill sites where no hazardous conditions exist.
- No development on slopes of 40% and greater.

<u>Characteristic Development Pattern</u>

Assign Development Pattern Types to specific hillside areas:

- No Development Pattern: The entire hillside zone should be preserved as natural landscape, with no buildings on the slope, at the crest, or at the foot of slopes.

- Developed Edges Pattern: Buildings should be located only along the crest or foot of the slope, and conform to applicable regulations.

- Ribbon Development Pattern: Buildings would be permitted at the crest and foot, and on infill sites along a designated street along the face of the slope.

- Grid Development Pattern: Buildings would be permitted on infill sites within an existing grid of streets on the face of a slope, as well as at the crest or foot.

No scattered site development would be permitted on slopes over 15%. Development would not be permitted on any site that would require extension of street or sewer.

<u>Soil and Geotechnical Conditions</u>
No development should be permitted where it would have an adverse effect on the health, safety, or welfare of any person regardless of slope percentage. Generally, these involve environmental hazards such as stability of soils, high water tables, and hydrologic hazards. See the Ecological report for further information on environmental hazards.

<u>Use of Existing Infrastructure</u>
Prohibit development on vacant parcels served only by steps, except for infill locations. Do not extend street and utility infrastructure beyond existing locations. Restrict the location of buildings in relation to infrastructure to maintain existing development patterns.

<u>Stormwater Retention on Site</u>
Prohibit development on any slope greater than 40% and to significantly restrict development on slopes greater than 25%. Paving on slopes greater than 25% is the most detrimental type of development and should be restricted to public rights of way. Any parking on such sites should be provided within the building and included in the building envelope restrictions.

General Hillside Development Guidelines

<u>Existing Pittsburgh Standards</u>
Where the existing regulations and standards are consistent with these recommendations, they should remain in force. It is recommended that changes, in the form of amendments, should be made to the existing texts and maps, rather than by introducing new legislation. The city's various standards should be made consistent with an overall hillsides policy.

<u>Use</u>
On slopes greater than 15% allow only residential uses as-of-right. Other uses, such as institutional, religious and cemeteries, should be by conditional use only and highly regulated to fit the context. Other uses should be prohibited.

Restrict permitted residential uses to one- or two-unit buildings. Townhouses as well as apartment buildings should be prohibited.

Allow public use of hillside open space for passive recreational use, such as hiking, where ecologically appropriate.

Consider permitting certain agricultural uses, such as orchards.

<u>Density</u>
Development on slopes, either as developed edges or ribbons, should match the local neighborhood density rather than conform to an across-the-city standard.

<u>Building Locations</u>
Keep infill and edge development as close to existing development as possible, consistent with local density. Dwellings should be placed far enough apart to reveal views of the hillcrest. Set maximum setback distances from roads on hillside sites.

Existing trees should be preserved so that vegetation provides a backdrop to the structure. Except where new infill buildings are located within a grid or ribbon development, buildings should be seen against retained vegetation rather than the sky.

<u>Streets</u>
The maximum street grade should not exceed 12%, which is consistent with good planning standards (23).

Hillside street design should minimize grading by aligning streets with the topography, running roads along natural ridges or valleys and working with existing grades where possible. Consider reducing or splitting street sections to minimize grading.

Generally reduce the width of street improvements, reduce sidewalk widths and use common driveways to minimize impact.

<u>On-Street Parking</u>
Allow for parking on only one side of hillside streets, if at all. Parallel parking can be eliminated to reduce road width in critical areas and then provided for in off-street bays or community parking lots at more suitable locations.

<u>Street Lighting</u>
Maintain a minimum of street lighting in hillside areas dominated by landscape. Locate street lights only at all intersections and where necessary to reduce traffic hazards. Continue the existing street lighting when extending development patterns. Shield street lights from off-site views, except when

specifically desired for connectivity and way-finding reasons.

Street Trees
Street trees should be installed in random patterns in hillside areas. Any trees that are provided should be native or similar to natives and should be arranged in natural-appearing clusters.

Utilities
Utility housings for transformers, control points and other utility housings should be located as to minimize their visual impact and should be safely screened with fencing and vegetation. No utility housings should be permitted in front yards.

New hillside development of more than one parcel or one building should be required to bury all utility services, such as electrical and telephone lines.

To the extent permitted by federal law, prohibit cell phone towers, commercial antennas and similar structures within 500 feet of high visibility slopes 15% and greater.

Creeks, Streams and Rivers
Build no closer than 100 feet to daylighted watercourses on hillside sites. Allow no stormwater runoff off site, except directly into an adjacent creek or stream.

Site Specific Design

Lot Size
Maintain lot sizes and dimensions based upon the prevailing neighborhood context. Control building placement on hillside properties.

Building Siting
Site the building on the least sensitive portion of the site, as close to the street as possible, to preserve natural landforms, geological features, and the landscape.

Orient parcels and buildings toward views and vistas at right angles to contour lines. Maintain the typical Pittsburgh building face to street relationship the same as on flat land parcels.

Buildings sited to maximize views at the expense of vegetation should be denied. Exposure of the building should be no more than 50%.

Set back at least 50 feet from cliffs, ridges, and hilltops so that the structure does not appear to be perched on the edge.

On uphill sites, buildings should build to front lot lines to reduce hillside grading disturbance. On downhill sites, buildings should minimize the front yard setback to reduce building massing hanging over the slope. Private rear yard space can be provided with a small yard, terrace, or deck.

<u>Open Space</u>
Regulate open space by controlling building footprint and placement on the site. Provide yard space between lot lines for trees and natural vegetation and to space buildings from one another. Open space should remain natural to the greatest extent possible, with the majority tree covered.

<u>Site Grading</u>
On slopes of 15% to 25%, limit site grading to the minimum necessary to provide for building and parking. Regulate the maximum area of allowable site disturbance.

Grading should preserve the natural shape of the land, especially at the horizon so as not to result in artificial terrace effects. Prohibit terracing for a large building or paving. Discourage uniform stair-stepping of building pads, unless it continues an existing building pattern.

Sharp angles at the top and toe of cut and fill slopes should be prohibited. When slopes cannot be rounded, vegetation should be used to alleviate a sharp, angular appearance. A round and smooth transition should be made when the planes of man-made and natural slopes intersect.

Some codes are explicit in their maximum slope and heights of cut and fill, which should be considered. Good practice indicates:

- 2:1 maximum cut slope adjacent to the public right-of-way with the guarantee that landscaping and maintenance of all slopes outside the right-of-way be maintained (18).
- 3:1 maximum unretained slope (11).
- 4 foot maximum height of unretained fill on slopes of less than 20% and 6 feet on slopes 20% and greater. Excess fill or cut to be contained by retaining walls or hauled off site. Maximum height should not exceed 8 feet in any combination (cut and retaining or fill and retaining) (11).

Recommendations for maximum disturbance require further engineering study. On slopes of 25% or more, the property developer should be required to provide an engineering study for all proposed re-grading.

<u>Stormwater Control</u>
Establish minimum stormwater retention, detention, and infiltration requirements following PWSA/DEP standards/guidelines, as applicable. One hillside ordinance requires a minimum of 2 hours based on a 10-year storm and released at a controlled rate equal to the runoff rate generated by the site in its natural condition, with a maximum of 0.2 cubic feet per second per acre (11).

Daylight roof drainage systems on all buildings on slopes greater than 15%, however this is good practice regardless of slope.

Preserve natural entrance and outflow points. Drain swales should be designed to minimize their visibility; they should be angled along a slope rather than creating an abrupt 90-degree intersection with contour lines. Do not allow ponding of water above cut or fill slopes and divert surface water away from cut faces and sloping surfaces of a fill.

Control the amount of impervious material permitted. Use pervious materials for driveways and patios instead of concrete and encourage wooden decks.

Site Improvements

The driveway should not be the predominant feature of a front yard. Generally, driveways should be eliminated by locating parking adjacent to the right-of-way. Shared access to parking should be encouraged.

Free-standing walls integral to a structure should be of the same material and design as the structure. Their maximum height should not exceed 6 feet, however a 4 foot height is recommended.

Retaining walls should be designed with smooth, continuous lines that conform to the topography. Maximum wall height at the base of slopes along roadways should not exceed 5 feet in order to avoid a contained, channel-like effect. Retaining wall structures holding back grade to accommodate a patio or terrace should conform to the natural hillside profile as much as possible. Retaining walls over 10 feet high should be prohibited, however a maximum of 5 feet or 6 feet above final grade is recommended. Multiple parallel walls should be designed to be part of a tiered or terraced retaining wall system and conform to the above height recommendations.

Site Vegetation and Landscape Design

Skyline planting should be used along developed crests and slope edges, including locations between buildings, to create a continuous treetop silhouette and provide either a backdrop or a setting for structures. In general, crest line trees should be taller than the structures so that the buildings are within the tree canopy.

Planting on the slope side of development should be designed to allow for controlled views out, yet screen and soften the architecture. In general, 50% screening of a building's view façade(s) is recommended. In grid development zones where edge planting at lower levels of a slope may block the view from parcels above, height restrictions on plant materials should be applied.

Restrict the removal of trees to avoid clear-cutting. Require replacement of all removed trees that are 6 inches in caliper to restore the site to its previous tree density before grading. 3 inch caliper trees should be the minimum size for new trees. Consider requiring that twice (2x) the total caliper of removed trees be required to restore the site, with any excess trees planted on publicly-owned land. Or consider requiring one tree per 150 square feet of natural area as required in Santa Clarita (18) and similarly required in other cities.

Allow only native tree planting on slopes 15% and greater. It is important to maintain visual continuity of these species and sustain fall colors.

Site Lighting

Shield all site lighting so that the light source (lamp) is not visible from 30% below the fixture. Outside lighting should be muted and directed so that it does not spill over and onto neighboring (including downhill) properties. Follow IES standards documented in LEED guidelines.

On-Site Parking

Parking should be provided within the envelope of hillside structures and, when not possible, by means of closely regulated open parking bays. On sites with grades no more than 25%, allow a maximum of one exterior space per residential lot, no more than 20 feet deep of paving and located immediately adjacent to the street.

Building Specific Design

Building Massing and Footprint

Compact development should be maintained through small footprints and minimum setbacks, thereby minimizing grading and making development less obtrusive. Single buildings are preferred. Attached townhouses should be limited to duplex units on hillsides.

On slopes greater than 15%, require new development to match the existing neighborhood massing and footprint pattern.

Setbacks

Place the building as close to the street as possible to preserve the natural terrain. Consider imposing 0 foot front yard setbacks or mandating continuation of adjacent existing setbacks on hillside sites where appropriate. Maintain minimum side and rear yard setbacks as presently regulated.

Building Height

Restrict heights of buildings within 100 feet of slope crests to the height of the natural tree canopy or a maximum height of 35 feet or 2-1/2 stories facing a street and 45 feet or 3-1/2 stories at the rear when facing a downhill slope, whichever is lower, measured from the lowest elevation grade to the top of the roof ridgeline. Half to fully-exposed basements on the downside of the slope would constitute a full story.

Restrict the heights of buildings at slope toes to a maximum height of 40 feet or 3 stories, whichever is less. Do not locate high-rise buildings on slopes or within 100 feet of the foot of a hill.

Building Profile

Proper scale is visually important and particularly so in high visibility slope areas. Limit the area of a single plane of façade to no more than 1,000 square feet so that the scale of the building is maintained generally consistent with the scale of a typical Pittsburgh residence.

On slopes greater than 15%, buildings should be required to have peaked or sloped roofs of at least a 4:12 profile. Flat roofs should be prohibited unless developed as "green" roofs.

Orient buildings perpendicular to the street so that the view façade is the narrower façade of the structure.

Color, Building Materials and Architectural Features

Colors of buildings should be selected to blend with the natural colors and hues of the surrounding hillsides. All exterior materials and colors, including roofs, walls and fences, should be predominantly muted earth and plant tones and should minimize contrast and glare. Roof colors should be of darker tones: browns, blacks, and dark grays. White and other bright colors should be avoided.

The maximum light reflectance of colors or materials used for building walls, trim, decks and architectural features should not exceed 60%. The light reflectance of exposed foundations, stone, brick, concrete and concrete block walls, including retaining walls, should not exceed 35%. Roofs should also have a 35% maximum reflectance.

Reflective coatings, such as chrome or reflective glass, are not appropriate on hillsides. Rough-textured, fire-retardant roof materials are recommended.

Large windows should be subdivided into panes. Large expanses of glass on south-facing slopes should be avoided as all glass is reflective depending on the sun angle.

Architectural compositions should be vertical in nature. Horizontal façade patterns, particularly those with protruding horizontal bands, contrast with the typical Pittsburgh building type and should be discouraged.

As a general rule, avoid using wide decks and other architectural features elevated on posts. Decks should be small-scaled and it is suggested they protrude no more than eight feet nor be wider than fifteen feet. Multiple decks are preferred rather than a single deck. Limit the extent of exposed undersides of buildings to 8 feet in depth and height of posts, when used, to 10 feet.

Foundations

When building on slopes, a fully enclosed structure should meet the ground. Stilt-supported buildings should be prohibited.

The foundations of all buildings on 15% and greater slopes should be designed and certified by a professional engineer. The foundation's design should follow the natural contours of the hillside with minimal exposure. Avoid high foundation walls, but when necessary extend the building's siding material or veneer finish to within three feet of grade level.

Rooftop Utilities

Avoid rooftop utilities over one foot in dimension unless these appurtenances would be completely screened from view by solid architectural elements compatible with the building's profile and character. Rooftop utilities should not exceed the building height limitations.

Three Test Sites

Three study sites were investigated in more detail to test development ideas and the recommendations. Several factors were considered in their selection:

- Examples of prototypical Pittsburgh slope conditions and patterns of development.
- The type of geography: edge, hill, or corridor slopes.
- Their potential for development pressure, either now or in the near future.
- Their location in Pittsburgh to achieve a good representation of typical hillside conditions.

The intention of this exercise was to look at hillside characteristics, test the application of the development prototypes, and understand where development and open space needed to be more carefully structured. The specific recommendations were tested to confirm the recommendations, not to apply them to specific parcels.

The sites selected by the built form team and the Steering Committee were:

Duquesne Heights: The south-facing slopes to the north of Sawmill Run Road (Route 51) from the West End to eastward of the Fort Pitt Tunnel entrance by Chatham Village. This site represents highly visible corridor slopes with heavily wooded hillsides. Much of the area is within existing Greenway or Parks and Open Space zoning designations.

Middle Hill District: The south- and west-facing slopes north of the Boulevard of the Allies from the western edge of SoHo, upper Fifth Avenue, to West Oakland and northward encompassing Aliquippa Terrace. This is a smaller area of wooded hilltop slope that contained historic development which experienced major disinvestment. This area has proximity to an area of Pittsburgh with little designated open space and has the potential for development pressure from nearby large institutions in Oakland and from the Pittsburgh Housing Authority.

South Side Slopes: The north-facing slopes of the South Side extending from the eastern-most edge of Grandview Avenue on Mt. Washington eastward to encompass most of the South Hills slopes that front onto the Monongahela River. This is an edge slope condition with the strongest development pressure in Pittsburgh. The area has a range of development types from steep undeveloped slopes to dense residential urban fabric. The area includes the Mt. Washington saddle.

Each site was examined for the following:
- Steep slope locations, with 15% to 25% and 25% and greater slopes identified. The intent was to understand the continuity of these slope classifications and their relationship to one another.
- Street locations, including paper streets and "stair" streets. Parcels not serviced by streets shows where development could occur.
- Hydrology, including surface water and sewer locations, to understand storm water conditions of the urban fabric.
- Ownership patterns, including public and private ownership and designated open space. Ownership shows where development pressures exist as well as the potential for open space protection.
- Mapped infrastructure, showing sewer lines, streets, and parcels and the areas most likely not serviced by them. Sewer line locations, along with streets, determine the infrastructure's ability to service development.
- Undermined locations. These locations provide a good picture of where historic mining activity occurred and the potential for future instability. Not mapped was the depth of the mines, which is a more significant factor in determining instability.
- Neighborhood identity, showing perceived boundaries, the major hillside paths that service them, and "hard" and "soft" development edges where the neighborhoods front onto hillside open space. These factors helped to understand how hillside neighborhood edges are formed and which edges are more effectively defined.
- Zoning designations currently applied to the study site. This information provided good information on those areas designated as parks and open space and the areas designated hillsides.

Two types of development actions are recommended:
1. Develop vacant infill sites to strengthen the prototype pattern.
2. Discourage development where sites should be incorporated into open space.

In certain locations selected open space should be improved for public use.

Duquesne Heights:
- Apply Developed Edges prototype aggressively.
- Maintain continuity of open space.
- Maintain and enlarge the open space surrounding the tunnel portal.
- Infill neighborhood edges to strengthen ragged crest with typical neighborhood residential buildings.
- Limit development at the foot of the slopes.
- De-map paper streets and parcels and convert to open space.
- Apply strict site and building development controls to maintain neighborhood pattern.

Middle Hill District:
- Increase the open space at the base of the eastern slope by claiming disinvested property utilizing the Developed Edges prototype.
- Utilize the Grid Development prototype to extend and integrate the neighborhood fabric with the public housing. This is an instance where built form is more advantageous than additional open space.
- Increase the amount of open space to strengthen the setting for the upper terrace public housing and to eliminate scattered development on the highly visible portion of the slope.
- Increase tree planting at the tops of the slopes to break down the scale and ribbon impact of the public housing and soften the visual ridge tops.
- New construction on the public housing sites should conform to the standards for crest development.

South Side Slopes:
- Apply the three prototypes, Developed Edges to the west, Ribbon Development to the center, and Grid Development to the east as shown.
- Develop infill sites for each prototype area.
- Discourage scattered site development on hillside above Ribbon Development.
- Maintain the continuity of the natural hillsides by not extending pattern development further onto the hillsides and discouraging scattered or any other development of hillside land.
- Do not allow attached townhouse development, other than duplex units, on any site.
- Impose strict building heights along the crest line so that the tree line dominates the ridge silhouette.
- Maintain small lot and small building footprints so that buildings will remain in scale with one another and in scale with the hillsides.
- Enforce the use of proper building colors and materials so as not to create visual anomalies.
- Plant only native species to maintain visual continuity and fall colors.

All of these sites exhibited evidence of multiple prototypes. They proved to be very helpful in understanding the underlying development pattern and suggestive of development strategies. They were also useful in making the case for protecting and, in some instances, increasing the open space.

The prototypes were most useful in guiding future development recommendations, which are more of a planning guidance nature than site-specific controls. What became apparent in each test site was the idea of completing the patterns, whether it be by filling in neighborhood edges to make them stronger and more recognizable, encouraging the infill of ribbon development so that these swaths of buildings do not appear as scatter-site development, or just filling in the vacant parcels within the existing street grid with the Grid Development prototype.

They were also useful in making decisions about open space. In the Middle Hill District site, the problem is the narrowness of the open space and natural hillside landscape. By applying the Edge Development prototype over disinvestment properties it became apparent that converting this formerly developed area into future open space provided the land area and vertical height to make a significant open space and setting for the public housing at the top. It places the housing into a better scaled relationship with the hillsides and provides much needed open space for the neighborhood residents. On the South Side Slopes site knowing where to encourage open space helps in deciding where development should stop.

What becomes important with the prototypes is the ability to maintain the continuity of the landscape and the continuity of development where either is appropriate and desired.

Other Potential Controls

<u>Development Environmental Impact Analysis</u>
All development on slopes 15% and greater should be required to prepare a Development Environmental Impact Analysis.

Suggested reports that comprise the Development Environmental Impact Analysis, covering impacts on the immediate site and the surrounding area, might include:

- Geologic and soils characteristics report.
- Grading or erosion control report that would also describe all site retaining and other proposed site improvements, including methods of preventing on-slope slippage and erosion.
- Vegetation and preservation report including tree caliper measurements, a proposed tree replacement plan, and a tree-screening plan of the proposed building.
- Hydrology and storm drainage report describing provisions for storm drainage and sewage disposal, how the drainage plan will meet PWSA daylighting requirements, and the downstream effects of development.

- Safety protection report describing site access by emergency vehicles as well as site improvements intended to lessen the impact of fire.

<u>Development Site and Building Plan</u>
All development on slopes 15% and greater should be required to prepare a Development Site and Building Plan that describes the development aspects of the proposed project. The Plan should include a detailed description of the proposed site and building plans, plus a visual analysis that describes how the building will be seen from off-site and in relationship to its hillside and landscape context.

<u>Maintenance of Hillside Property</u>
The Ada County, Idaho, hillsides ordinance has a very interesting maintenance clause that should be considered for Pittsburgh:

> "The owner of any private property on which grading or other work has been performed pursuant to a grading plan approved subject to the regulations of the Hillside Overlay Standards shall maintain in perpetuity and repair all graded surfaces and erosion-prevention devices, retaining walls, drainage structures, …, and plantings and ground cover installed or completed. Such require ments shall be incorporated into the protective covenants for a subdivision and the conditions of approval for development appli cations."

The clause could be strengthened by having it also apply to building and other construction not covered by a grading permit.

Require a bond to guarantee the completion of revegetation plans, the stabilization of grading sites, cuts and fill, and construction/maintenance of storm water runoff facilities for several years after the completion date.

Require the owner to provide a maintenance covenant or notice in any deed conveying the property to another, particularly where the development is not part of a subdivision or planned community and has no protective covenants in its basic legal documents.

<u>Design Review</u>
All development on slopes 15% and greater should be required to submit site and building plans for design review by the Zoning Administrator. All development which seeks to extend a development pattern on slopes 15% and greater should also be reviewed by the City Planning Department for compliance with the hillside's physical and development characteristics to assure that this new development maintains the desired development pattern. This two-step design review makes a distinction between infill and development extension sites. Infill sites would only require review by the Zoning Administrator. Development extension sites, because of their greater impact on the hillside development pattern, would receive more scrutiny.

Any hillside development design review should look beyond the typical use and massing review to also look at the aesthetic qualities of the landscape and building design. Tree placement and screening, the visual impact of site improvements, the visual impact of the building's design and profile, materials, colors, utilities, and other significant features of the building and site should be reviewed. The basic criteria should be compatibility with the development's hillside landscape context, both from on-site and off-site perspectives.

Appropriate visual material should be provided for the design review. In addition to the usual site and building plans and elevations, computer simulation, sight-line analysis, and models should be considered.

<u>Taxation of Hillside Parcels by "True Cost" Method</u>

At the present time differential taxation would require an amendment to the Pennsylvania Constitution as all real estate taxation must be uniform. Consider the following as ideas that might begin a community dialogue on this subject.

Consider adjusting real estate taxation to account for higher on-going infrastructure and public safety costs that would reflect the "true" or "full" costs of hillside development. Higher taxation rates might apply to buildings on slopes of 15% and greater, with the rate increasing as the slope percentage increases.

Consider incentives to redirect Pittsburgh development to infill sites and non-hillside sites. Provide tax incentives to live on neighborhood infill sites.

- Lower or eliminate property taxes on undeveloped/unimproved hillside parcels on slopes of 15% and greater.
- Create tax incentives for development on vacant infill sites within all neighborhoods.
- Do not incent development on vacant infill sites located at the edges of neighborhoods bordering on hillside open space.
- Create impact fees or other disincentives for development on new sites on slopes of 15% and greater that extend an existing neighborhood development pattern, with the penalties increasing as the slope percentage increases.
- Create an impact fee for developing on sensitive hillside and other sensitive sites where it would be in the public's interest to encourage preservation.

Consider other taxes and fees based on user impact.

- Storm water user fees based on the amount of impervious surface proposed on hillside sites.
- Automobile parking usage fee based on the narrowness of hillside streets and the inability to provide on-site parking.
- Adjust building and other permit costs to reflect the full cost of providing infrastructure for site improvements.

- Charge impact fees or other disincentives for developing adjacent to public hillside open space.
- Require that utilities charge true or full costs of utility infrastructure for any extensions on hillside properties of 15% slope and greater.

<u>Taxation of Hillside Parcels by Hillside and Open Space Market Value</u>
Recognize the value of slope edge properties in the tax assessment rates.
- Increase the assessed values of slope ridge/edge parcels to more accurately reflect their true market value.
- Gradient assessed values from open space edges to infill locations, with the higher rates at the edges of open spaces

This is another form of differential taxation and is presently unconstitutional. An alternative strategy might be to offer tax abatement on non-hillside development as an incentive, but not on hillside development

<u>Other Funding for Hillside Preservation</u>
The district option appears to be similar to that of an authority in Pennsylvania. Establishing a hillsides authority might be an option if city residents and the state could be convinced that it was in their interest to protect hillsides as open space.

<u>Density Transfer Options</u>
Some form of density transfer option should be given serious consideration. If development rights, or higher densities, be transferred from sensitive hillside areas, such as those proposed within the Highly Visible slope areas, to infill sites elsewhere in Pittsburgh where increased densities could be absorbed, hillside open space could be preserved or, at least, hillside densities lowered. Another possibility would be to sell hillside property density development rights to fully-serviced, tax-delinquent and repossessed infill properties in existing neighborhoods. This transfer of development rights would not only support the infill strategy discussed in this report but would also generate income for the city. Transfers would need to be an option, not a requirement, for them to be legally acceptable.

EXECUTIVE SUMMARY – LEGAL REPORT

LAND-USE CONTROLS FOR HILLSIDE PRESERVATION IN THE CITY OF PITTSBURGH

Cyril A. Fox
Prepared for Perkins Eastman Architects

Although it is a Pennsylvania Home Rule Municipality, the City of Pittsburgh (the City) obtains its authority to adopt land use regulations, including zoning regulations, from legislation adopted in 1927, not the Pennsylvania Municipalities Planning Code. Land use control ordinances, such as zoning and subdivision ordinances, are an exercise of the police power entrusted to the City under the enabling legislation and the City's Home Rule Charter. These ordinances are presumed valid and any challenger must carry a heavy burden to establish that they are not.

To be valid when applied to a particular parcel of land, a zoning regulation must (1) be substantially related to the protection of a legitimate public purpose, (2) not be arbitrary, capricious, nor an abuse of the City's legislative authority, and (3) not deprive an owner all reasonable economic use of its land.

A land use regulation is valid when it promotes legitimate police power purposes • protection of the public health, safety, morals, or general welfare. Its provisions must be substantially related to the purpose it seeks to serve. Pennsylvania courts have attempted to maintain a sensitive balance between the need of the public to adopt regulations for public benefit and the right of private property owners to make reasonable use of their property. They grant a presumption of validity to police power regulations, including zoning regulations. This presumption is not easily overcome. However, the municipality must act in a manner which does not sacrifice the constitutionally protected rights of its citizens. Whether a regulation serves a legitimate police power interest involves a balancing of the interest to be served and the rights of the landowner to make reasonable use of its property.

The City's enabling legislation sets forth several public police power purposes to be served by zoning regulations that readily encompass regulations to protect and preserve hillsides or steeply sloped land within the City and hillsides views from locations within the City. The same section of the enabling legislation specifically requires that zoning regulations "be made with reasonable consideration, among other things, to the topography and character of the district, with its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout such city." This language invites regulations that respect and preserve the City's distinct hillside development patterns where that "character" is appropriately defined or described in the regulations. Pittsburgh' unique development patterns, the prototypes described elsewhere in the larger REPORT, provide a sound basis for these regulations.

A regulation may be found to be arbitrary where it results in different treatment of similarly situated properties without providing a reasonable basis for that difference. The nature of a significant hillside slope suggests the reasons for treating the sloping land differently from flat land.

Successful "regulatory takings" challenges to police power regulations are relatively rare. Successful challenges allow the court to weigh the impact of the regulation on a specific parcel of land. Sometimes, this impact will be so severe as to deny the owner any reasonable economic use of its land, overcoming the presumption of validity and swinging the balance in favor of the property owner. The Pennsylvania "regulatory taking" analysis parallels that of the United States Supreme Court, so that the Pennsylvania and federal tests are essentially the same.

A zoning regulation that is intended to preserve the character of the City by protecting its steep hillsides from the dangers of over-development or to preserve the City's character should be found to serve a legitimate police power purpose, particularly when reference is had to the purposes of zoning as set forth in the City's enabling legislation. As long as the owner of the zoned parcel is allowed some reasonable use of its property, the regulation should also satisfy the "regulatory takings" test.

There are few Pennsylvania appellate court decisions evaluating hillside protection regulations. One case upheld a zoning ordinance preserving steep slopes, forests and woodlands, and streams in a particular development district. The other upheld an ordinance prohibiting timbering on landslide prone land anywhere within the municipality. Both ordinances survived reasonableness and "regulatory takings" challenges.

Hillside or slope protection zoning is a relatively new zoning objective. Hillside protection zoning ordinances have been upheld in five states on substantive due process grounds. One state found the regulations unconstitutional because transfer development rights were used to compensate landowners in preservation districts for their loss of all development value. The state's constitution required that compensation be in the form of money; the granting of development rights did not satisfy this requirement. A lesson from this case is that one must not get too greedy in the efforts to restrict private property for public benefit. The property owner must be left with some reasonable economic use of its land if the regulation is to survive a "regulatory takings" challenge, unless what the property owner proposed to do with its land would amount to a nuisance. No one has a constitutional right to use their land to create a nuisance, as by increasing the danger of landslide or surface water flow to neighboring public or private properties.

The existence of administrative relief from the strictures of the regulation by way of a variance can greatly reduce the risk of a successful "regulatory takings" challenge. The variance granting agency can conduct the intensely factual inquiry required in "regulatory takings" cases and tailor relief that both protects the essential objectives of the regulation and the landowner's right to make reasonable use of its property.

It is exceedingly tempting to bottom many hillside preservation measures solely on aesthetic values. However, the Pennsylvania courts have not looked with favor on regulations designed primarily to serve aesthetic values. In Pennsylvania, a 'municipality may include aesthetic factors in the exercise of its zoning powers, but aesthetics alone cannot justify zoning decisions.'" Thus, where aesthetic considerations support other legitimate police power objectives • "provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks and other public requirements, they should be upheld.

Pennsylvania's courts have long held that land-use activities by some other governmental agencies are or are not subject to land-use control authority of a municipality, while others are not. Where the legislature has expressly stated that a state agency is subject to local zoning control, that intent will be given effect. The question is one of legislative intent. The City's zoning enabling act provides evidence of legislative intent that the City's requirements pre-empt less restrictive provisions of conflicting state statutes. Where the conflicting statutes are silent on this question, the court will employ traditional principles of statutory interpretation to find that intent.

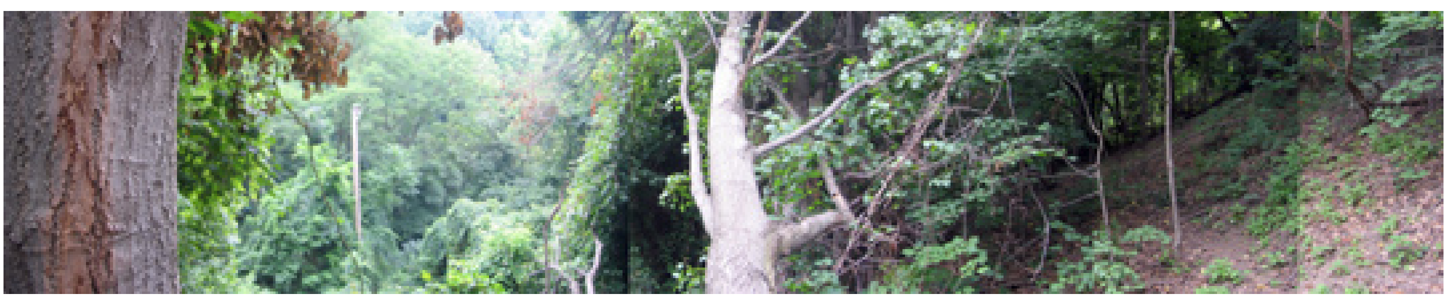
The City of Pittsburgh's land-use control enabling legislation makes reference to a "major street plans," "official street map," and "street plats." The "major street plan" is an element of the City's master plan. No building may be erected on a lot unless "the street giving access to the [lot] … shall have received the legal status of … a public street …" or is shown on the "official street map" or "or unless such tract, lot or parcel has been created or transferred in compliance with this act [subdivision regulations]." Where a dedicated street has not been actually opened and used within 21 years of the offer of dedication, the City's power to accept that street ends. The vacation of existing paper streets in development sensitive areas would serve to reduce pressure for undesirable development as would a determination of those offers of dedication shown on the City's official street map that have now expired.

An Ecological and Physical Investigation of Pittsburgh's Hillsides

ECOLOGICAL REPORT

Prepared in cooperation with Allgheny Land Trust for the City of Pittburgh Hillsides Committee

August 31, 2004



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August 31, 2004

"No city of equal size in America or perhaps the world, is compelled to adapt its growth to such difficult complications of high ridges, deep valleys and precipitous slopes as Pittsburgh."

Frederick Law Olmstead Jr.,

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Summary

Project Description

Provide research, analysis and tools that will inform a hillsides zoning ordinance for the city of Pittsburgh. The specific focus of this section of the report is the ecological systems of said hillsides, expressed below in terms of geology, soils, botany and forest cover.

Purpose

To provide analysis of both quantitative and empirical data that can inform rational decision making on steep slope properties at the level of zoning policy, regulation and enforcement, as well as land use guidance, guidelines and recommendations which may follow zoning use approval.

Methodology

The bulk of this work is based upon quantitative analysis of pre-existing computer mapping data, described in terms of GIS or Geographic Information Systems. The primary sources of this data are the city of Pittsburgh, and Allegheny County. The GIS analysis is used to inform the following narratives on ecological context and cultural need, as well as sections on decision making and recommendations. Specific City of Pittsburgh data sets focused upon existing hillside infrastructure (roads, sewers, buildings) and the United States Department of Agriculture data on soil stability (for roads, buildings and erosion) are used for the land-use decision recommendations. Soil and infrastructure data is then integrated in an interactive database where city parcels can be queried for their relationship to the mapped information. Two additional metrics have been added, first the parcels relationship to underground coal, and secondly the parcels relationship to existing forest cover.

Participants

The Hillsides study team is managed by the Allegheny Land Trust, (ALT). Perkins Eastman Architects (PE) takes the lead on cultural forms and systems, precedents, recommendations for regulation and enforcement, as well as the final report. 3 Rivers 2nd Nature, in the STUDIO for Creative Inquiry, at Carnegie Mellon University (3R2N) takes the lead on natural forms and systems, prototypical site selection, botany and geology field work as well as GIS analysis.

The Hillsides study team is directed by Tim Collins. Priya Lakshmi, MS was the 3R2N research associate working on the GIS mapping. Lena Andrews, policy analyst for Carneige Mellon University's Center for Economic Development, did the work on Access Database. Consultants to the 3R2N team include Susan Kalisz, Ph.D., University of Pittsburgh, Henry Prellwitz, Ph.D, Allegheny Geoquest, and Kostoula Vallianos, MEM, Vallianos Consulting. The final design and review team included project co-director Reiko Goto, research associate and planning coordinator Jonathan Kline. Final design of th maps and report by research asssociate John Oduroe. with graphic support from research associate Noel Hefele.

I. Project Purpose and Goals

Our purpose here, is to provide analysis of both quantitative and empirical data that can inform rational decision making on steep slope properties at the level of zoning policy, regulation and enforcement. The focus in this section is upon 25% slopes or steeper, this is an angle at which many soils become unfit for urban development. Specific goals include contextual analysis at the watershed scale, open space needs analysis at the neighborhood scale and decisions analysis at the parcel scale. Beyond this a plant material and geology baseline has been established through site specific field work on three steep slope properties which can inform land use guidelines and recommendations.

These materials have been developed with the express intention of reflecting the analysis and outcomes of Cyril Fox' study of the authority and jurisprudence of land-use controls. Following the Fox report, we were seeking an analytical methodology that would "identify potential danger from landslide and other development problems" as well as examine the cities current stock of "adequate public services and infrastructure" at each of these parcels. Finally we were seeking to minimize any "perception of arbitrary decision making" – through the rigorous application of accepted material data sets supported by the City of Pittsburgh, Allegheny County and the United State Agricultural Service.

Bio Regional Values

Pittsburgh is located in an ecologically diverse and environmentally important area of the United States. It is part of the Class I Appalachian Mixed Mesophytic Forest Ecoregion, which has been identified as globally outstanding and requiring immediate protection and restoration. This region harbors the most diverse temperate forests in North America. (Ricketts et al. 1999). Southwestern Pennsylvania is also considered a "hot spot" or area of immediate conservation concern for a number of neotropical migratory bird species (Rosenberg and Wells 2004).

Local Field Values

Surprisingly, of our small but diverse list of Pittsburgh hillsides sites sampled - the majority of trees identified were native species. The hillsides of Pittsburgh appear to function as refugia for the native species of the region. At one of the three sites studied we found a tulip tree over three meters in circumference— while the average tulip tree circumference was over one meter. We also found evidence of bear (scat) at this site. (Kalisz 2004)

DISCLAIMER

The following recommendations are conceptual in nature; based on analysis of pre-existing City of Pittsburgh GIS data themes, and United States Department of Agriculture Soil Survey Data provided to us in GIS form, by Allegheny County. This data, is a viable tool to inform decision making. The data has not been field verified by the authors of this report. Everything that follows, are recommendations to inform land-use decision making. In the case of both soils and underground infrastructure onsite analysis and testing by licensed professionals are the only definitive means of assessing infrastructure viability and soil stability on a parcel by parcel basis.

1.2 Overview of General Methodology (with concept-matrix)

The bulk of this work is based upon quantitative analysis of pre-existing computer mapping data, described in terms of GIS or Geographic Information Systems. This work intends to inform the development of Pittsburgh City Zoning regulation. Extending this work is a limited field study of three selected sites. The field work intends to inform development guidelines and recommendations.

The primary sources of this data are the city of Pittsburgh, and Allegheny County. The first level of general GIS analysis occurs at the watershed scale, addressing the ecological condition of our City's hillsides. This study addresses geomorphology, watersheds, steep slopes, forest cover and lost streams, defined as surface drainage networks replaced by underground stormwater infrastructure. The Second analysis occurs at the neighborhood scale and is intended to explore the idea of "need" for open space. This study examines household income, tax values, population density, vacant parcels and parks on a neighborhood by neighborhood basis. Both sections are an attempt to establish a discursive outline for a rational discussion of the potential value and relative need for hillside open space, preservation and restoration. This is presented as a narrative to provide context for the decisions that follow.

The third level of analysis is based upon existing city infrastructure data. Here we examine the geo-spatial area defined by >25% slopes for the current existence of – buildings, roads and sewers. When infrastructure is present, adjacent or nearby an argument can be made for development. The common geo-spatial unit used is a standard GIS polygon from the Allegheny County 25% slope theme. The fourth level of analysis is based upon United States Department of Agriculture soil survey units. Again, we examine the geo-spatial area defined by >25% slopes for the existence of soils that meet the standard USDA definitions of severe and moderate threat to roads and building as well as the potential threat from erosion. When a severe or moderate threat due to soil/slope relationships is present, the relative cost of development may be prohibitive. The common geo-spatial unit used is the USDA soils polygons. (See section 4.2 Understanding the Soil Survey for Plannng for more info.)

In the fifth level of analysis the specific City of Pittsburgh data sets focused upon existing hillside infrastructure (roads, sewers, buildings) and the United States Department of Agriculture data on soil stability (for roads, buildings and erosion) are used for a comparative land-use decision recommendation. Soil and infrastructure data is integrated in an interactive database where city parcels can be queried for their relationship to the mapped infrastructure and soils information. Included in this tool are two additional maps, one based on geology data for coal seams that lie just below the surface, the other is based upon a forest cover analysis. The additional data sets are included in terms of additional analysis – a yes/no query that pushes final decision towards development or preservation based upon real data. See the specific methodology for parcel classification in section 1.3 below.

Field studies in botany and geology address three specific sites but dissimilar sites. The map location of the field studies and the protocol can be found in section 1.4 below, the results can be found in section IV. Natural Systems - Field Studies.

Hillside Ecological Analysis- the Concept Matrix

The matrix is intended to take us to a point where each parcel in the city can be analyzed and sorted into areas for preservation, conservation or development. We primarily rely upon City of Pittsburgh Infrastructure maps and the United States Department of Agriculture Allegheny County Soil Survey, to arrive at the following standardized defnitions:

Preservation: land deemed environmentally unfit for development due to erosive soils, and a lack of available infrastructure.

Conservation: land with sensitive but not exclusionary soil characteristics for safe building practices, with some of the infrastructure necessary to support development.

Development: land with both the soill characteristics for safe building practices and available infrastructure to support development.

Analysis Matrix & List of Maps:			10-Sep-04
Scope/Scale	**Ref Map**	**Intention**	**Rating Scheme**
CITY WIDE CONTEXT			
Watershed Scale		**Narrative of Ecolgical Context**	
	1.1 Topography / Geomorphology	nature in the city	context
	1.2 River Valley View Corridor		context
	1.3 Watershed Delineation for City of Pittsburgh		context
	1.4 Watersheds with Lost Streams		context
	1.5 Watesheds with Slopes greather than 25%		context
	1.6 Watersheds with Woodlands and Parks		context
	1.7 Watersheds with woodland and interior patches		context
	1.8 Current Land Conservation Tactics		context
	1.9 Watersheds with sites for potential field study		
CITY WIDE CONTEXT			
Neighborhood Scale		**Narrative of Cultural Need**	
	2.1 Mean House hold Income	for access and open space	Natural Breaks based
	2.2 Average Tax value		Natural Breaks based
	2.3 Population Density		Natural Breaks based
	2.4 Number of vacant parcels		Natural Breaks based
	2.5 Parks by neighborhood		Natural Breaks based
	2.6 Cumulative Value: Need		Natural Breaks based
CITY WIDE CONTEXT		**DECISION**	
Slope Polygon Scale		**INFRASTRUCTURE**	2-6 Rating Scheme
	3.1 25% Slope + Buildings	Support for Development	Onsite - 30' - 100'
	3.2 25% Slope + Streets		Onsite - 30' - 100'
	3.3 25% Slope + Sewers		Onsite - 30' - 100'
	3.4 Cumulative Value - Infrastructure		
CITY WIDE CONTEXT		**DECISION**	
Soil Polygons		**GEOLOGIC HAZARD**	1-3 Rating Scheme
	4.1 Erosion Hazard	Constraints on Development	slight - moderate - severe
	4.2 Stability for Dwellings		slight - moderate - severe
	4.3 Stability for Roads		slight - moderate - severe
	4.4 Cumulative Geological Hazard		
	4.5 Coal Overburden		
CITY WIDE CONTEXT		**DECISION**	
Parcels		**ACCESS DATABASE**	
Slope Polygons	Infrastructure	If/then Argument for Development	sewers/roads/bldgs
Soil Polygons	Geologic Hazards	If/then Argument for Preservation	USDASCS Standards
Woodland Polygon	Forest Cover	Yes/No Push Preservation	Adjacent patch/corridor
USCS	Coal Seam	Yes/No Push Preservation	USDASCS Standards
	5.1 Parcels w/out woodlands or coal		
	5.2 Parcels with woodlands or coal		
	5.3 Parcels w coal only		
	5.4 Parcels w woodlands only		
	DECISION TITLES	**DECISION NARRATIVES**	NUMERICAL VALUES
RATING	5 Preservation	For Woodland/ vacant	
	4 Conserved	for building in park	
	3 Restoration	for vacant land/ woodland	
	2 Eco Development	for vacant parcels	
	1 Development	for already built	

1.3 Specific Methodology for (>25% Slope) Parcel Classification for Zoning Decisions.

The parcel score is based on six categories:

Soils are double weighted for public safety at 2, 4, or 6
Dwellings: 2, 4, or 6 based on soil type – higher value means better soil for dwellings.
Roads: 2, 4, or 6 based on soil type – higher value means better soil for roads.
Erosion: 2, 4, or 6 based on soil type – higher value means less erosion.

Infrastructure: 1, 2, or 3.
Roads:
1 = Parcel is outside of the 300 foot road buffer.
2 = Parcel touches the 300 foot road buffer but does not touch the 100 foot road buffer.
3 = Parcel touches road or 100 foot road buffer.
Sewers:
1 = Parcel is outside of the 300 foot sewer buffer.
2 = Parcel touches the 300 foot sewer buffer but does not touch the 100 foot sewer buffer.
3 = Parcel touches sewer or 100 sewer buffer.
Buildings:
1 = Parcel does not have a building on it nor does it have adjacent buildings.
2 = Parcel has adjacent buildings, but does not have a building on it.
3 = Parcel has a building on it.

These six categories were combined to reach a cumulative score of 9 – 27. Higher numbers indicate parcels that are better suited for development. The ten foot building buffer picked up the majority

Based on this score, parcels were divided into three categories.
1 = Preservation = 9-14
2 = Conservation = 15-20
3 = Development = 21-27

Because the soil categories (2-6) have twice the weight of the infrastructure categories (1-3), the soil categories are the primary determinants of the final score.

Examples:

- A parcel receives a score of 2 in each soil category, meaning that the parcel is situated on soil that is least suitable for development. This parcel will not fall into the Development category, even if the parcel receives a 3 for each infrastructure category.
- A parcel receives a score of 6 in each soil category, meaning that the parcel is situated on soil that is most suitable for development. The parcel will fall into the Development category, even if the parcel receives a 1 for each infrastructure category.
- A parcel receives a score of 4 in each soil category, or an average score of 4 for all three categories, meaning that the parcel is situated on soil that is somewhat suitable for development. This parcel

could then fall into either the Conservation or Development category, depending on the infrastructure scores.

After the initial classification, we identified which parcels are located in woodland areas, and which parcels are located on coal seams. If a parcel is not located in a woodland area or on a coal seam, then it retains its original ranking based on the values above. If it is located in a woodland area or a coal seam, it moves one category lower (closer to preservation). If the parcel is located on a coal seam and in a woodland area, it moves two categories lower (closer to preservation). Preservation is the lowest possible category.

1.4 Specific Field Study Protocols to Produce Data that can Infrom Land Use Guidelines.

Botany:

Primary Themes:
- Create a baseline data set of woody plant diversity in the Pittsburgh landscape.
- Ascertain forest structure and quantify amount of disturbance.

Method:
- Determine area and size
- Mark transect(s) through survey area (number and length are site-specific and determined by size and access)
- List all woody species
- Mark out 10meter by 10meter plot at every 50meters
- Identify every woody plant in plot and relative abundance
- Measure diameter at breast height of every tree
- Identify important native herbs

Analysis:
- Determine % invasives
- Determine forest continuity
- Determine species structure and DCNR's Native Plant Community types where possible

1. Vegetated
    a. modified if information is available to distinguish woody from herbaceous
    b. if there is any estimate of disturbance or proximity to a road cut, etc. that would be valuable, as disturbance is typically correlated with invasive plants
    c. distance from a major road or highway, which are significant barriers to wildlife
2. Connectivity to vegetated areas downslope from "natural" areas or parks would be especially significant
3. Area and width of the corridor -- the larger the area, the better

4. Aspect and Steepness will determine
    a. if species can live there and

b. which species we might find

5. Distance to “interior forest” defined as the forest area approximately 100 m from the edge of forest patch (Moyer 2003

Geology:

Primary Theme:

To identify site typologies that would indicate geologic instability.

Create a baseline data set of geologically diverse conditions.

Secondary Theme:

To Show cause and effect relationships between soils and vegetation.

For Each Site:

1. Consult existing GIS maps, Slopes, Erosion Hazard and Coal Seam

2. If Slope maps shows susceptible areas, look for evidence such as unstable vertical cliffs, landslide, soil creep and rockfall, slow, medium and mass wasting. indicated by tree-trunk changes, landslides/soil slumps etc.

3. If erosion maps show susceptible areas, look for physical characteristics of an eroding soil, such as gullying, lack of vegetation.

4. If coal, look for evidence, such as subsidence, AMD etc.

II. Context

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Applied Ecology

The emergent area of knowledge known as restoration ecology is a logical response to the post-industrial era. Preservation and conservation emerged in the years around the turn of the 20th century in response to the tools and economies of the industrial era and growth and development in the American West. Preservation began with the aesthetic/scientific interests of botanist and gardeners in the subject of trees. Organized groups at that time helped to establish Arbor Day and promoted a plan for national forest preserves. This interest in nature was fueled by the writings of the naturalist/authors Emerson, Thoreau and Muir. A popular movement, preservation was soon balanced by a more practical and scientific voice. The project of conservation has been described by Samuel Hays (1959: 123) as “efficiency in the development and use of all natural resources.” Established during Theodore Roosevelt’s presidency, conservation was defined by Gifford Pinchot and others as a rational approach to land management. Conservation theory was rooted in an engineering approach to applied knowledge. The ultimate goal was to properly inventory all natural resources prior to a planned development intended to achieve efficient use and minimize waste. This is still the focus of conservation biologists worldwide who inventory natural communities and their movements and then manage habitat so that select species (either migratory or indigenous) will prosper despite impacts from humans. Conservation and preservation are programs that are driven by a reaction to human disturbance of natural systems. Conservation projects today involve large habitat areas, nesting areas and numerous migration areas where landscapes are managed to the best advantage of a single species or groups of similar species.

Preservation and conservation were a reaction to the perception of encroaching physical limits within the United States. Preservationists believed that wilderness was in a state of grace, beyond the limits of human habitation. Nature was something to be preserved and contained for future generations. Conservationists believed that wilderness was a resource bounty to be managed and controlled for long-term economic benefits. Both of these philosophical and political positions placed nature (in the form of wilderness and land-resource) well beyond the limits of cities or towns.

“Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.” (www.ser.org) Restoration ecology is a new way of thinking. It links citizens and experts, as well as cities and wilderness, in a broad program of ecological awareness and action. It is a community of disciplines synthesizing a continuum of diverse knowledge and practices. On one end lie the arts and humanities, in the middle are the design professions, at the other end, science and engineering. Restoration ecology has been touted as a new relationship to nature, one in which the old reductionist paradigm is reversed. Scientists are charged with re-assembling a working nature from the pieces discovered over the last 200 years, while taking it apart. While the machine metaphor was useful in the disassembly and analysis of nature, it is less useful when reassembling nature. The aesthetic roots of restoration ecology can be found in the urban-nature design projects of Frederick Law Olmsted (particularly the Fens of Boston, 1881). The roots of its' science can be found in Aldo Leopold's work restoring the lands of the University of Wisconsin-Madison Arboretum in 1934 (Jordan, 1984).

It can be argued that this "discipline" was established in the early 1980's, in part by the efforts of William Jordan III, a botanist and journalist who was employed at the Madison Arboretum and saw the potential of Leopold's ideas in a contemporary setting. During the 50th anniversary of the Madison Arboretum, he published a seminal text declaring the import of this area. This was followed by a symposium on restoration ecology, which brought together some of the key thinkers worldwide. This resulted in an edited text, "Restoration Ecology: A Synthetic Approach to Ecological Research." (Jordan, 1987). In Jordan's original document, restoration ecology was interpreted as a mixture of cultural and scientific efforts, "....active as a shaper of the landscape, yet attentive to nature and receptive to its subtlest secrets and most intricate relationships. The restorationist is in this sense like an artist and a scientist, impelled to look closer, drawn into lively curiosity and the most intricate relationships" (Jordan, 1984: 24). After Leopold, Jordan is clear that restoration is about restoring a "whole natural community, not taking nature apart and simplifying it, but putting it back together again, bit by bit, plant by plant", "....the ecologist version of healing. " (Jordan, 1984: 23) Jordan commented on the import of restoring whole communities in this text, but he also recognized the import of restoring (reclaiming) industrial sites. Referencing the noted biologist Anthony Bradshaw's pioneering work on coal mining sites in England, Jordan sees the Arboretum as a research laboratory for work that will be in increasing demand in the future, due to the fact that the industrial revolution has provided humanity with the tools to affect nature on a grand scale. The work that first found its symbolic and intellectual focus as a result of the anniversary of the Madison Arboretum occurs around the world today. Today there are academic, private industry, non-profit and federal government models of restoration practices. (Pittsburgh's first major restoration project is underway in Frick Park.) There are two journals attending the area, "Restoration Ecology: The Journal of the Society for Ecological Restoration" published by Blackwell Science, and "Ecological Restoration, published by the University of Wisconsin-Madison Arboretum". Each year, the disciplines of anthropology, art, biology, botany, ecology, engineering, philosophy and poetry participate with government regulators, first peoples, citizen activists, policy makers and spiritual leaders at the annual Society for Ecological Restoration conferences. (http://www.ser.org)

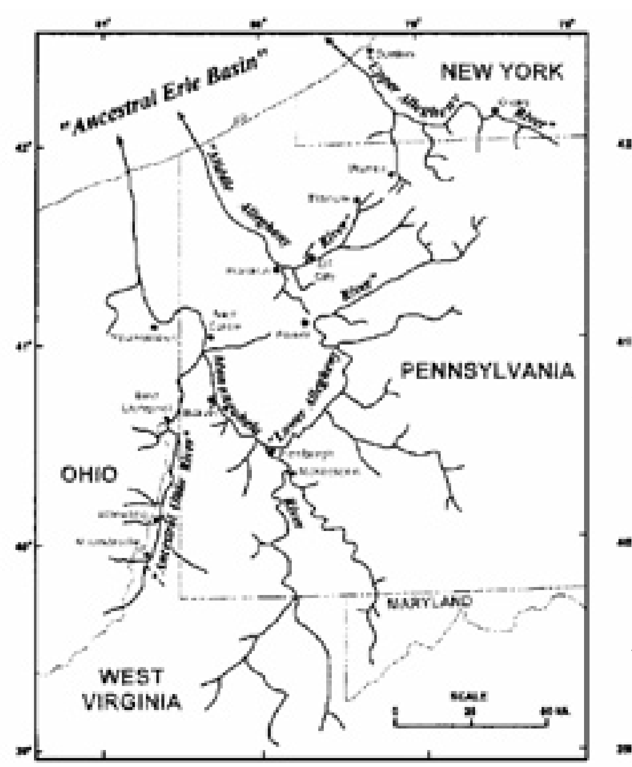
Restoration ecology attempts to both define and reconstruct nature while staying aware (and respectful) of the complexities of natural process, its ethical context and the social and political potential of its performative aspects. Restoration ecology is an important new arena of thinking and acting. It provides us with experience and knowledge that can transform the human relationship to nature. (See appendix I, for more information.)

Restoration ecology, land preservation and species conservation are important tools for, rust-belt cities like Pittsburgh that struggle to recover social, political and economic vitality. Nature was subsumed and ignored during the height of the industrial economy; part of the challenge to recovery involves a restoration of the visible aesthetic vitality, the quality and relationship between the built and natural environment that make places like Pittsburgh unique and interesting places to live and conduct business.

2.1 Watershed Scale

Map 1.1 Topography Geomorphology

History: The Ohio River is formed by the confluence of the Monongahela and Allegheny Rivers, and shares characteristics of both. It is slowly eroding and downcutting the flat-lying sedimentary beds of shale, sandstone, limestone, claystone, and coal deposited during the Pennsylvanian Period of geological time (about 310 million years ago). The history of the Ohio River as we know it today probably began back at the beginning of the Cenozoic Era, about 60 million years ago (Wagner, 1970). During this time, Western Pennsylvania was a broad, flat plain similar to those now seen in the midwestern United States. There was probably very little topographic relief, and there was little elevation difference between the tops of any hills and the water levels of the Ohio. The topographic relief in Pittsburgh is now nearly 700 feet, as the level of the water in the Ohio at the Point is 710 feet above sea level, and the tops of the highest hills are almost 1400 feet above sea level. If one looks out at the Pittsburgh landscape from a high point (such as the USX Tower downtown) one can see that all the hilltops are level, and represent the remnants of this old plain.



The Ohio River has not always flowed south, emptying into the Mississippi River. The Ohio River originally flowed northwards up the Beaver River and French Creek valleys to Lake Erie.

Today if one looks closely at a current map you can see a remnant oxbow of the ancient river at the center of the city, along the rivers edge we see broad flat floodplains that rise steeply into the hillsides which are the primary topic of this report. On a slightly smaller scale, you can see the stream valleys that attenuate the landscape further, streams that once channeled water to the Monongahela, Ohio and Allegheny Rivers. Today, urban surface flow is mostly captured in combined sewer conduits for treatment.

The significant broad flat historic floodplain bordering the rivers has been the site of housing and commerce since the earliest days of human civilization. From this floodplain steep hills rise leading to the ancient plateau described in the previous section on history.

Map 1.2 River Valley View Corridor

The valley view corridor is a simple GIS map, it has a faint topography layer in grey, with a hillsides analysis color-ramped from red to yellow to green illustrating hillside areas that are visible from up 45 separate points in the region (mapped in red) to hillsides that are only visible from a single vantage point which are mapped in dark green. Valley View Corridor is determined by a series of quarter mile points along the centerline of the river at 25 feet above the pool elevation.

With visibility comes an opportunity to create a message. The south side slopes vary from the homes that dot the hillsides, centered upon 18th street to the vertical cliffs of Mount Washington, which feature two restored Pittsburgh Incline railways or funiculars.

Map 1.3 Watershed Delineation for City of Pittsburgh

Watersheds describe the hydrological flow of water over the surface of a landscape. At each point in the landscape – once a saturation point has been reached - water runs downhill. This map describes the areas in an ideal world, where water flows from the high point to a cohesive low point before draining to a stream then to a river below. This map reveals two things that are important first the areas outside the city in black clearly indicate the lack of overlap between our natural hydrologic boundaries and our municipal boundaries. Secondly, you may notice that there are a number of landforms that drain directly from singular hillsides directly to the rivers, in contrast to interior valleys that drain multiple hillsides. It should be noted that much of this hydro-logic is interrupted by combined sewage and stormwater systems throughout the city.

We took the time to delineate the lost watersheds of Pittsburgh so that we might have a ¬hydro-logical land form as the baseline for this eco-logical discussion about the city of Pittsburgh.

Map 1.4 Watersheds with lost streams

A number of streams have been "lost" (i.e. buried or placed in culverts) in the City of Pittsburgh. This map illustrates lost streams and existing streams in addition to the location of woodland patches in the City. The lost streams were generated using GIS analysis (Pinkham 2002). The woodland and interior patches were defined in the same manner as described in for the Woodland and Interior Patch Map. The existing streams were buffered by 100m, a minimum width recommended for neotropical migrants and area sensitive species (Fischer and Fischenich 2000). In addition, 100-meter buffers are sufficient to cover the 100-year FEMA floodplain and some upland area. This buffer is not recommended for streams in Pittsburgh, but merely serves as a way to evaluate the amount and contiguousness of woodland vegetation near the streams.

Riparian vegetation improves water quality and serves as wildlife corridors and habitats. Riparian buffers (i.e. strips of vegetation along either side of a waterway) have been shown to improve stream bank stabilization, reduce sediment, remove chemicals, moderate the temperature of the waterway, and reduce particulate matter (National Council for Air and Stream Improvement 2000). Riparian buffers provide habitat for a large variety of plant and animal species. They have also been documented to be habitat components that promote faunal movement, gene flow, and provide habitats for animals either outright or during disturbance in adjacent habitats (Fischer and Fischenich 2000).

Very few streams still exist within the City limits. Nearly all the existing streams have some woodland near them; though it is important to note that the woodland within the 100 meter buffer along most streams is sparse. The stream valleys are some of the flattest areas in the City and were likely the first areas developed. Saw Mill Run is one of the few streams that is contiguous within the City limits and has a fair amount of woodland area surrounding it. Maintaining woodland areas near existing streams particularly on steep slopes could improve water quality, reduce slope erosion and hillside instability, while providing added green space (Forman 1997).

Map 1.5 Watersheds with 25% + slope

This map depicts 25% slopes in relationship to parks, woodlands and watersheds. It is at a 25% slope that the bulk of our regional soils exhibit what the USDA Soil Conservation Service describes as moderate to severe soil limitations. Moderate is defined as "soil properties that are favorable (to development) but can be overcome or modified by special planning and design. Severe defines "soil properties that are so unfavorable and so difficult to correct or overcome that major soil reclamation, special designs or intensive maintenance are required." (USDA, 1973:53) Note that may of our parks are organized around steep slope environments.

Map 1.6 Watersheds with Woodlands and Parks

This map illustrates parks and woodland areas. By comparing this map with the previous slope map we can see the vast majority of steep slopes are located on woodland areas. In many instances steep slopes could serve as corridors between existing parks and woodland patches. A corridor consists of a strip of a particular type that differs from adjacent land on both sides and connects patches that would otherwise be isolated (Forman 1997). In many instances corridors are discussed in terms of the movement of a particular species in a landscape. The main function of the steep slope corridors suggested above would be to create linked parklands in the City of Pittsburgh for recreational, aesthetic, hazard reduction, and potentially ecological functions. Several areas in the City limits could be connected through this method. For example, from Saw Mill Run to Mount Washington, to the Southside and through the Hays Site, there are steep slopes that create a corridor along the southern side of the Monongahela River. North of the Monongahela River, Schenley Park can be connected to Frick Park using steep slopes south of Schenley Park and woodland areas and steep slopes surrounding Nine Mile Run.

Map 1.7 Watersheds with Woodlands and Interior Patches

The City of Pittsburgh is a fragmented urban landscape containing few woodland patches relative to the rest of Allegheny County. Nearly all the forested land in Allegheny County was previously cut, put to some human use, then reverted back to woodland. This map shows the location, size, interior forest areas, and clustering of woodland patches in the City. Because habitat quality cannot be verified at this time, this data can only provide insight based on the amount of interior forest, and size and shape of the patches.

Woodland patches were classified into 2 size classes: 250 acres and larger, and less than 250 acres. These categories were based on avian studies. Studies have shown that the number of individuals and diversity of neotropical migrants dramatically drops in forest patches smaller than 250 acres or approximately 100 ha. (Robbins et al. 1989 and Askins 2000). Interior or core forest was defined as the forest area approximately 100 m from the edge of forest patch (Moyer 2003). Interior forest habitat is critical in maintaining populations of many organisms by providing stable and valuable sources of food, and cover. The forest edge differs from forest interior in its micro-climate, vegetation, and species present (Moyer 2003, Meffe et. al. 1997, and Turner 2003). The more edge a forest patch has the less likely an interior species will be found within it and more likely wildlife generalist will be present. Larger woodland patches have less edge area and more interior habitat proportionally to smaller patches. Complex and linear shapes consist of more edge and less interior habitat; while simple circular shapes contain the least amount of edge and the most interior habitat (Turner et al. 2003). Generally species richness increases and interior habitat increases with patch size. In this map the largest woodland patches would likely be most valuable because of their size (i.e. they are least fragmented and largest), generally contain the most interior habitat and less edge proportionally to the smaller patches.

Woodland patches in Pittsburgh are concentrated around stream hillsides and steep slopes. These areas tend to be difficult to develop, which is likely the reason they remained woodlands. Frick Park and woodland areas of the Hays Site contain the largest woodland patches and most interior forest in the City. The large proportion of woodland in the City is located in and around the Hays Site. The remaining woodland patches in the City limits are linear and complex in shape, containing mostly edge and little if any interior forest. These woodland areas while not as potentially valuable ecologically as the large patches, they are valuable in reduction of erosion and slope instability and as potential corridors between larger patches.

Map 1.8 Watersheds with Current Land Conservation Tactics

Current land conservation tactics are based upon the Pittsburgh Public Greenway Plan.

Map 1.9 Watersheds with sites for potential field study

During the study phase of the project five sites were, reccomended by the science team for possible inclusion in the field study. Three of the five occurred in watersheds without significant parks or open space. Below you can see the initial review of these sites. Discussion with the Hillsides planning committee and a subsequent assembly of a smaller group from the committee resulted in the choice of three sites. The decision was primarily based upon two factors, onsite soil diversity and potential for biodiversity of plants. The resultant record provides a baseline of potential soils and plant conditions relevant to issues of zoning and land use guidance on steep slope properties.

Sue Kalisz, Ph.D.

INSERT SECTION 1.X MAPS HERE

1. Hayes: on the Monongahela watershed, largest contiguous forest, with interior areas. Floodplain forest and steep hillside forest indicates landscape diversity and likely biodiversity of plants, mam-

mals, birds and insects. Recovering/remnant forest cover.

Best example of a recovering/remnant biological system for city baseline.
Most likely to succeed as a preservation, restoration site.

2. Sawmill Run: Large, urban stream. Has the heterogeneity of habitat found throughout the city, from steep wooded hillsides to developed hillsides. Geology/topography relationship to the stream valley indicates a wide range of native, exotic and invasive species. Small floodplain little bit of everything.

Best example of an urbanized system, a counterpoint to Hayes.
(Proposed greenway development.)

3. Brilliant: Allegheny site, industrial but less so than Monongahela. Indicative of that kind of watershed, parallels the Hays site, both are south side of the river, an intermediate site. Similar in aspect, different topography/limestone outcrops. Real mix of native-wildflower in the understory, exotics, invasives, more intact connections to highland park.

Alternatives:
4. Hill: recovering forest.

5. Swisshelm: Steep slopes, 1.75mi floodplain forest and the connection to Frick.

Henry Prellwitz Ph.D., Allegheny GeoQuest

	Hayes Hillsides	Sawmill Run	Brilliant Hills	Swisshelm Park	Hill District
Soils	10 types	5 Types	3 types	3 types	4 types
Soil Diversity	Highly Diverse	Median	low	low	low
Coal	half underlay	all underlay	no underlay	minimum	all underlay
stream Valley	young valley	y valley, floodplain	Remnant Eroded Plateau	Remnant Eroded Plateau	Remnant Eroded Plateau
	V-shape	V-shape	w young valleys	w young valleys	
				Fossil Riverbed	
Slopes	all sites bordered on 1-2 sides by 30% + Slopes.			all sites bordered on 1-2 sides by 30% + Slopes.	

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2.2 Neighborhood Scale

The following maps are provided as a point of reference when considering the social need for parks and open space. In this series of analysis we were trying to gain a spatial understanding of the economic and social conditions in each city neighborhood as well as the relative accessibility to city parks and open spaces.

Data sets used in Section 2 of the Hillsides slope analysis were :
A. Pittsburgh 2000 Census information obtained at the city block Level from www.pasda.org . This data set was summarized geometrically and statistically to represent the city neighborhood level.
B. Property Tax Value Data obtained from the City of Pittsburgh. This data was joined spatially to Land Parcel/Lot block data also obtained from the City of Pittsburgh.

Map 2.1 Per Capita House Hold Income
Using U.S. Census data, we analyzed per capita income within each city neighborhood. This analysis with the parks theme overlay gives us a general sense of the relationship between parks/lack of parks and relative income.

Map 2.2 Average Parcel Value by Neighborhood
This is another means of getting to the relationship between economic values and city neighborhoods. Here we analyze the current assessed tax values of city parcels on an acre by acre basis then translate that into average neighborhood property tax values. This analysis with the parks theme overlay gives us a general sense of parks/lack of parks in relationship to the current tax value of the existing housing stock.

Map 2.3 Population Density
Population density by neighborhood in relationship to parks gives us a general sense of the potential need for open space. It could be argued that if a neighborhood has high population density and minimum park space nearby - there is a need for open space.

Map 2. 4 Number of Vacant Parcels
This is a neighborhood by neighborhood analysis of open and abandoned City properties. It tells us that there may be potential within the existing city property grid for either infill housing, or a shift away from development toward open space.

Map 2.5 Parks by Neighborhood
In an attempt to make the relationship between parks and neighborhoods more clear, we analyzed each city neighborhood for its spatial relationship to existing city parks. We are seeking to highlight the areas of the city that are underserved with this map.

Map 2.6 Cumulative Value I: Need
These values represent neighborhoods in need of open space. Values were calculated by weighing and combining the rankings of each neighborhood based on Per Capita Income (map 2.1), Average Tax Value (map 2.2) and Population Density (map 2.3). Neighborhoods with low per capita income, low Average Tax Values, and high population density were given higher need rankings.

INSERT SECTION 2.X MAPS HERE

III. Decisions

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3.1 Slope Polygon Scale
SOURCE: The Slope polygon of 25% and above has been sourced from the SPC. Each polygon encloses all continuous slopes of 25% and higher.

Process of Generation: Land is represented in a map via contour lines. The accuracy of these contour lines is to a precision of 10 feet at the data obtained from the city of Pittsburgh. To calculate slope, this contour information is converted to a format called "GRID" within the GIS system and more importantly the scale of precision of the conversion is set. The GRID representation of slope is simplified by grouping together certain ranges of slopes for example from 0-15% and representing such a group as a polygon. This polygon representation of slope data is therefore dependent on three critical parameters, the level of detail of the original contour data, the scale of conversion to the grid format and the range of grouping it represents.

Slope, Infrastructure and Zoning
Using a standard GIS polygon from the slope theme, we can map the location of buildings, streets and sewers that occur in slopes of 25% or more. This analysis gives us an understanding of the infrastructure that is currently available to support development.
All infrastructure data is as-supplied by the City of Pittsburgh GIS services.

Map 3.1 25% Slope + Buildings
We wanted to understand where there has been building development on steep slopes and where there has not. If there has already been development in an area, it may indicate that infrastructure is in place and soils conditions are not prohibitive to development.

Map 3.2 25% Slope + Streets
We wanted to understand where streets had been graded, paved and maintained on steep slopes.

Map 3.3 25% Slope + Sewers
We wanted to understand where sewer services were currently available.

Map 3.4 Cumulative Value Infrastructure
The cumulative map takes data on buildings, streets and sewers and integrates it on a single map illustrating areas on slopes of 25% or higher where development has occurred in the past, and is most likely to occur in the future.

INSERT SECTION 3.X MAPS HERE

3.2 Soil Polygon Scale

SOURCE: Soil Polygons are from the AGIS dataset of Soil Polygons of Allegheny County. The soil polygons are based on the Soil Survey of Allegheny County Pennsylvania. by the United States Department of Agriculture, Soil Conservation Service. Data is at a scale of 1:24,000 at an accuracy of +-5'.

We followed the section in the Soil Survey on the "Use of Soils for Town and County Planning" to develop a geo-referenced database that could be used to illustrate conditions that are either favorable or unfavorable (in terms of public safety) for development. (USDA, 1973: 52)

Soil limitations for development are indicated by the ratings such as slight, moderate and severe. Slight means that soil properties generally are favorable for the rated use or, in other words, that limitations are minor and easily overcome. Moderate means that some soil properties are favorable, those that are not can be overcome or modified by special planning and design. Severe means that soil properties are so unfavorable to development and so difficult to correct or overcome that major soil reclamation, special design or intensive maintenance are required.

Each rating, is applied to dwellings, roads and erosion in the following manner

Ratings for Erosion are based on "erosion indexes derived from certain variable of the Universal Soil Loss Equation (Wischmeier and Smith, 1978) and the Wind Erosion Equation (Woodruff and Siddoway, 1965). The indexes are the quotient of tons of soils loss by erosion predicted for bare ground divided by the sustainable soil lost (T factor)." (USDA Soil Survey Manual, 1993: 302)

Ratings are for dwellings with basements or other buildings that are no more than three stories high and have no more than an 8-foot excavation. Buildings larger than this, or buildings with more than an 8-foot foundation excavation are excluded from this rating scheme.

Ratings for roads and streets are based on load supporting capacity, stability of the subgrade, and the workability and quantity of cut and fill material available. Roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Map 4.1 Erosion Hazard
In this map we have analyzed existing soil survey data for the soils that are rated for severe erosion hazard.

Map 4.2 Soil Stability for Dwellings
In this map we have analyzed existing soil survey data for the soils that are rated severe, or moderate for the development of dwellings that are no more than three stories high with no more than an 8-foot excavation.

INSERT SECTION 4.X MAPS HERE

Map 4.3 Stability for Roads
In this map we have analyzed the soil survey for soils that are rated severe or moderate for load sup-

port capacity, subgrade stability and workability and quantity of available cut and fill material.

Map 4.4 Cumulative Geological Hazard
We have integrated the ratings for severe and moderate impacts for erosion, dwellings and roads.

Map 4.5 Coal Overburden
The Pittsburgh City map containing the outcrop lines and overburden areas that are fifty feet above the Pittsburgh Coal seam. It has been produced to be used as a guide in locating any geological hazards connected with past coal mining activity. Potential hazards that are usually associated with coal mining include mine subsidence (cave-in), waste coal pile landslides, waste coal pile fires, and AMD (acid mine drainage).

The Pittsburgh Coal is about 8 feet thick, and was extensively mined in the City limits from the late Eighteenth century to the 1940's. The other economically important coal seam (the Upper Freeport) occurs in Pittsburgh, but is below the elevation of the three rivers, and has no impact on the land surface. The Pittsburgh Coal is found in the higher hills (Squirrel Hill, Herron Hill, etc.) and at slightly lower elevations in the South Hills. This coal bed (along with the other sedimentary beds that are the bedrock in the City of Pittsburgh) do not lie flat, or have a consistent thickness. All of the rocks in the City have a slight inclination down to the south, at about 40 feet per mile, or 2 degrees angle. Other geological structures, including folds, further confuse the geometry of the Pittsburgh Coal.

The Coal Overburden Map was compiled using data from Dodge (1985). This data includes the outcrop lines of the Pittsburgh Coal, and the local geological structures. Since the elevation values in one coal "polygon" change over distance, a single elevation was assigned to a particular area underlain by the coal bed. This value is very accurate at the center of the land area underlain by the coal, and has increasing error towards the edges of the polygon. The map assumes a perfectly flat coal bed, while such is not the case in reality. The polygon areas do serve as a guide for analysis to a particular land parcel, and will alert planners to any potential dangers from past mining activity. After viewing this map, if more detail is needed, the maps in Dodge (1985) can be consulted.

3.3 Parcel by Parcel Scale

With the clear understanding that this exercise is intended to inform Pittsburgh City Zoning, we realized that the geo-referenced data sets would need to be effectively queried at the level of individual city parcels. Working with Lena Andrews, policy analyst to the Carnegie Mellon Center for Economic Development we were able to develop a Microsoft Access Database Tool we call the "parcel identifier." This tool allows the casual user, or city planner to query the infrastructure and soils databases for each city parcel using the lot and block numbers. The results of that query are recommendations for preservation, conservation or development based upon material conditions that either support, mitigate, or deny development. In addition – we added two "push" categories that affect the score and inform the user of potential threats to development due to the underlying coal seam, or potential benefits to preservation in terms of adjacent woodlands.

The relative affects of the "parcel identifier" data base are then mapped and charted for the number of parcels in each category, see maps 5.1 – 5.4 in the section that follows. For this study, we provide the following definitions:

> Preservation: land deemed environmentally unfit for development.
> Conservation: land with sensitive but not exclusionary environmental characteristics, with some of the infrastructure necessary to support development.
> Development: land with both the environmental characteristics for safe building practices and available infrastructure.

The Decision systems
Soils are double weighted for public safety at 2, 4, or 6
Dwellings: 2, 4, or 6 based on soil type – higher value means better soil for dwellings.
Roads: 2, 4, or 6 based on soil type – higher value means better soil for roads.
Erosion: 2, 4, or 6 based on soil type – higher value means less erosion.

Infrastructure: 1, 2, or 3.
Roads:
1 = Parcel is outside of the 300 foot road buffer.
2 = Parcel touches the 300 foot road buffer but does not touch the 100 foot road buffer.
3 = Parcel touches road or 100 foot road buffer.
Sewers:
1 = Parcel is outside of the 300 foot sewer buffer.
2 = Parcel touches the 300 foot sewer buffer but does not touch the 100 foot sewer buffer.
3 = Parcel touches sewer or 100 sewer buffer.
Buildings:
1 = Parcel does not have a building on it nor does it have adjacent buildings.
2 = Parcel has adjacent buildings, but does not have a building on it.
3 = Parcel has a building on it.

These six categories were combined to reach a cumulative score of 9 – 27. Higher numbers indicate parcels that are better suited for development, lower number indicate preservation.

Based on this score, parcels were divided into three categories.
1 = Preservation = 9-14
2 = Conservation = 15-20
3 = Development = 21-27

Because of public safety concerns, the soil categories (2-6) have twice the weight of the infrastructure categories (1-3), the soil categories are therefor the primary determinants of the final score.

Examples:
• A parcel receives a score of 2 in each soil category, meaning that the parcel is situated on soil that is least suitable for development. This parcel will not fall into the Development category, even if the parcel receives a 3 for each infrastructure category.
• A parcel receives a score of 6 in each soil category, meaning that the parcel is situated on soil that is most suitable for development. The parcel will fall into the Development category, even if the parcel receives a 1 for each infrastructure category.
• A parcel receives a score of 4 in each soil category, or an average score of 4 for all three categories, meaning that the parcel is situated on soil that is somewhat suitable for development. This parcel could then fall into either the Conservation or Development category, depending on the infrastructure scores.

After the initial classification, we identified which parcels are located in woodland areas, and which parcels are located on coal seams. If a parcel is not located in a woodland area or on a coal seam, then it retains its original ranking based on the values above. If it is located in a woodland area or a coal seam, it moves one category lower (closer to preservation). If the parcel is located on a coal seam and in a woodland area, it moves two categories lower (closer to preservation). Preservation is the lowest possible category.

The relative affects of the "parcel -identifier" database are mapped and charted for the number of parcels in each category. The maps below provide the committee with an understanding of the affects of the analysis on each category. The 11x17 maps as included in this report are a good representation of the general condition. To see the true detail, the maps need to be printed out at 18x24 or larger.

Map 5.1 Parcels Without Woodlands or Coal
This map is the cleanest presentation of the relationship between existing infrastructure and soil conditions as analyzed by the "parcel identifier." Using just soils and infrastructure we have a very simple, clear and concise tool to inform decisions on zoning.

At 11x17 it is hard to read the true resolution of this map – but it proves a good general idea of the areas that may or may not be best candidates for preservation, conservation and development.

Preservation	3494 parcels (30%)
Conservation	3951 parcels (34%)
Development	4310 parcels (36%)

Map 5.2 Parcels with Woodlands and Coal

With the addition of the woodland and coal “push” categories the categories either increase or decrease by the following number of parcels/percentage:

Preservation	5992 parcels (51%)
Conservation	2860 parcels (24%)
Development	2903 parcels (25%)

Map 5.3 Parcels with Coal Only

If we were to only include the Coal underlay as a push factor the categories increase or decrease by the following number of parcels/percentage:

Preservation	3806 parcels (33%)
Conservation	3937 parcels (33%)
Development	4012 parcels (34%)

Map 5.4 Parcels with Woodlands Only

If we were to only include the woodlands condition as a push factor the categories increase or decrease by the following number of parcels/percentage:

Preservation	5782 parcels (49%)
Conservation	2897 parcels (25%)
Development	3076 parcels (26%)

INSERT SECTION 5.X MAPS HERE

IV. Natural Systems - Field Studies

Geology: Henry Prellwitz, Ph.D., Allegheny GeoQuest
Botany: Sue Kalisz, Ph.D., Biology University of Pittsburgh
Jessica Dunn, Research Ecologist

Introduction

Pittsburgh is located in an ecologically diverse and environmentally important area of the United States. It is part of the Class I Appalachian Mixed Mesophytic Forest Ecoregions, which has been identified as globally outstanding and requires immediate protection and restoration. This region harbors the most diverse temperate forests in North America. (Ricketts et al. 1999). Southwestern Pennsylvania is also considered a “hot spot” or an area of immediate conservation concern for a number of neotropical migratory bird species (Rosenberg and Wells 2004).

Surprisingly of our small but diverse list of sites, the three Pittsburgh hillsides sampled - the majority of trees identified belong to native species. The hillsides of Pittsburgh appear to function as refugia for the native species of the region.

4.1 Geology, Soils

Introduction

The City of Pittsburgh has seen most of its past development on the flattest areas including floodplains (recent and fossil), and hilltops, which are usually flat topped. The flat hilltops are remnants of an ancient plateau that has been subsequently eroded. Many of the hillsides in Pittsburgh, due to their steepness, remain undeveloped. The purpose of this section of the report is to pinpoint geological hazards that could hinder development from an engineering standpoint, and then use the information from the slope stability, soils, and coal overburden maps to perform a field reconnaissance that confirms or negates the existence of any possible hazards. Suggestions for further testing are outlined at the end of this report.

Methods

The Pittsburgh Hillsides Project Committee selected three areas for field studies. The Pittsburgh Watershed/Woodlands Maps, compiled by Kostoula Vallianos, were used as a basis for site selection, using the following criteria: size of green space, amount of development, and site steepness (> 25% slope). The field traverses were conducted on July 22 and 23, 2004 at three selected sites within Allegheny county. The geological hazards GIS maps were first consulted, to alert the presence of any hazards; these potential hazards were then confirmed in the field.

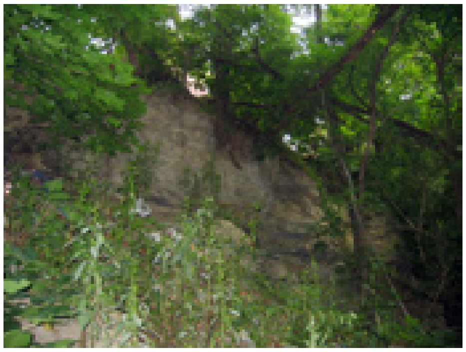


figure 1

Site A Field Reconnaissance

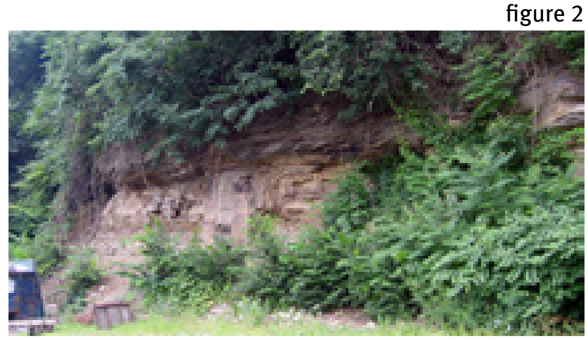
The traverses conducted on Site A cover territory that is very urban in character. Except for some small bedrock outcrops, all of the hillsides have been disturbed, and do not have natural soil cover. Large scale development and past strip mining activities have obliterated the natural soils and hillside profiles.

The first traverse started from a residental street, northward up a flight of abandoned cement steps, to a flat area on the hilltop. This flat hilltop was the original level of the Pittsburgh Coal, which has long since been mined out. The traverse turned east, along an old drainage ditch, ending at a 15 foot high cliff, which is a bedrock outcrop of sandstone and shale (figure 1).

The hillside has a 45 degree (100%) slope (average) and consists of clay, construction rubble, and assorted garbage. The rubble includes local rock fragments, bricks, cement, and other debris. No sign of past landslide activity was observed. The rock outcrop near the top of the hill appeared stable, but could pose a rockfall hazard if disturbed. Near the bottom of the outcrop there is a 1.5 foot thick bed of limestone. No evidence of coal mining (waste piles or subsidence) was seen, as the traverse was below the elevation of the Pittsburgh Coal. Elevations for this traverse were 970’ to 1060’ above sea level.

The second traverse was along a residential street. This traverse showed little geology, as this area has deep vegetation cover. One small outcrop was found (about a 1 foot high siltstone exposure) and a longer 10’ high exposure of siltstone that could be followed for 50 feet. The hillside has slopes from 15 degrees (27%) to 45 degrees (100%). These slopes are all a result of man-made activity, with no original natural materials. Compositions of soils are similar to those found on the first traverse. Elevations ranged from 970’ to 1000’ above sea level. The slopes here appear to be stable, with no evidence of sliding or creeping.

The third traverse on Site A, is from the bottom the hill to the flat top of the hill. The elevation change is from 920’ to 1040’ above sea level. The top of the hill is the site of a long-ago abandoned strip mine in the Pittsburgh Coal, and was later developed. The bottom of the hillside has an average 45 degree slope (100%), and nearer the top, an average 20 degree (36%) slope. All of the slopes appear stable, with no evidence of slide or creep.

figure 2


The slope materials are similar to traverses 1 and 2, and consist of “urban rubble”, with no naturally placed materials. At the bottom of the traverse there is a high (25 foot) outcrop of bedrock (figure 2). This outcrop is made up of sandstone, siltstone, claystone, and limestone. This vertical cliff could have a potential rockfall hazard. The outcrop appears artificial, being an excavation into the hillside. Figure 3 is a closer view of this outcrop, showing the cross-bedded sandstone.

figure 3

The fourth traverse revealed some small rock outcrops consisting of shale and siltstone. Elevation change for this traverse is from 900' to 1040' above sea level. The flat topped Hilltop is the same as seen in Traverse 3, as was the abandoned Pittsburgh Coal strip mine. The soil material is similar to the first three traverses, and is urban rubble. No evidence of the old coal mine operations could be seen (waste piles, subsidence, etc.). The hillside slope ranges from 35 degrees (70%) to 15 degrees (27%).

The fifth (and last) traverse is along an abandoned street right-of-way. This traverse starts from the barrier at the end of the usable portion of the street and extends eastward. The elevations range from 885' to 960' above sea level. This street was abandoned due to severe slope failure (figure 4). This failure is not due to coal mining activity, as the Pittsburgh Coal is well above this locality. Above the street remains is an outcrop of sandstone and siltstone about 20' high (figure 5). This exposure could be a potential rockfall hazard. The hillside slopes range from vertical to 35 degrees (70%), and consist of urban rubble with a mix of more natural rubble, mostly as fall material from the cliffs above the street right-of-way. This site would be a poor location for development, unless the hillside slopes could be stabilized.

All of the soils in the Site A hillsides are classified by the U.S. Department of Agriculture (1981) as "UCE", or Urban land – Culleoka Complex, Steep. The Urban Land soil designation consists of land so altered by excavation and earth moving that the original soils cannot be identified. Culleoka Complex soils are well-drained upland types that result from the weathering of shales and sandstones. The soils observed in the field traverses have an Urban component of over 95%, as there has not been a great enough time period to form a large amount of Culleoka soil. As bedrock weathering progresses over time, the Culleoka portion will increase, if the slopes are not disturbed.

figure 4

Site B1 & Site B2 Road Corridor Field Reconnaissance

Two traverses were walked in the area of a highway road corridor. The first is a residential road, and the second is below a residential development. These two traverses represent a more suburban setting, with the soils and hillside profiles less disturbed than those in Site A.

The first traverse begins in a parking lot on the east side of a major roadway, across from a residential Avenue. This traverse skirted the hillside, and proceeded northward into the westward side of a small valley. The lowest point of the traverse is a small westward flowing stream, under a Port Authority (PAT) right-of-way. Elevations ranged from 880' to 1020' above sea level. The southern portion of this hillside has slopes from 40 degrees (85%) to almost level, with almost all natural soils. A few places have been disturbed by minor excavation. A small bed of limestone was seen on the less steep portions of the hill. As the traverse proceeded northward (and upward in elevation) into the small valley, evidence of coal mining was observed. Several small coal mine waste piles (figure 6) were noted. According to the coal mine overburden map (map 4.5) this elevation is where the Pittsburgh Coal occurs. A small housing development to the west was probably the site of the old mine that generated the observed "gob" piles. The hillside slopes in this vicinity contained less natural material, and more man-made or man-placed soil. Along with the gob piles, there was also an abandoned garbage dump, with numerous old tires, washing machines, and hot water tanks. This valley has a more urban character than the southern portion of the hillside. The coal waste piles can be a source of slide-prone material, and acid mine drainage (AMD). At the bottom of the southern face of the hillside, on return to the starting point, the traverse paralled the small westward flowing stream. About 10 feet above water level, the north bank has slumped into the creek (figure 7). The slumped material does not appear natural, and looks like man-placed fill. This site has very poor soil, from an engineering standpoint.

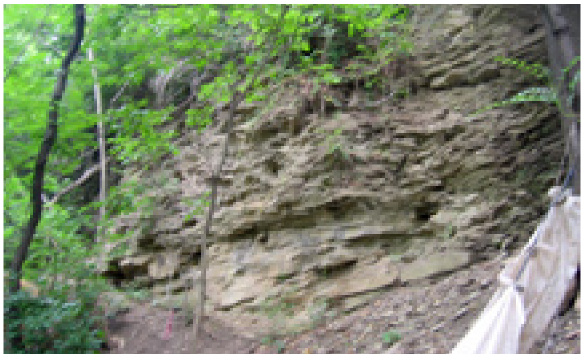


figure 5

figure 6

The second traverse, conducted across a residential development, covers an area that was disturbed to a small extent many years ago. The elevations of the traverse were from 980' to 1080' above sea level. There was no evidence at this site of any past coal mining activity. No coal mine waste piles or subsidence was evident here. The slopes of this hillside ranged from 10 degrees (18%) to 45 degrees (100%). Even though the soils looked disturbed, the materials observed were over 95% naturally occurring. Very little rubble of man-made origin was seen. There was no evidence of slope failure, and no bedrock outcrops were encountered. All of the soils found in these hillsides are classified by the U.S. Department of Agriculture (1981) as "GSF",

figure 7

or Gilpin, Weikert, and Culleoka Shaley silt loams, very steep. This mixture of soils should also include an Urban component; this can be a large percentage of the total. This soil has been reworked, and dumped upon. The soils at the residential development site have been reworked many years ago, and are returning to a more natural state as the weathering process continues.

Site C Field Reconnaissance

Four traverses were walked at Site C: 1) from the starting point across the hilltop to Ravine I, and down to a main access roadway, 2) from the main access road up the old haulage road back to staring point 3) at a railroad right-of-way southwards into a small ravine (Ravine 2) with a 25 foot high waterfall, and 4) from the starting point across the hilltops into the same ravine as Traverse 3. The topographic relief for these traverses is from 740' to 1150' above sea level.

Traverse 1 begins at the uphill end of Ravine 1, downhill to road, and finishes at the lower end (mouth) of Ravine 1. With the exception of man-made materials in the abandoned roadbed (slag, mine waste, bricks, etc.) the soils and rubble were all naturally occurring. This valley has seen little disturbance for many years, except for an old quarry at the bottom of the ravine where it intersects with the main access road. This quarry (figure 8) is in the Morgantown Sandstone, and was probably utilized for building foundation stone. The quarry is on the mineral resource map of Johnson (1929). About halfway down the ravine are some small siltstone outcrops. The slopes are steep (from 20 to 80 degrees or 36% to >100%) but appear stable. There seems to have been no recent landslide activity here.

Traverse 2 also begins at the main access road, and uphill to the top of the site. One outcrop, near a stream, occurs along the side of this abandoned haul road, and is probably not natural. All of the soils on this traverse are natural, until one approaches the top of the site. Site C is covered with a layer of slag on the hilltops. There is no evidence of slope failure anywhere along Traverse 2.

Traverse 3 begins on an old Railroad right-of-way, southward into Ravine 2, containing a small waterfall. The exposed bedrock that forms the waterfall (figure 9) is the Birmingham Siltstone and Shale. The exposed vertical cliff, about 25 feet high, could present a rockfall hazard, if developed. Above the waterfall, all of the soils appear natural and undisturbed in recent times. Much loose soil and fill has been dumped at the mouth of the ravine near the railroad line, and is probably very unstable. This dumping activity is very recent, and no evidence of slide or slump can be seen. Many of the soil piles have been badly eroded and gullied. The sides of the ravine are steep, ranging from 45 to 90 degrees, all greater than 100% slopes. Figure 10 is a close-up view of the BirminghamShale.

figure 8

Traverse 4 goes overland to the head of Ravine 3, but not down to the waterfall elevation. At about elevation 1040' above sea level, much evidence of mining in the Pittsburgh


figure 9

Coal is present: many abandoned waste coal piles (“gob”) and areas that appear to be caved-in mine entrances. Mining was active here during the 1920’s (Johnson, 1929). The Johnson report (1929) shows many coal mine adits (entrances) at this site. Some of these waste piles show signs of minor downhill movement, or creep. Except for coal mining disturbance, most of the ravine sides have naturally occurring soils and rubble. The slopes in Ravine 3 are steep, from 30 to over 60 degrees (58% to ›100%).

Most of the soils in the traversed ravines are classed by the USDA (1981) as GQF, or Gilpin-Upshure complex, very steep. This soil is common in Allegheny County on the steep sides of small stream valleys. It is a product of the weathering of shale, siltstone, and sandstone. Many areas of the four traverses showed high sand content in these soils, due to weathering from sandstones. Where coal mining has disturbed the surface, an Urban component could be added.

Conclusions

The traverses walked on the three major site areas illustrates the importance of field checking maps of geological hazards and soil types before any decisions are made as to the suitability of hillside land for development. An “order of operations” for hillside land selection on a geological basis could be as follows:

Step 1 – Consult the GIS maps generated for this report, including coal mine overburden, soil maps for dwelling construction suitability on slopes, soil maps for street and sewer construction on slopes, and the erosion potential map.

Step 2 – Consult geological references and pinpoint the exact elevation of the Pittsburgh Coal, if the selected parcel is located on or above the coal elevation on the Overburden Map.


figure 10

Step 3 – Field check any potential geological or soil hazards on selected hillside. Record any suspicious looking waste piles and dumps. Check for erosion and landslide evidence, such as gullying, bent tree trunks, and general natural earth movement due to gravity, especially after a prolonged and heavy rainfall.

Step 4 – If the hillside site appears favorable, then test borings and a thorough geotechnical engineering study is warranted, to determine the load carrying capacity and stability of the soils and bedrock for development.

4.2 Understanding the Soil Survey for Planning

Introduction: Use and importance of the Allegheny County Soil Survey

The focus of the GIS mapping and the terrestrial portions of this report have been soils, for two reasons, the first being that soils are the first and uppermost layer of natural materials encountered when excavating for foundations, streets, and sewers. The second reason for a soils focus versus bedrock studies is that soils are generally more susceptible to downslope movement due to gravity.

The land in the City of Pittsburgh is covered by soils, except in very steep areas of bedrock outcrop. Since soils are the first natural materials that are penetrated by excavation activity, and often are the bottom foundation for structures and streets, determination of their mechanical and engineering properties is paramount for successful infrastructure improvements and other development. While the weathering of bedrock produces soil, and determines their physical properties, few structures and streets in Pittsburgh are built directly on bedrock. Soils provide mechanical support for the majority of buildings, excepting large skyscrapers and streets built in tunnels.

With the exception of rockfalls along highway roadcuts, and coal mine subsidence, soils are the main offenders in natural downslope movement and failure. Most of the landslides, slumps, and areas of slow downward creep involve the soil layers, instead of bedrock failure. Compared to other United States cities, Pittsburgh has an acute landslide problem, mainly due to steep slopes and slide prone soil mechanical properties

The Soil Survey of Allegheny County, Pennsylvania (USDA, 1981) has been published as a guide for those in the agriculture industry and urban planners. The Survey contains both agricultural and engineering information pertaining to natural soils. The soils in the Pittsburgh area form as a result of bedrock disintegration through natural and human weathering processes, and reflects the composition of the parent rocks from which it is derived. A few soil types in the Allegheny and Ohio River valleys contain soil that was introduced from sources further north, due to outwash from the glaciers. The great majority of Allegheny County soils are from local sources.

Soil Classification

Soils are classified using many variables; the main factors are the grain sizes of the particles that make up the soil, the natural thickness of the soil, the water holding capabilities, and the topography on which the soil occurs.

Soil texture is the weight percent of certain grain size groups, all less than 2 mm. in diameter. The USDA Soil Survey Manual gives the particle size ranges as:

Very coarse sand	2.0 – 1.0 mm
Coarse sand	1.0 – 0.5 mm
Medium sand	0.5 – 0.25 mm
Fine sand	0.25 – 0.10 mm
Very fine sand	0.10 – 0.05 mm

Silt	0.05 – 0.002 mm
Clay	‹0.002 mm

Using the USDA Soil Texture triangle, a classification can be utilized with three variables: sand, silt, and clay. Each endpoint of the composition triangle represents 100% of the respective component (figure 11, USDA, 1993) If a soil has 40% sand, 40% silt, and 20% clay, the composition triangle indicates a loam. In this diagram, all the different sizes of sand, from 2.0 mm. to 0.05 mm. are included as one component.

Soils are divided into Series, usually named for the locality in which they were first studied. Each series can be further subdivided into Phases, which are different slope environments for a series. Sometimes, more than one series can be combined to form a soil complex. On the soil survey maps, one can find symbols for series, phases, and complexes.

Table 2, on pages 38 to 42 in the Allegheny County Soil Survey (USDA, 1981), is a tabulation of soil properties useful to engineers. The USDA textures refer to the texture triangular diagram in the Soil Survey Handbook (USDA 1993). Also on this table are the series names and map symbols.

Table 5, on pages 54 to 61 (USDA, 1981) is probably the most useful for planners. Each series and phase is listed, with its map symbol, and six columns describing the soils suitability for certain applications, including dwellings with basements, roads and streets, etc. Soil limitations are ranked and slight, moderate, or severe, and the reason for this ranking. These ranks are a result of laboratory tests that have determined the competency of a particular soil. The variables for competency are grain size percentages, porosity (ratio of pore space to solid material) permeability (water transmittability), slope, and compaction tests. For example, a very sandy soil, with large grains, is a good aquifer, but on a slope is susceptible to erosion. A soil with a large clay content will not conduct water well, but has good compaction characteristics, due to its low porosity. All of these variables are taken into account in tables 2 and 5 classification and suitability charts. If one is planning to develop a land parcel, one must conduct test borings and geotechnical engineering studies to quantify the amount of load a particular soil can bear, its slope stability, and ability to drain water.

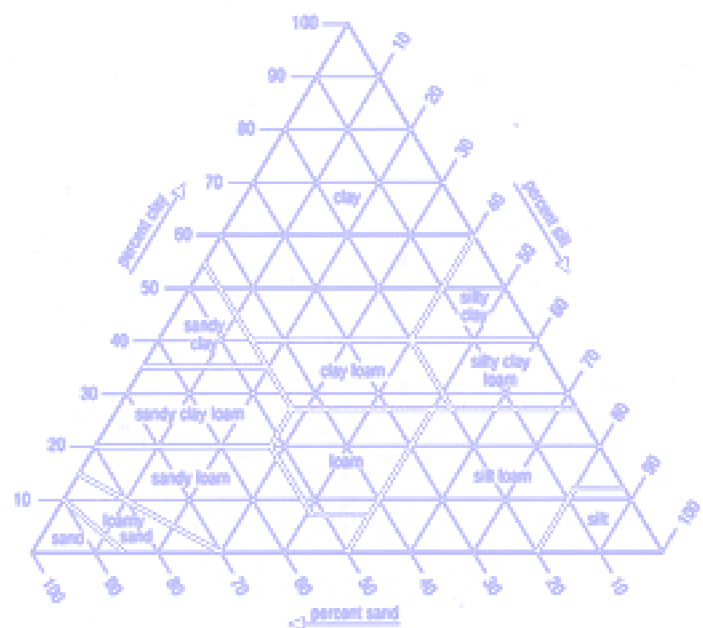


figure 11. USDA Soil Texture triangle

Table 8 (USDA, 1981) on pages 70 to 73 lists the soil series and phase, with its ability to support plant life. Categories are good, fair, poor, and very poor. This table is particularly useful for forest area conservation and preservation.

Example

A practical way to explain the use and application of the Allegheny County Soil Survey (USDA, 1981) is to provide a hypothetical example. You, the developer, want to build a residential and retail complex at the west end of the Carrie Furnace site in Rankin, PA. The flat floodplain land between the CSX railroad and the Monongahela River is level land, suitable for retail use, and the hillside behind the CSX railroad would offer a spectacular view for residential use. After looking at the Allegheny County Soil Survey Map, one sees the floodplain labeled URB, and the hillside GQF.

The text of the Soil Survey indicates that URB is the Urban land - Rainsboro Complex. Since this is a complex, and not a single soil, two descriptions will have to be consulted. The slopes for URB are 0 – 8 percent grade, which fits a river floodplain well. The description shows the URB complex to be 75% urban soil, 15 % Rainsboro soil, and 10 % “other” soils. The Rainsboro soils (see text description) are silty loams, and occur on old river terraces. The USDA Soil composition triangle (USDA, 1993) shows that a “silty loam” would have 60% silt, 20% sand, and 20% clay sized particles. The Urban soils have been disturbed and contaminated enough that no particle size classification applies. In the URB area, extensive test borings, grain size analysis, and engineering studies would have to be performed by geotechnical personnel to determine load bearing characteristics.

The GQF portions on the map are on a steep hillside. The GQF soils, in the Survey text, name this as the Gilpin – Upshure Complex, very steep. Slopes are 25 to 80 percent grade. The description also indicates that the complex has 50% Gilpin soils, 15% Upshur soils, and 35% “other” soils. The surface is silt loam, and deeper soil is silt clay loam. Silt clay loam has about 60% silt, 10% sand, and 30% clay. If one actually walks into this hillside area, the grades are steep, and in some places, there are vertical rock outcrops. Test borings and grain size analysis will confirm or disprove these labels. The soils in the Pittsburgh area are variable, and the Soil Survey map is used as a guide.

After reading the descriptions, the tables in the Allegheny County Soil Survey (USDA, 1981) can be consulted. For this example, Table 5 (Soil Limitations for Town and Country Planning) will be referenced. For URB, the table indicates that the properties of urban land are too variable to be rated. Since 15% of this complex is Rainsboro, that portion of the table can be consulted, and ratings for Dwellings with Basements show a moderate limitation, due to a seasonal high water table. The Gilpin soil lists the limitations as severe, because of slope. Bedrock depth for the Gilpin soils is only about three feet down, making excavation more difficult. The bedrock would provide the most secure foundation on a steep slope, however. The Upshur portion of the complex is rated at very severe, due to slope and proneness to landslides. After reviewing these limitations in Table 5, the reasons for non-development of this hillside are apparent.

Other factors, along with soil analysis, have to be taken into account before developing land in an urban setting, including environmental assessments to check for
any toxicity.

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4.3 Vegetation Assessment

Table 2. Allegheny County Soli Survey: Estimated Soil Properties Significant in Engineering

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock[1]	Depth from surface	USDA texture	Engineering classification Unified	Engineering classification AASHTO	Coarse fraction larger than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
Allegheny variant: AgB, AgC	>6	>5	0–8	Silt loam	ML or CL	A–4 or A–6	—
			8–35	Silt loam, gravelly loam, gravelly sandy loam.	SM, GC, ML, or CL	A–4 or A–6	0–10
			35–60	Very gravelly loamy sand.	GM, GC, SM, or SC	A–1 or A–2	0–20
Atkins: At	0–½	>5	0–8	Silt loam	ML or CL	A–4 or A–6	—
			8–34	Silt loam, loam	ML or CL	A–4 or A–6	—
			34–60	Loam, silty clay loam	SM, SC, ML, or CL	A–2 or A–4	—
Brinkerton: BrB	0–½	>5	0–8	Silt loam	ML or CL	A–4 or A–6	—
			8–24	Silty clay loam	ML or CL	A–4, A–6, or A–7	—
			24–60	Silty clay loam	SM, SC, ML, or CL	A–4, A–6, or A–7	—
Cavode: CaB, CaC	½–1½	>3½	0–10	Silt loam	ML or CL	A–4 or A–6	—
			10–40	Silty clay loam, silty clay.	ML, CL, or MH	A–4, A–6, or A–7	—
			40–60	Shaly silty clay	ML or CL	A–4 or A–6	0–20
Clarksburg: CkB, CkC	1½–3	>5	0–9	Silt loam	ML	A–4	—
			9–28	Silty clay loam	ML or CL	A–4 or A–6	—
			28–60	Silt loam	ML or CL	A–4 or A–6	—
Clymer: CmB, CmC, CmD	>6	3½–6	0–9	Silt loam	ML	A–4	—
			9–37	Loam, clay loam, channery sandy clay loam.	SM, GM or ML	A–2 or A–4	0–15
			37–55	Very channery loamy sand.	GM, SM, GP, or GM	A–1 or A–2	0–20
			55	Sandstone bedrock			
*Culleoka: CuB, CuC, CuD, CwB, CwC, CwD. For the Weikert part of CwB, CwC, and CwD, see the Weikert series.	>6	1½–3½	0–7	Silt loam	ML	A–4 or A–6	—
			7–27	Silt loam, silty channery clay loam, clay loam.	GM, GC, SM, SC, ML, or CL	A–4 or A–6	0–15
			27–29	Very channery clay loam.	GM or GW	A–1, A–2, or A–4	5–15
			29	Shale and sandstone bedrock.			
Dormont: DoB, DoC, DoD, DoE	1½–3	>4	0–7	Silt loam	ML or CL	A–4 or A–6	—
			7–53	Silt loam, silty clay loam.	ML or CL	A–4 or A–6	—
			53–72	Silty clay	ML or CL	A–6 or A–7	0–30
*Ernest: ErB, ErC, ErD, EvB, EvC, EvD. For the Vandergrift part of EvB, EvC, and EvD, see the Vandergrift series.	1½–3	>5	0–6	Silt loam	ML or CL	A–4	—
			6–28	Silt loam, silty clay loam.	ML or CL	A–4 or A–6	0–20
			28–72	Silt loam	GM, GC, ML, SM, SC, or CL	A–4 or A–6	0–20

Percentage smaller than 3 inches passing sieve—				Perme-ability	Available water capacity [2]	Reaction	Compaction data		Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				Optimum moisture	Maximum dry density		Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
95–100	95–100	85–100	70–90	2.0–6.0	0.18–0.24	4.5–5.5			Low	Low	High.
80–100	60–100	55–100	45–75	0.6–2.0	0.12–0.18	4.5–5.5	10–15	100–125	Low	Low	High.
40–80	30–60	25–50	15–30	0.6–6.0	0.08–0.12	4.5–5.5	5–10	105–130	Low	Low	High.
90–100	80–100	80–100	75–95	0.6–2.0	0.18–0.22	4.5–6.0			Low	High	High.
90–100	80–100	80–100	60–95	0.6–2.0	0.14–0.18	4.5–5.5	12–18	100–110	Low	High	High.
80–100	60–100	45–100	30–85	0.6–6.0	0.08–0.16	4.5–5.5	8–14	108–120	Low	High	High.
95–100	85–95	80–95	75–95	0.2–6.0	0.18–0.24	5.1–6.0			Low	High	Moderate.
95–100	85–100	80–100	65–95	0.2–0.6	0.14–0.18	5.1–6.0	16–22	95–112	Moderate	High	Moderate.
70–100	60–100	55–95	40–90	0.06–0.2	0.08–0.12	5.1–6.0	12–17	100–120	Moderate	High	Moderate.
90–100	85–100	80–95	75–95	0.6–2.0	0.18–0.24	5.1–6.0			Low	High	Moderate.
80–100	75–100	70–95	65–95	0.06–0.2	0.10–0.14	4.5–5.5	15–18	95–110	Moderate	High	High.
80–100	75–95	70–95	65–90	0.06–0.2	0.08–0.12	4.5–5.5	12–15	110–120	Moderate	High	High.
95–100	85–95	70–90	55–85	0.6–6.0	0.18–0.24	5.1–6.0			Low	Moderate	Moderate.
80–100	70–95	60–90	55–85	0.6–2.0	0.12–0.16	5.1–6.0	15–18	100–115	Moderate	High	Moderate.
80–100	70–95	60–90	55–85	0.06–0.2	0.08–0.12	5.1–6.0	12–17	115–120	Moderate	Moderate	Moderate.
85–100	75–90	70–85	60–85	2.0–6.0	0.14–0.20	4.5–6.0			Low	Low	High.
60–85	55–85	50–75	30–60	2.0–6.0	0.10–0.14	4.5–5.5	11–16	115–123	Low	Moderate	High.
40–70	20–65	20–40	10–20	2.0–6.0	0.04–0.08	4.5–5.5	10–14	116–122	Low	Low	High.
85–100	35–95	70–95	60–85	0.6–6.0	0.18–0.24	5.1–6.0			Low	Low	Moderate.
50–100	45–95	45–95	40–85	0.6–2.0	0.12–0.18	5.1–6.0	12–17	108–118	Low	Moderate	Moderate.
25–50	20–45	15–40	10–40	0.6–2.0	0.06–0.10	5.1–6.0	10–15	115–125	Low	Low	Moderate.
95–100	90–100	85–95	80–90	0.6–2.0	0.14–0.18	5.1–6.0			Low	High	Moderate.
90–100	60–100	80–95	55–90	0.06–0.2	0.14–0.18	5.1–6.0	12–18	100–115	Moderate	High	Low.
80–100	60–100	75–100	55–100	0.06–0.2	0.08–0.12	5.6–6.0	12–16	95–110	Moderate	High	Low.
90–100	85–100	85–100	70–95	0.6–6.0	0.18–0.24	5.1–6.5			Low	Moderate	High.
90–100	85–100	85–100	70–95	0.6–2.0	0.12–0.16	4.5–5.5	15–19	102–112	Moderate	High	High.
85–95	80–90	50–75	40–70	0.06–0.2	0.08–0.12	4.5–5.5	12–17	114–120	Moderate	Moderate	High.

Table 2. Allegheny County Soli Survey: Estimated Soil Properties Significant in Engineering (cont.)

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bed-rock[1]	Depth from surface	USDA texture	Engineering classification Unified	Engineering classification AASHTO	Coarse fraction larger than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
*Gilpin: GIB, GIC, GID, GpB, GpC, GpD, GQF, GrE, GSF. For the Upshur part of GpB, GpC, GpD, and GQF, see the Upshur series. For the Vandergrift part of GrE, see the Vandergrift series. For the Weikert and Culleoka parts of GSF, see the Weikert and Culleoka series.	>6	1½–3½	0–5	Silt loam	ML	A–4	—
			5–23	Shaly silt loam	GM, SM, ML, or CL	A–4 or A–6	0–10
			23–31	Very shaly loam	GM, SM, or ML	A–1, A–2, or A–4	10–30
			31	Shale bedrock.			
*Guernsey: GuB, GuC, GuD, GvB, GvC, GvD. For the Vandergrift part of GvB, GvC, and GvD, see the Vandergrift series.	1–2	>4	0–7	Silt loam	ML or CL	A–4 or A–6	—
			7–38	Silty clay loam, silty clay, clay.	ML, CL, or CH	A–4, A–6, or A–7	—
			38–50	Shaly silt loam	ML, CL, or CH	A–4, A–6, or A–7	0–20
Hazleton: HaB, HaC, HaD, HTE	>6	3½–6	0–6	Loam	GM, SM, or ML	A–2 or A–4	0–20
			6–28	Channery sandy loam	GM, SM, or ML	A–2 or A–4	0–40
			28–60	Very channery loamy sand.	GM or SM	A–1, A–2, or A–4	0–40
			60	Sandstone bedrock.			
Huntington: Hu	>4	>5	0–20	Silt loam	ML	A–4	—
			20–48	Silt loam	ML	A–4	—
			48–60	Sandy loam	SM or ML	A–2 or A–4	—
Library: LbB, LbC, LbD	½–1½	3½–6	0–8	Silty clay loam	ML or CL	A–4 or A–6	—
			8–25	Silty clay	ML, CL, MH, or CH	A–6 or A–7	—
			25–54	Shaly silty clay loam, shaly loam.	ML, SM, MH or GC	A–6 or A–7	0–15
Lindside: Ln	1½–3	>5	0–8	Silt loam	ML	A–4	—
			8–38	Silt loam	ML	A–4	—
			38–60	Loam	SM or ML	A–2 or A–4	—
Newark: Ne	0–1	>5	0–9	Silt loam	ML or CL	A–4 or A–6	—
			9–34	Silty clay loam, silt loam.	ML or CL	A–4 or A–6	—
			34–60	Loam stratified with silt loam.	ML or CL	A–4 or A–6	—
Philo: Ph	1½–3	>5	0–9	Silt loam	ML or CL	A–4	—
			9–34	Silt loam	ML	A–4	—
			34–60	Loam, sandy loam	SM or ML	A–4	—
Rainsboro: RaA, RaB, RaC	1½–3	>5	0–13	Silt loam	ML	A–4	—
			13–26	Silt loam	ML or CL	A–4 or A–6	—
			26–65	Silt loam, sandy clay loam, loam.	SM or ML	A–4	—
Rayne: RyB, RyC	>6	3½–5	0–8	Silt loam	ML or CL	A–4	—
			8–33	Silt loam, silty clay loam.	ML or CL	A–4 or A–6	0–20
			33–46	Shaly loam, very shaly loam.	GM, GC, SM, or SC	A–2 or A–4	0–30
			46	Shale bedrock.			
Upshur: UaB, UaC	>3	4–6	0–6	Silty clay loam	CL or ML	A–4 or A–6	—
			6–31	Clay, shaly silty clay	CL, MH, or CH	A–6 or A–7	—
			31–64	Shaly silty clay, very shaly silty clay.	CL, GC, or SC	A–4, A–6, or A–7	0–40

Percentage smaller than 3 inches passing sieve—				Permeability	Available water capacity [2]	Reaction	Compaction data		Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				Optimum moisture	Maximum dry density		Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
85–100	70–90	65–85	55–85	0.6–6.0	0.18–0.24	4.5–5.5			Low	Low	High.
50–95	45–90	35–80	35–70	0.6–2.0	0.10–0.14	4.5–5.5	13–15	110–120	Low	Moderate	High.
40–70	20–65	20–60	15–55	0.6–2.0	0.06–0.10	4.5–5.5	11–14	114–125	Low	Low	High.
95–100	90–100	90–100	85–100	0.6–2.0	0.14–0.18	5.6–6.5			Moderate	High	Low.
95–100	75–100	85–100	65–100	0.06–0.2	0.10–0.14	5.6–7.3	15–20	95–110	High	High	Low.
80–100	80–100	75–100	65–100	0.06–0.2	0.08–0.12	5.6–7.3	15–20	95–115	High	High	Low.
80–90	75–90	35–65	15–55	2.0–6.0	0.12–0.16	4.5–5.5			Low	Low	High.
50–85	45–80	40–75	20–55	2.0–6.0	0.08–0.12	4.5–5.5	10–15	115–123	Low	Low	High.
45–85	40–80	35–65	15–45	2.0–6.0	0.04–0.08	4.5–5.5	9–13	115–125	Low	Low	High.
95–100	90–100	85–100	65–100	0.6–2.0	0.18–0.24	6.1–7.3			Low	Low	Low.
95–100	90–100	85–100	65–100	0.6–2.0	0.16–0.20	5.6–6.5	12–18	100–110	Low	Low	Low.
85–100	60–100	50–70	30–65	2.0–6.0	0.10–0.14	5.6–6.5	10–16	105–120	Low	Low	Low.
95–100	85–100	85–100	80–100	0.6–2.0	0.14–0.18	5.1–6.5			Moderate	High	Moderate.
95–100	85–100	85–100	80–100	0.06–0.2	0.10–0.14	4.5–7.3	17–24	95–105	High	High	Low.
80–100	45–100	40–100	35–95	0.06–0.2	0.08–0.12	4.5–7.3	13–20	90–117	High	High	Low.
100	95–100	90–100	70–80	0.6–6.0	0.18–0.24	6.1–7.3			Low	Low	Low.
100	95–100	80–95	80–90	0.6–2.0	0.18–0.24	5.6–7.3	12–18	100–110	Low	Moderate	Low.
100	95–100	90–100	30–90	0.6–6.0	0.14–0.20	5.6–7.3	10–16	105–120	Low	Moderate	Low.
90–100	90–100	85–100	75–95	0.6–2.0	0.18–0.22	5.6–7.3			Low	High	Low.
90–100	90–100	85–100	65–90	0.6–2.0	0.18–0.22	5.6–7.3	12–18	100–112	Moderate	High	Low.
90–100	90–100	80–100	60–80	0.6–2.0	0.12–0.18	6.1–7.3	12–18	100–112	Low	High	Low.
65–100	65–100	60–80	55–75	0.6–2.0	0.14–0.18	5.1–6.0			Low	Low	Moderate.
65–100	65–100	60–80	55–75	0.6–2.0	0.14–0.18	4.5–5.5	10–14	110–120	Low	Moderate	High.
60–95	55–95	55–75	45–65	2.0–6.0	0.08–0.10	4.5–5.5	8–12	115–122	Low	Moderate	High.
95–100	95–100	85–100	65–90	0.6–2.0	0.18–0.24	5.1–6.5			Low	Moderate	Moderate.
95–100	95–100	85–100	65–90	0.6–2.0	0.14–0.18	5.1–6.0	12–18	110–116	Moderate	High	Moderate.
80–100	75–100	60–95	45–90	0.06–0.2	0.10–0.12	5.1–6.0	10–16	110–122	Low	Moderate	Moderate.
95–100	90–100	80–95	60–85	0.6–2.0	0.14–0.18	4.5–6.0			Low	Low	High.
85–100	60–100	60–95	55–95	0.6–2.0	0.12–0.16	4.5–5.5	12–16	113–120	Low	Moderate	Moderate.
40–75	25–70	25–60	10–50	2.0–6.0	0.08–0.12	4.5–5.5	11–15	113–125	Low	Low	Moderate.
95–100	90–100	80–95	70–95	0.2–0.6	0.14–0.20	5.1–6.5			Moderate	High	Moderate.
95–100	90–100	80–95	70–95	0.06–0.2	0.10–0.14	5.6–7.8	18–22	100–110	High	High	Low.
60–95	40–95	40–90	35–85	0.06–0.2	0.08–0.12	5.6–7.8	15–18	110–115	High	High	Low.

Table 2. Allegheny County Soli Survey: Estimated Soil Properties Significant in Engineering (cont.)

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Engineering classification		Coarse fraction larger than 3 inches
	Seasonal high water table	Bed-rock[1]			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
*Urban land. Properties are too variable to be estimated. For the Culleoka part of UCB, UCD, and UCE, see the Culleoka series. For the Guernsey part of UGB and UGD, see the Guernsey series. For the Rainsboro part of URB, and URC, see the Rainsboro series. For the Wharton part of UWB and UWD see the Wharton series.							
Vandergrift .... Mapped only in complexes with Ernest, Gilpin, and Guernsey soils.	1–2	>5	0–8	Silt loam	ML or CL	A–4 or A–6	----
			8–42	Silty clay loam, silty clay.	CL, MH, or CH	A–6 or A–7	0–5
			42–60	Clay, channery silty clay loam.	CL	A–6 or A–7	0–5
Weikert: WEF .... Rock outcrop part of WEF not rated.	>6	1–1½	0–6	Shaly silt loam	GM, SM, or ML	A–1, A–2, or A–4	0–10
			6–15	Very shaly silt loam, very shaly loam.	GW, GM, SW, or SM	A–1 or A–2	0–20
			15	Shale bedrock.			
Wharton: WhB, WhC, WhD	1½–3	>4	0–10	Silt loam	ML or CL	A–4 or A–6	----
			10–42	Silt loam, silty clay loam, silty clay.	ML, CL, or MH	A–4, A–6, or A–7	----
			42–60	Silty clay	ML, CL, or MH	A–4, A–6, or A–7	0–20

Percentage smaller than 3 inches passing sieve—				Permeability	Available water capacity [2]	Reaction	Compaction data		Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				Optimum moisture	Maximum dry density		Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
95–100	90–100	85–100	80–100	0.6–2.0	0.16–0.20	5.1–6.0			Moderate	High	Moderate.
90–100	90–100	80–100	75–100	0.06–0.2	0.10–0.16	5.1–7.3	15–22	100–115	High	High	Low.
80–100	55–95	55–95	50–95	0.06–0.2	0.08–0.12	5.6–7.3	14–20	100–115	High	High	Low.
30–70	25–65	25–60	20–55	2.0–6.0	0.08–0.14	4.5–5.5			Low	Low	High.
10–60	10–55	10–35	5–35	2.0–6.0	0.04–0.08	4.5–6.0	10–15	110–125	Low	Low	High.
95–100	85–100	80–95	70–90	0.6–2.0	0.18–0.24	5.1–6.0			Low	High	Moderate.
85–100	75–100	70–100	65–95	0.06–0.2	0.14–0.18	4.5–5.5	16–22	95–112	Moderate	High	High.
80–100	75–100	55–100	55–100	0.06–0.2	0.08–0.12	4.5–5.5	14–18	109–118	Moderate	High	High.

Table 5. Allegheny County Soli Survey: Soil Limitations for Town and Country Planning

Soil series and map symbols	Septic tank absorption fields [1]	Sewage lagoons [1]
Allegheny variant:		
AgB	Slight: hazard of ground water contamination.	Severe: moderately rapid permeability in substratum.
AgC	Moderate: slope; hazard of ground water contamination.	Severe: moderately rapid permeability in substratum; slope.
Atkins: At	Severe: hazard of flooding; high water table; hazard of ground water contamination.	Severe: hazard of flooding; moderately rapid permeability in substratum.
Brinkerton: BrB	Severe: high water table; slow permeability.	Moderate: slope; hazard of inflow.
Cavode:		
CaB	Severe: slow permeability; seasonal high water table.	Moderate: slope; bedrock at a depth of 3½ or more feet; hazard of inflow.
CaC	Severe: slow permeability; seasonal high water table.	Severe: slope
Clarksburg:		
CkB	Severe: seasonal high water table; slow permeability.	Moderate: slope; hazard of inflow.
CkC	Severe: seasonal high water table; slow permeability.	Severe: slope
Clymer:		
CmB	Moderate: bedrock at a depth of 3½ to 6 feet; hazard of ground water contamination.	Severe: moderately rapid permeability.
CmC	Moderate: bedrock at a depth of 3½ to 6 feet; hazard of ground water contamination; slope.	Severe: moderately rapid permeability; slope.
CmD	Severe: slope; hazard of ground water contamination.	Severe: moderately rapid permeability; slope.
Culleoka:		
CuB, CwB For the Weikert part of CwB, see the Weikert series.	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet.
CuC, CwC For the Weikert part of CwC, see the Weikert series.	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
CuD, CwD For the Weikert part of CwD, see the Weikert series.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
Culleoka part of GSF	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
Culleoka part of UCE	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
Dormont:		
DoB	Severe: seasonal high water table; slow permeability.	Moderate: slope
DoC	Severe: seasonal high water table; slow permeability.	Severe: slope
DoD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope
DoE	Severe: seasonal high water table; slow permeability; slope.	Severe: slope
Dumps: Du, Dw. Properties are too variable to be rated.		
Ernest:		
ErB	Severe: seasonal high water table; slow permeability.	Moderate: slope
ErC	Severe: seasonal high water table; slow permeability.	Severe: slope

Dwellings with basements	Lawns and landscaping	Roads and streets	Sanitary landfills (trench)[1]
Slight	Slight	Slight	Severe: moderately rapid permeability in substratum.
Moderate: slope	Moderate: slope	Moderate: slope	Severe: moderately rapid permeability in substratum.
Severe: hazard of flooding; high water table.	Severe: hazard of floooding; high water table.	Severe: hazard of flooding; high water table; potential frost action.	Severe: hazard of flooding; high water table; moderately rapid permeability in substratum.
Severe: high water table	Severe: high water table	Severe: high water table; potential frost action.	Severe: high water table.
Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: potential frost action; seasonal high water table.	Severe: clayey; seasonal high water table.
Severe: seasonal high water table.	Moderate: seasonal high water table; slope.	Moderate: potential frost action; seasonal high water table; slope.	Severe: clayey; seasonal high water table.
Moderate: seasonal high water table.	Slight	Slight	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: slope	Severe: seasonal high water table.
Slight[2]	Slight	Slight[2]	Severe: moderately rapid permeability.
Moderate[2]: slope	Moderate	Moderate[2]: slope	Severe: moderately rapid permeability.
Severe[2]: slope	Severe: slope	Severe[2]: slope	Severe: moderately rapid permeability.
Moderate[2]: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Slight[2]	Moderate: bedrock at a depth of 1½ to 3½ feet.
Moderate[2]: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate[2]: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Severe[2]: slope	Severe: slope	Severe[2]: slope	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Severe[2]: slope	Severe: slope	Severe[2]: slope	Severe: slope.
Severe[2]: slope	Severe: slope	Severe[2]: slope	Severe: slope.
Moderate: seasonal high water table.	Slight	Slight	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: slope	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: slope	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: slope	Severe: seasonal high water table; slope.
Moderate: seasonal high water table.	Slight	Slight	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: slope	Severe: seasonal high water table.

Table 5. Allegheny County Soli Survey: Soil Limitations for Town and Country Planning (cont.)

Soil series and map symbols	Septic tank absorption fields [1]	Sewage lagoons [1]
ErD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope
EvB Rating is for both Ernest and Vandergrift parts.	Severe: seasonal high water table; slow permeability.	Moderate: slope
EvC Rating is for both Ernest and Vandergrift parts.	Severe: seasonal high water table; slow permeability.	Severe: slope
EvD Rating is for both Ernest and Vandergrift parts.	Severe: seasonal high water table; slow permeability; slope.	Severe: slope
Gilpin:		
GIB, GpB For the Upshur part of GpB, see UaB in the Upshur series.	Severe: bedrock at a depth of 1½ to 3 feet.	Severe: bedrock at a depth of 1½ to 3 feet.
GIC, GpC For the Upshur part of GpC, see UaC in the Upshur series.	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
GID, GpD For the Upshur part of GpD, see the Upshur series.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
GQF For the Upshur part of GQF, see the Upshur series.	Severe: bedrock at a depth of 1½ to 3 feet; slope.	Severe: bedrock at a depth of 1½ to 3 feet; slope.
GrE For the Vandergrift part of GrE, see the Vandergrift series.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
GSF For the Culleoka part of GSF, see the Culleoka series. For the Weikert part of GSF, see the Weikert series.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
Guernsey:		
GuB	Severe: seasonal high water table; slow permeability.	Moderate: slope
GuC	Severe: seasonal high water table; slow permeability.	Severe: slope
GuD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope
GvB Rating is for both Guernsey and Vandergrift parts.	Severe: seasonal high water table; slow permeability.	Moderate: slope
GvC Rating is for both Guernsey and Vandergrift parts.	Severe: seasonal high water table; slow permeability.	Severe: slope
GvD Rating is for both Guernsey and Vandergrift parts.	Severe: seasonal high water table; slow permeability; slope.	Severe: slope
Gullied land: Gx. Properties are too variable to be rated.		
Hazleton:		
HaB	Moderate: bedrock at a depth of 3½ to 6 feet; hazard of ground water contamination.	Severe: moderately rapid permeability.
HaC	Moderate: bedrock at a depth of 3½ to 6 feet; hazard of ground water contamination; slope.	Severe: moderately rapid permeability; slope.
HaD	Severe: slope; hazard of ground water contamination.	Severe: moderately rapid permeability; slope.
HTE	Severe: slope; hazard of ground water contamination.	Severe: moderately rapid permeability; slope.
Huntington: Hu	Severe: hazard of flooding	Severe: hazard of flooding; moderately rapid permeability in substratum.
Library:		
LbB	Severe: seasonal high water table; slow permeability.	Moderate: slope; hazard of inflow.

Dwellings with basements	Lawns and landscaping	Roads and streets	Sanitary landfills (trench)[1]
Severe: slope	Severe: slope	Severe: slope	Severe: seasonal high water table.
Moderate: seasonal high water table.	Slight	Slight	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: slope	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: slope	Severe: seasonal high water table.
Moderate[2]: bedrock at a depth of 1½ to 3 feet.	Moderate: bedrock at a depth of 1½ to 3 feet.	Slight[2]	Moderate: bedrock at a depth of 1½ to 3 feet.
Moderate[2]: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate[2]: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Severe[2]: slope	Severe: slope	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Severe[2]: slope	Severe: slope	Severe[2]: slope	Severe: slope.
Severe[2]: slope	Severe: slope	Severe[2]: slope	Severe: slope.
Severe[2]: slope	Severe: slope	Severe[2]: slope	Severe: slope.
Moderate: seasonal high water table.	Slight	Slight	Severe: seasonal high water table; too clayey.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: slope	Severe: seasonal high water table; too clayey.
Severe: slope	Severe: slope	Severe: slope	Severe: seasonal high water table; too clayey.
Moderate: seasonal high water table.	Slight	Slight	Severe: seasonal high water table; too clayey.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: slope	Severe: seasonal high water table; too clayey.
Severe: slope	Severe: slope	Severe: slope	Severe: seasonal high water table; too clayey.
Slight[2]	Slight	Slight	Severe: moderately rapid permeability.
Moderate[2]: slope	Moderate: slope	Moderate: slope	Severe: moderately rapid permeability.
Severe[2]: slope	Severe: slope	Severe: slope	Severe: moderately rapid permeability.
Severe[2]: slope	Severe: slope	Severe: slope	Severe: moderately rapid permeability; slope.
Severe: hazard of flooding	Moderate: hazard of flooding	Severe: hazard of flooding	Severe: hazard of flooding; moderately rapid permeability in substratum.
Severe: seasonal high water table.	Moderate: seasonal high water table; too clayey.	Moderate: frost action; seasonal high water table.	Severe: seasonal high water table; too clayey.

Table 5. Allegheny County Soli Survey: Soil Limitations for Town and Country Planning (cont.)

Soil series and map symbols	Septic tank absorption fields [1]	Sewage lagoons [1]
LbC	Severe: seasonal high water table; slow permeability.	Severe: slope
LbD	Severe: seasonal high water table; slow permeability.	Severe: slope
Lindside: Ln	Severe: hazard of flooding; seasonal high water table.	Severe: hazard of flooding; moderately rapid permeability in substratum.
Newark: Ne	Severe: hazard of flooding; high water table.	Severe: hazard of flooding
Philo: Ph	Severe: hazard of flooding	Severe: hazard of flooding; moderately rapid permeability in substratum.
Rainsboro:		
RaA	Severe: seasonal high water table; slow permeability.	Slight
RaB	Severe: seasonal high water table; slow permeability.	Moderate: slope
RaC	Severe: seasonal high water table; slow permeability.	Severe: slope
Rayne:		
RyB	Moderate: bedrock at a depth of 3½ to 5 feet.	Severe: moderately rapid permeability in substratum.
RyC	Moderate: bedrock at a depth of 3½ to 5 feet; slope.	Severe: moderately rapid permeability in substratum; slope.
Strip mines: SmB, SmD, SmF. Properties are too variable to be rated.		
Upshur:		
UaB	Severe: slow permeability	Moderate: slope; bedrock at a depth of 4 to 6 feet.
UaC	Severe: slow permeability	Severe: slope
Upshur part of GpD	Severe: slow permeability; slope.	Severe: slope
Upshur part of GQF	Severe: slow permeability; slope.	Severe: slope
Urban land: UB, UCB, UCD, UCE, UGB, UGD, URB, URC, UWB, UWD. Properties of Urban land are too variable to be rated. For the Culleoka part of UCB and UCD, see CuB and CuD in the Culleoka series. For the Culleoka part of UCE, see the Culleoka series. For the Guernsey part of UGB and UGD, see GuB and GuD in the Guernsey series. For the Rainsboro part of URB and URC, see RaB and RaC in the Rainsboro series. For the Wharton part of UWB and UWD, see WhB and WhD in the Wharton series.		
Vandergrift:		
Vandergrift part of GrE	Severe: slow permeability; seasonal high water table; prone to landslides.	Severe: slope; prone to landslides.
Weikert:		
WEF Properties of the Rock outcrop part are too variable to be rated.	Severe: bedrock at a depth of 1 to 1½ feet; slope.	Severe: bedrock at a depth of 1 to 1½ feet; slope.

Dwellings with basements	Lawns and landscaping	Roads and streets	Sanitary landfills (trench)[1]
Severe: seasonal high water table.	Moderate: seasonal high water table; too clayey; slope.	Moderate: frost action; seasonal high water table; slope.	Severe: seasonal high water table; too clayey.
Severe: seasonal high water table; slope.	Severe: slope	Severe: slope	Severe: seasonal high water table; too clayey.
Severe: hazard of flooding	Moderate: hazard of flooding.	Severe: hazard of flooding	Severe: hazard of flooding; seasonal high water table; moderately rapid permeability in substratum.
Severe: hazard of flooding; high water table.	Severe: hazard of flooding; high water table.	Severe: hazard of flooding; high water table.	Severe: hazard of flooding; high water table.
Severe: hazard of flooding	Moderate: hazard of flooding.	Severe: hazard of flooding	Severe: hazard of flooding; seasonal high water table; moderately rapid permeability in substratum.
Moderate: seasonal high water table.	Slight	Moderate: frost action	Severe: seasonal high water table.
Moderate: seasonal high water table.	Slight	Moderate: frost action	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: frost action; slope.	Severe: seasonal high water table.
Slight[2]	Slight	Slight	Severe: moderately rapid permeability in substratum.
Moderate[2]: slope	Moderate: slope	Moderate: slope	Severe: moderately rapid permeability in substratum; slope.
Moderate: high shrink-swell.	Moderate: too clayey	Slight	Severe: too clayey.
Moderate: high shrink-swell; slope; prone to landslide.	Moderate: too clayey; slope	Moderate: slope	Severe: too clayey.
Severe: slope; prone to landslide.	Severe: slope	Severe: slope; prone to landslide.	Severe: too clayey; prone to landslide.
Very severe: slope; prone to landslide.	Severe: slope	Very severe: slope; prone to landslide.	Severe: too clayey; slope; prone to landslide.
Severe: slope; prone to landslides.	Severe: slope; prone to landslides.	Severe: slope; prone to landslides.	Severe: slope; prone to landslides.
Severe: slope	Severe: bedrock at a depth of 1 to 1½ feet; slope.	Severe: slope	Very severe: bedrock at a depth of 1 to 1½ feet; slope.

Table 5. Allegheny County Soli Survey: Soil Limitations for Town and Country Planning (cont.)

Soil series and map symbols	Septic tank absorption fields [1]	Sewage lagoons [1]
Weikert part of CwB	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.
Weikert part of CwC	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.
Weikert part of CwD	Severe: bedrock at a depth of 1 to 1½ feet; slope.	Severe: bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.
Weikert part of GSF	Severe: bedrock at a depth of 1 to 1½ feet; slope.	Severe: bedrock at a depth of 1 to 1½ feet; slope.
Wharton:		
WhB	Severe: seasonal high water table; slow permeability.	Moderate: slope; bedrock at a depth of 4 feet or more.
WhC	Severe: seasonal high water table; slow permeability.	Severe: slope
WhD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope

Dwellings with basements	Lawns and landscaping	Roads and streets	Sanitary landfills (trench)[1]
Severe[2]: bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet.	Severe[2]: bedrock at a depth of 1 to 1½ feet.	Severe: moderately rapid permeability.
Moderate[2]: bedrock at a depth of 1 to 1½ feet; slope.	Severe: bedrock at a depth of 1 to 1½ feet.	Moderate[2]: bedrock at a depth of 1 to 1½ feet; slope.	Severe: moderately rapid permeability.
Severe[2]: slope	Severe: bedrock at a depth of 1 to 1½ feet; slope.	Severe[2]: slope	Severe: moderately rapid permeability.
Severe[2]: slope	Severe: bedrock at a depth of 1 to 1½ feet; slope.	Severe[2]: slope	Severe: bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.
Moderate: seasonal high water table.	Slight	Slight	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: slope	Moderate: slope	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: slope	Severe: seasonal high water table.

Table 7. Allegheny County Soli Survey: Suitability of the Soils for Elements of Wildlife Habitat

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
Allegheny variant:				
AgB	Good	Good	Good	Good
AgC	Fair	Good	Good	Good
Atkins: At	Poor	Fair	Fair	Fair
Brinkerton: BrB	Poor	Fair	Fair	Good
Cavode:				
CaB	Fair	Good	Good	Good
CaC	Fair	Good	Good	Good
Clarksburg:				
CkB	Good	Good	Good	Good
CkC	Fair	Good	Good	Good
Clymer:				
CmB	Good	Good	Good	Good
CmC	Fair	Good	Good	Good
CmD	Poor	Fair	Good	Good
Culleoka:				
CuB	Good	Good	Good	Good
CuC	Fair	Good	Good	Good
CuD	Poor	Fair	Good	Good
CwB, CwC, CwD	Poor	Poor	Poor	Poor
Dormont:				
DoB	Good	Good	Good	Good
DoC	Fair	Good	Good	Good
DoD	Poor	Fair	Good	Good
DoE	Very poor	Fair	Good	Good
Ernest:				
ErB	Good	Good	Good	Good
ErC	Fair	Good	Good	Good
ErD	Poor	Fair	Good	Good
EvB	Fair	Good	Good	Good
EvC	Fair	Good	Good	Good
EvD	Poor	Fair	Good	Good
Gilpin:				
GlB	Fair	Good	Good	Good
GlC	Fair	Good	Good	Good
GlD	Poor	Fair	Good	Good
GpB	Fair	Good	Good	Good
GpC	Fair	Good	Good	Good
GpD	Poor	Fair	Good	Good
GQF	Very poor	Poor	Good	Good
GrE	Very poor	Fair	Good	Good
GSF	Very poor	Poor	Poor	Poor
Guernsey:				
GuB	Good	Good	Good	Good
GuC	Fair	Good	Good	Good
GuD	Poor	Fair	Good	Good
GvB	Fair	Good	Good	Good
GvC	Fair	Good	Good	Good
GvD	Poor	Fair	Good	Good
Hazleton:				
HaB	Good	Good	Good	Good
HaC	Fair	Good	Good	Good
HaD	Poor	Fair	Good	Good
HTE	Very poor	Poor	Good	Good
Huntington: Hu	Good	Good	Good	Good

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow water plants	Openland	Woodland	Wetland
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Fair	Good	Good	Fair	Fair	Good.
Good	Poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Poor	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Poor	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.

Table 7. Allegheny County Soli Survey: Suitability of the Soils for Elements of Wildlife Habitat (cont.)

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
Library:				
LbB	Fair	Good	Good	Good
LbC	Fair	Good	Good	Good
LbD	Poor	Fair	Good	Good
Lindside: Ln	Good	Good	Good	Good
Newark: Ne	Poor	Fair	Fair	Fair
Philo: Ph	Good	Good	Good	Good
Rainsboro:				
RaA	Good	Good	Good	Good
RaB	Good	Good	Good	Good
RaC	Fair	Good	Good	Good
Rayne:				
RyB	Good	Good	Good	Good
RyC	Fair	Good	Good	Good
Upshur:				
UaB	Good	Good	Good	Good
UaC	Fair	Good	Good	Good
Urban land: UB, UCB, UCD, UCE, UGB, UGD, URB, URC, UWB, UWD. Properties of Urban land are too variable to be rated. For the Culleoka part of UCB, UCD, and UCE, see CuB, CuD, and CwD in the Culleoka series. For the Guernsey part of UGB and UGD, see GuB and GuD in the Guernsey series. For the Rainsboro part of URB and URC, see RaB and RaC in the Rainsboro series. For the Wharton part of UWB and UWD, see WhB and WhD in the Wharton series.				
Weikert: WEF	Very poor	Very poor	Very poor	Poor
Wharton:				
WhB	Good	Good	Good	Good
WhC	Fair	Good	Good	Good
WhD	Poor	Fair	Good	Good

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow water plants	Openland	Woodland	Wetland
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Fair	Good	Good	Fair	Fair	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Poor	Very poor	Very poor	Very poor	Poor	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.

Recent studies have generated interest and increasing awareness of the importance of urban green space. In addition to aesthetic value, studies suggest that green surroundings improve both physical and mental fitness (Ulrich 84, Williams and Harvey 2001). Furthermore, urban green space provides economic and environmental benefits including habitat for a wide range of wildlife (Jim 2003), removal of pollutants from groundwater, especially storm water runoff, and removal of fossil fuel combustion emissions from the air (Nowak 1994, Hyun-Kil 2001).

In the Pittsburgh area, most of the valleys and floodplains in the region have been developed while the steep hillsides, which provide green space in the city and contribute to the beauty of the Pittsburgh landscape are far less developed. These greater than 25% slope hillsides occupy 38% of Pittsburgh's total forest space and 33% of Pittsburgh's total forest and park area. Information about the quality of these areas, the identity of species found on these hillsides and the level of disturbance on the hillsides is needed to make land management decisions. Our goal was to census the woody vegetation in three areas in Pittsburgh that are characterized by steep hillsides. We evaluated the quality of the vegetation by 1) determining the species identity and of the woody vegetation in our sampling area, 2) quantifying the proportion of each species in the sample area, 3) determining the average size of individual tree species for a subset of trees in our sampling area and 4) assessing the proportion of woody species that were native or invasive. 5) When present, we also noted the identity of the herbaceous species in our sampling area, as the association between key woody and herbaceous species is indicative of distinct forest types.

Methods

In collaboration with the Hillsides Planning Committee, (5/18/2004 meeting) three areas representing the range of green hillsides found in Pittsburgh were chosen. These sites were identified using a map of Pittsburgh green space developed by Kostoula Vallianos based on size of the green space and/or proximity to other green spaces, degree of development in the surrounding area, and the steepness of the site (greater than 25% slope). The sampling was conducted in late July, 2004. The three sites are listed as follows:

SITE A - Steep recovering urban forest with disturbed soils.
SITE B1 and SITE B2 - Steep remnant urban forest, mostly natural soils.
SITE C - A large steep grade urban forest on a mix of natural soils, undermined soils and fill. A mix of remnant and recovering forest.

Site A was expected to be representative of the most urban green space. Site B1 and Site B2 and is more neighborhood to suburban in character. Site C is the largest green space we sampled. It contains a great amount of interior forest (defined as the forest area approximately 100 m from the edge of forest patch) as well as varying topography that could potentially support several different types of plant communities, as well as other wildlife that require a larger minimum habitat area.

Data collection: At each site, we identified all woody and the native herbaceous species present within our chosen sites by walking transect through or just below each steep hillside area and recording all species noted. [Note: Because of late sampling date within the growing season, fewer native herbaceous species than expected were observed in the sampled areas. Many herbaceous species of forests senesce by early July in this region.] Within each area, we set up 3-5 10X10 meter plots at each site, which were spaced at least 50 meters apart. Within each plot, we estimated the abundance of each woody species present and took diameter at breast height measurements for all overstory trees. This data allowed us to calculate the percent of overall abundance and to determine if the species present in these areas indicated remnants of the previous intact communities. The species at each site were compared with those listed in the Pennsylvania DCNR's plant communities (Appendix A). We also calculated the overall percent exotic species abundance for each site.

Results

Overall, we found a high diversity of woody species within each of the sites and evidence of four typical forest community types in the three areas sampled. We identified 84 woody species in total: 66 of which were native (=79%), and 13 of which are native hardwood trees (15%) (See Table 1). We also identified many native herbaceous species (See table 2), and the forest communities in some areas indicate the likely presence of a diverse vernal flora, although we surveyed too late in the season to see vernal species. Most sites also supported an abundance of native understory shrubs and small tree species (Table 1), which is important for many species of wildlife, especially songbirds. Large, mature overstory trees were found at all sites. Many trees were greater than two meters in circumference and one tree at Site C exceeded three meters in circumference. The steep hillsides of Pittsburgh indeed sustain a diverse assemblage of tree species with their attending shrubs and understory trees. An overview of forest structure at all three sites is listed in Table 6.

Black Locust (Robinia psuedoacacia)

We identified elements of four hardwood forest native plant communities along the hillsides (See Appendix A for complete descriptions of these forest types):

<u>Dry oak– mixed hardwood forest</u>, typically occurs on slopes with dry soil

<u>Red oak– mixed hardwood forest</u>, occurs in mesic soils and found on lower slopes in our survey

<u>Sugar maple– basswood forest</u>, often occurs on rich soils with rocky slopes and supports a rich vernal flora .

<u>Mixed mesophytic forest</u>, which is typically found on lower slopes, which is unique to the southwestern portion of Pennsylvania, and supports an extremely rich and diverse herbaceous flora.

Site A

Steep recovering urban forest with disturbed soils.

Although the Site A was the most disturbed of the sites sampled, we identified 52 woody species, 35 of which are native, across the four sampled areas (Table 3). The overall percent abundance of native species was 66%. The more abundant native species are associated with disturbed areas, including black locust (Robinia psuedoacacia) and staghorn sumac (Rhus typhina). However, remnants of native forests were found here, with very large red oak (Quercus rubra), black walnut (Juglans nigra), American elm (Ulmus Americana), and basswood (Tilia Americana) occurring. Exotic species represented 34% of the total percent abundance, the highest of the three sites. This is to be expected, as disturbance in an area increases the likelihood of invasive species establishment, the smaller a fragment is, the more likely non-native species are to establish. These are among the smallest green areas in the city and they are traversed by old, abandoned roads, side walks, and staircases that are no longer maintained but are used. Despite the impact to the hillsides, native species still predominate in the Site A. It is also important to note that seedlings and saplings of these common native species were present in the understory, as well as seedlings of other native species not present in the overstory. This suggests that even on this urban hillside that is surrounded by development, there exists the potential to support native trees.

Site B1 & Site B2

Steep remnant urban forest, mostly natural soils.

Both sites appeared intact and supported diverse and distinctive forest community types. Overall, 48 woody species were identified, 36 of which are native. See Table 4 for a list of species found on this hillside. Both sites had low abundance of invasive species and both supported a diverse flora.

Jack-in-the-pulpit (*Arisaema triphyllum*)

The B1 area is forested predominantly by intact dry oak-mixed hardwood forest. The dominant species are sugar maple (Acer saccharinum), black oak (Quercus velutina), red oak (Quercus rubra), bitternut hickory (Carya cordiformis), and white ash (Fraxinus americana). Native species comprise more than 95% of overall abundance. Herbaceous species seen at the time of survey were Jack-in-the-pulpit (Arisaema triphyllum), false Solomon's seal (Smilacena racemosa), mayapple (Podophyllum peltatum), smooth Solomon's seal (Polygonatum biflorum), and enchanter's nightshade (Circaea lutetiana). The presence of these native species indicates the likely occurrence of other associated native species, especially spring ephemeral species, which are not visible in late July, when the survey was conducted.

The B2 area has a very rich and diverse overstory and understory. Very few exotic species are present, comprising only 2% of overall abundance. The DCNR's Red oak – mixed hardwood forest best describes this site (See Appendix A). The overstory is dominated by red oak (*Quercus rubra*), white oak (*Quercus alba*), sugar maple (*Acer saccharum*), black cherry (*Prunus serotina*), tulip tree (*Liriodendron tulipifera*), white ash (*Fraxinus Americana*), and basswood (*Tilia Americana*). Understory species include Hop-hornbeam (*Ostrya virginiana*), Hornbeam (*Carpinus carolinana*), Spicebush (*Lindera benzoin*), Arrowwood (*Viburnum dentatum*), Maple-leaved viburnum (*Viburnum acerifolium*), and Hydrangea (*Hydrangea arborescens*). Herbaceous species present include: Jack-in-the-pulpit

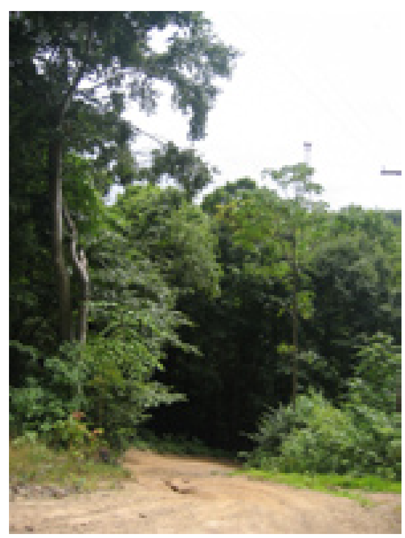
(*Arisaema triphyllum*), wild geranium (*Geranium maculatum*), false Solomon's seal (*Smilacena racemosa*), Mayapple (*Podophyllum peltatum*), smooth Solomon's seal (*Polygonatum biflorum*), and enchanter's nightshade (*Circaea lutetiana*). As indicated by the forest type, this area also likely supports an abundant native herbaceous flora. This area is managed by a private housing development. Grass paths and hiking paths are maintained that run along the top of the ridge and afford views of the forest vegetation growing along the steep hillsides. This tract of land exemplifies how land stewardship can maintain and enhance both the natural and housing value of a site.

Site C

A large steep grade urban forest on a mix of natural soils, undermined soils and fill. A mix of remnant and recovering forest.

Of all three sites, the Site C supports the most diversity in habitat types-- from early successional grass/shrublands to mature forests. It occupies2576 hectares, and has been undeveloped for many years since it was last partially logged and mined. Given the presence of early successional areas, it is surprising that native plants dominate the site. We found that native plants comprise 95% of the overall abundance. We identified 44 woody species on the steep hillsides of the Site C site, 33 of which are native.

Two types of native forest types were identified at the Site C. Some of the steep slopes are best described by the DCNR's Sugar – Maple Basswood forest. This forest type is dominated by sugar maple (*Acer saccharum*), basswood (*Tilia Americana*), red oak (*Quercus rubra*), tulip tree (*Liriodendron tulipifera*), and Yellow Birch (*Betula allegheniensis*). This forest type sometimes overlapped with Mixed Mesophytic forest, a rare and rich forest type found only in the Southwest portion of Pennsylvania. It is dominated by sugar maple (*Acer saccharum*), tulip tree (*Liriodendron tulipifera*), red oak (*Quercus rubra*), black cherry (*Prunus serotina*), and white ash (*Fraxinus Americana*). (insert info for Agnew 2) An abundance of herbaceous species were seen in association with these forest types. Some of these include perfoliated bellwort (*Uvularia perfoliata*), Jack-in-the-pulpit (*Arisaema triphyllum*), mayapple (*Podophyllum peltatum*), tall bellflower (*Campanula americana*), bloodroot (*Sanguinaria canadensis*), and wild geranium (*Geranium maculatum*). The presence of these forest types also indicates the likely presence of other spring ephemeral wildflowers that were not seen at the time of survey. Notable at this site was the largest tree in our sample, a tulip tree over three meters in cirumference—while the average tulip tree circumference was over one meter. We also found evidence of bear (scat) at this site.



Summary/Recommendations

Our methods of sampling provide a rapid assessment of the quality of the vegetation on Pittsburgh's hillsides. These areas were identified using Kostoula Vallianos' Ecological context maps, which classify the woodland and interior forest characteristics of the green space. Our data indicate that there is strong agreement between the map classification and the quality of the site.

Surprisingly, the majority of tree species on the steep hillsides of Pittsburgh we sampled were native species. The hillsides of Pittsburgh appear to function as refugia for the native species of the region. Even Site A, which is the most disturbed, and surrounded by an area that is densely inhabited, native woody species predominate on the hillsides. The well-drained soils and thriving old oaks seen at the site are likely to be found in other south-facing steep hillsides. Site B1 and Site B2 are both relatively intact: Site B1 currently protected and the Site B2 is less intact, but clearly ranks higher in quality than the Site A sites. The Site C is comprised of a variety of forest types on the steep hillsides, with high value for species conservation. There are areas of intact forest where land preservation would ensure the protection of this forest and fauna diversity that probably exists, given the size of the area. This area is likely indicative of other large tracts of land in the Pittsburgh region.

Overall, we found that the forested hillsides of Pittsburgh are surprisingly beautiful, wild areas that potentially offer the residents of Pittsburgh a place for recreation and learning, in addition to the aesthetic and environmental benefits. Land management decisions need to be made that consider the possibilities of conservation and restoration as well as development. In addition – we believe that the information provided in the following tables can be used to develop specific guidelines for steep slope development.

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4.4 Appendix B: Vegetation Assesment Table

Plant Community Types Identified on Steep Hillsides of Pittsburgh.
Native Plant Community Types found on Pittsburgh's slopes based on DCNR's Terrestrial and Palustrine Plant Communities of Pennsylvania

1. Dry oak-mixed hardwood forest

This forest type occurs in areas with dry soils, and is often found on south-facing or southwest-facing slopes. Common trees in this forest type are *Quercis alba* (white oak), *Betula spp.* (birch), *Carya spp.* (hickory), *Celtis occidentalis* (hackberry), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Quercus montana* (chestnut oak), *Quercis velutina* (black oak), *Quercus rubra* (red oak), F*raxinus americana* (white ash), and *Tilia americana* (basswood). This forest type characteristically supports an abundance of understory species, especially *Cornus florida* (flowering dogwood), *Carpinus caroliniana* (hornbeam), *Amelanchier arborea* (shadbush), *Cercis Canadensis* (redbud), and *Ostrya virginiana*. This forest type also supports a relatively plentiful herbaceous flora including *Smilacena racemosa* (false solomon's-seal), *Polygonatum biflorum* (smooth solomon's seal), *Asplenium platyneuron* (ebony spleenwort), *Desmodium spp.* (tick-trefoil), *Hieracium venosum* (rattlesnake weed), *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (a sedge), *Carex communis* (a sedge), and *Lysimachia quadrifolia* (whorled loosestrife).

2. Red oak – mixed hardwood forest

This common forest type occurs throughout Pennsylvania in areas with mesic soil conditions. *Quercus rubra* is often the dominant or co-dominant overstory species. Other commonly occurring species are *Acer rubrum* (red maple), *Quercus velutina* (black oak), *Quercus alba* (white oak), *Carya spp.* (hickory), *Betula lenta* (sweet birch), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Fagus grandifolia* (American beech), and/or *Liriodendron tulipifera* (tuliptree). This forest type includes the understory species *Viburnum recognitum* (northern arrowwood), *Viburnum dentatum* (southern arrowwood), *Viburnum acerifolium* (maple-leaved viburnum), *Amelanchier laevis* (smooth serviceberry), *Ameanchier arborea* (shadbush), *Kalmia latifolia* (mountain laurel), *Carpinus caroliniana* (hornbeam), *Ostrya virginiana* (hop-hornbeam), *Hamamelis virginiana* (witchhazel), and *Lindera benzoin* (spicebush). The herbaceous layer of this forest type is very variable, but some herbaceous species that we found in our survey here are *Smilacena racemosa* (false solomon's seal), *Polygonatum biflorum* (smooth solomon's-seal), *Geranium maculatum*, *Sanguinaria Canadensis* (bloodroot), *Arisaema triphyllum* (jack-in-the-pulpit), and *Dryopterus spp*. (wood ferns).

3. Sugar maple – basswood forest

This forest type is commmonly found on rich rocky slopes, but can also be found in a range of substrate conditions in Western Pennsylvania. *Acer saccharum* (sugar maple) and *Tilia americana* (basswood), are the most common species in this forest, co-occurring with *Quercus rubra* (red oak), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), *Betula alleghanienis* (yellow birch), and *Betula lenta* (sweet birch). Understory species occurring here are *Lindera benzoin* (spicebush), *Hamamelis virginiana* (witch hazel), and in rich areas *Asimina triloba* (pawpaw), and *Staphylea trifolia* (bladdernut). This forest type supports an abundant herbaceous flora including many spring wildflowers, which among many include *Anemone quinquefolia* (wood anemone), *Cimicifuga racemosa* (black cohosh), *Geranium maculatum* (wild geranium), *Caulophllum thalictroides* (blue cohosh), *Sanguinaria canadens*is (bloodroot), *Erythronium americanum* (trout lily), *Arisaema triphyllum* (jack-in-the-pulpit), *Mitella diphylla* (bishop's-cap), and *Asarum canadense* (wild ginger), as well as other herbs including *Smilacena racemosa* (false solomon's-seal), *Dryopteris marginalis* (evergreen wood fern), and *Botrychium virginianum* (rattlesnake fern).

4. Mixed mesophytic forest

In Pennsylvania, this type of forest only occurs in the southwestern portion of the state, and supports a rich and diverse flora, including several species whose northern and eastern limits occur in southwest Pennsylvania. This community type is most often found on lower slopes. Tree species include *Liriodendron tulipifera* (tuliptree), *Acer sachharum* (sugar maple), *Fagus grandifolia* (American beech), *Tilia americana* (basswood), *Quercus rubra* (red oak), *Magnolia acuminata* (cucumber tree), *Prunus serotina* (black cherry), *Fraxinus americana* (white ash), *Juglans nigra* (black walnut), *Carya* ovata (shagbark hickory), *Aesculus glabra* (Ohio Buckeye), and *Aesculus flava* (yellow buckeye). Understoy specis include *Asimina triloba* (pawpaw), *Staphylea trifolia* (bladdernut), *Rhododendron maximum* (rosebay), *Magnolia tripetala* (umbrella magnolia), *Cercis* canadensis (redbud), *Lindera benzoin* (spicebush), *Hydrangea arborsescens* (wild hydrangea), and *Hamamelis virginiana* (witch-hazel). The herbaceous flora in this forest type is among the most diverse in Pennsylvania. Herbaceous species include *Trillium grandiflorum* (white trillium), *Trillium erectum* (purple trillium), *Trillium* sessile (toadshade), *Erythronium americanum* (trout-lily), *Phlox divaricata* (wild blue phlox), *Anemone quinquefolia* (wood anemone), *Dicentra canadensis* (squirrel corn), *Dicentra cucullaria* (dutchman's breeches), *Clintonia umbellulata* (speckled wood-lily), *Cimicifuga racemosa* (black cohosh), *Geranium maculatum* (wild geranium), *Caulophyllum thalictroides* (blue cohosh), *Tiarella cordifolia* (foamflower), *Hepatica nobilis* (liverleaf), *Allium tricoccum* (wild leek), *Sanguinaria canadensis* (bloodroot), *Corydalis flavula* (yellow fumewort), *Botrychium virginianum* (rattlesnake fern), *Claytonia virginica* (spring beauty), *Cardamine concatenata* (cut-leaved toothwort), *Mitella di-*

Table 1. List of woody species

Summary list of all woody species identified in vegetation survey of three sites in the Pittsburgh Steep Hillsides project, 2004. Font color indicates status (black=native, blue=introduced, red=introduced & invasive). Note: Japanese knotweed is herbaceous, but included in this list.

Species	Common Name	Family	Status
Acer negundo	Box Elder	Aceraceae	Native
Acer platanoides	Norway Maple	Aceraceae	Introduced from Europe/Invasive
Acer rubrum	Red Maple	Aceraceae	Native
Acer saccharinum	Silver Maple	Aceraceae	Native
Acer saccharum	Sugar Maple	Aceraceae	Native
Aesculus hippocastanum	Horse Chestnut	Sapindaceae	Native
Ailanthus altissima	Tree of Heaven	Simaroubaceae	Introduced from Asia/Invasive
Amelanchier canadensis	Serviceberry, Shagbush	Rosaceae	Native
Aralia spinosa	Devil's Walking Stick	Vitaceae	Native

Aesculus hippocastanum	Horse Chestnut	Sapindaceae	Native
Ailanthus altissima	Tree of Heaven	Simaroubaceae	Introduced from Asia/Invasive
Amelanchier canadensis	Serviceberry, Shagbush	Rosaceae	Native
Aralia spinosa	Devil's Walking Stick	Vitaceae	Native
Aronia melanocarpa	Black Chokeberry	Rosaceae	Native
Asimina adans	Paw Paw	Annonaceae	Introduced from Southern US
Betula allegheniensis	Yellow Birch	Betulaceae	Native
Betula spp.	Birch	Betulaceae	Native
Carpinus caroliniana	Musclewood	Betulaceae	Native
Carya cordiformis	Bitternut Hickory	Juglandaceae	Native
Carya ovata	Shagbark Hickory	Juglandaceae	Native
Carya tomentosa	Mockernut Hickory	Juglandaceae	Native
Catalpa spp.	Catalpa	Bignoniaceae	Introduced from Southern US
Celastrus orbiculatus	Oriental Bittersweet	Celastraceae	Introduced from Asia/Invasive
Celtis occidentalis	Hackberry	Ulmaceae	Native
Cornus florida	White Flowering Dogwood	Cornaceae	Native
Craetagus spp.	Hawthorne	Rosaceae	Native
Euonymus alatus	Winged Wahoo	Celastraceae	Introduced from Asia
Fagus grandifolia	Beech	Fagaceae	Native
Forsythia cv.	Forsythia	Oleaceae	Introduced from Europe
Fraxinus americana	American Ash	Oleaceae	Native
Fraxinus nigra	Black Ash	Oleaceae	Native
Fraxinus spp.	Ash spp.	Oleaceae	Native
Ginko biloba	Ginko	Class Ginkoopsida	Introduced from Asia
Gleditsia triacanthos	Honey Locust	Fababceae	Native
Hamamaelis virginiana	Witchhazel	Hamaelidaceae	Native
Hibiscus syriacus	Rose of Sharon	Malvaceae	Introduced from Asia
Hydrangea arborescens	Hydrangia	Hydrangeaceae	Native
Juglans nigra	Black Walnut	Juglandaceae	Native
Ligustrum vulgare	Privet	Oleaceae	Introduced from Europe
Lindera benzoin	Spicebush	Lauraceae	Native
Liriodendron tulipifera	Tulip Poplar	Magnoliaceae	Native
Lonicera spp.	Honeysuckle	Caprifoliaceae	Introduced/Invasive
Lonicerna japonica	Japanese Honeysuckle	Caprifoliaceae	Introduced from Asia/Invasive
Lonicerna maccki	Amur honeysuckle	Caprifoliaceae	Introduced from Asia/Invasive
Maclura pomifera	Osage Orange	Moraceae	Introduced from Southern US
Malus coronaria	Crabapple	Rosaceae	Native
Malus pumila	Apple	Rosaceae	Introduced from Asia
Menispermum canadense	Moonseed	Menispermaceae	Native
Morus rubra	Red Mulberry	Moraceae	Native
Morus spp.	Mulberry spp.	Moraceae	Native/Introduced
Ostrya carpinus	Hop-hornbeam	Betulaceae	Native
Parthenocissus quinquefloia	Virginia Creeper	Vitaceae	Native
Pinus resionsa	Red Pine	Pinaceae	**Introduced**
Pinus strobus	White Pine	Pinaceae	Native
Plantanus occidentalis	American Sycamore	Plantanceae	Native
Polygonum cudpidatum	*Japanese Knotweed*	*Polygonaceae*	*Introduced from Asia/Invasive*
Prunus serotina	Black Cherry	Rosaceae	Native
Prunus spp.	Cherry spp.	Rosaceae	Native
Quercus macrocarpa	Burr Oak	Fagaceae	Native
Quercus alba	White Oak	Fagaceae	Native
Quercus prinus	Chestnut oak	Fagaceae	Native
Quercus rubra	Red Oak	Fagaceae	Native
Quercus spp.	Oak spp.	Fagaceae	Native
Rhamnus frangula	*Buckthorn Alder*	*Rhamnaceae*	*Introduced from EurAsia/Invasive*
Rhamnus spp.	Rhamnus spp.	Rhamnaceae	Native/Introduced
Rhus spp.	Sumac	Anacardiaceae	Native

Rhus typhina	Staghorn Sumac	Anacardiaceae	Native
Robinia psuedoacacia	Black Locust	Fabaceae	Introduced from Southern US
Rosa multiflora	Multiflora Rose	Rosaceae	Introduced from Asia/Invasive
Rubus oderatus	Purple-flowering raspberry	Rosaceae	Native
Rubus spp.	Blackberry, Raspberry	Rosaceae	Native
Sambucus canadensis	Elderberry	Caprifoliaceae	Native
Sassafras albidum	Sassafrass	Lauraceae	Native
Smilax spp.	Greenbriar	Similicaceae	Native/Introduced
Solanum dulcamara	Bittersweet Nightshade	Solanaceae	Introduced from Europe/Invasive
Sorbus aucuparia	Moutain Ash	Rosaceae	Introduced from Europe
Syringa vulgaris	Lilac	Oleaceae	Introduced from EurAsia
Tilia americana	Basswood	Tiliaceae	Native
Toxicodendron radicans	Poison Ivy	Anacardiaceae	Native
Tsuga canadensis	Hemlock	Pinaceae	Native
Ulmus americana	American Elm	Ulmaceae	Native
Ulmus spp.	Elm spp.	Ulmaceae	Native/Introduced
Viburnum acerifolium	Maple leaved Viburnum	Adoxaceae	Native
Viburnum dentatum	Arrowwood	Adoxaceae	Native
Vitus spp.	Grapevine	Vitaceae	Native/Introduced

Table 2. List of herbaceous species

List of native herbaceous species identified in woody vegetation survey of Pittsburgh hillsides in July 2004.

Species Name	Common Name	Family Name
Smilacina racemosa	False Solomon's Seal	Liliaceae
Circaea lutetiana	Enchanter's Nightshade	Onagraceae
Arisaema triphyllum	Jack in the Pulpit	Araceae
Geranium maculatum	Wild Geranium	Geraniaceae
Campanula americana	Tall Bellwort	Campanulaceae
Sanguinaria canadensis	Bloodroot	Papaveraceae
Podophyllum peltatum	Mayapple	Berberidaceae
Uvularia perfoliata	Bellwort	Liliaceae
Polygonatum biflorum	Smooth Solomon's Seal	Liliaceae

Table 3. Species Site A

List of species identified in woody vegetation survey. Font color indicates status (Black=native, blue=introduced, red=introduced & invasive).

Species Name	Common Name	Family	Native/Introduced/Invasive
Acer negundo	Box Elder	Aceraceae	Native
Acer platanoides	Norway Maple	Aceraceae	Introduced from Europe/Invasive
Acer rubrum	Red Maple	Aceraceae	Native
Acer saccharinum	Silver Maple	Aceraceae	Native
Acer saccharum	Sugar Maple	Aceraceae	Native

Acer rubrum	Red Maple	Aceraceae	Native
Acer saccharinum	Silver Maple	Aceraceae	Native
Acer saccharum	Sugar Maple	Aceraceae	Native
Aesculus hippocastanum	Horse Chestnut	Sapindaceae	Native
Ailanthus altissima	Tree of Heaven	Simaroubaceae	Introduced from Asia/Invasive
Amelanchier arborea	Shadbush	Rosaceae	Native
Catalpa spp.	Catalpa	Bignoniaceae	Introduced from Southern US
Celatrus orbiculatus	Oriental Bittersweet	Celastraceae	Introduced from Asia/Invasive
Celtis occidentalis	Hackberry	Ulmaceae	Native
Craetagus spp.	Hawthorn	Rosaceae	Native
Creatagus spp.	Hawthorn	Rosaceae	Native
Forsythia cv.	Forsythia	Oleaceae	Introduced from Europe
Fraxinus americana	American Ash	Oleaceae	Native
Fraxinus nigra	Black Ash	Oleaceae	Native
Ginkgo biloba	Ginkgo	Class Ginkoopsida	Introduced from Asia
Gleditsia triacanthos	Honey Locust	Fabaceae	Native
Hibiscus syriacus	Rose of Sharon	Malvaceae	Introduced from Asia
Juglans nigra	Walnut	Juglandaceae	Native
Ligustrum vulgare	Privet	Oleaceae	Introduced from Europe
Lonicerna japonica	Japanese Honeysuckle	Caprifoliaceae	Introduced from Asia/Invasive
Lonicerna maccki	Honeysuckle	Caprifoliaceae	Introduced from Asia/Invasive
Maclura pomifera	Osage Orange	Moraceae	Introduced from Southern US
Malus pumila	Apple	Menispermaceae	Native
Morus rubra	Red Mulberry	Moraceae	Native
Morus spp.	Mulberry spp.	Moraceae	Native/Introduced
Parthenocissus quinquefloia	Virginia Creeper	Vitaceae	Native
Pinus resionsa	Red Pine	Pinaceae	Native
Plantanus occidentalis	American Sycamore	Plantanceae	Native
Poloygonum cudpidatum	Japanese Knotweed	Polygonaceae	Introduced from Asia/Invasive
Prunus serotina	Black Cherry	Rosaceae	Native
Prunus spp.	Cherry spp.	Rosaceae	Native
Quercus macrocarpa	Burr Oak	Fagaceae	Native
Quercus alba	White Oak	Fagaceae	Native
Quercus rubra	Red Oak	Fagaceae	Native
Quercus spp.	Oak, red or black	Fagaceae	Native
Rhamnus frangula	Buckthorn Alder	Rhamnaceae	Introduced from Eurasia/Invasive
Rhus spp.	Sumac	Anacardiaceae	Native
Robinia psuedoacacia	Black Locust	Fabaceae	Introduced from Southern US
Rosa multiflora	Multiflora Rose	Rosaceae	Native
Rubus spp.	Raspberry spp.	Rosaceae	Native
Sambucus canadensis	Elderberry	Caprifoliaceae	Native
Solanum dulcamara	Bittersweet Nightshade	Solanaceae	Introduced from Asia/Invasive
Sorbus spp.	Moutain Ash	Rosaceae	Introduced from Europe
Tilia americana	Basswood	Tiliaceae	Native
Toxicodendron radicans	Poison Ivy	Anacardiaceae	Native
Ulmus americana	American Elm	Ulmaceae	Native
Ulmus spp.	Elm spp.	Ulmaceae	Native/Introduced
Viburnum acerifolium	Maple leaved Viburnum	Adoxaceae	Native
Viburnum dentatum	Arrow-wood	Adoxaceae	Native
Vitus spp.	Grapevine	Vitaceae	Native/Introduced

Table 4. Species Site B1 + Site B2

List of species identified in woody vegetation survey. Font color indicates status (Black=native, blue=introduced, red=introduced & invasive).

Species Name	Common Name	Family	Native/Introduced/Invasive
Acer negundo	Box Elder	Aceraceae	Native
Acer rubrum	Red Maple	Aceraceae	Native
Acer saccharinum	Sugar Maple	Aceraceae	Native
Ailanthus altissima	Tree of Heaven	Simaroubaceae	Introduced from Asia/Native
Aralia spinosa	Devil's Walking Stick	Vitaceae	Native
Aronia melanocarpa	Black Chokeberry	Rosaceae	Native
Asimina triloba	Paw Paw	Annonaceae	Introduced from Southern US
Betula alleghiensis	Yellow Birch	Betulaceae	Native
Carpinus caroliniana	Musclewood	Betulaceae	Native
Carya cordiformis	Bitternut Hickory	Juglandaceae	Native
Carya ovata	Shagbark Hickory	Juglandaceae	Native
Carya tomentosa	Mockernut Hickory	Juglandaceae	Native
Celastrus orbiculatus	Oriental Bittersweet	Celastraceae	Introduced from Asia/Invasive
Celtis occidentalis	Hackberry	Ulmaceae	Native
Craetagus spp.	Hawthorn spp.	Rosaceae	Native
Eunoymus atropurpureus	Winged Wahoo	Celastraceae	Introduced from Asia
Fagus grandifolia	Beech	Fagaceae	Native
Forsythia cv.	Forsythia spp.	Oleaceae	Introduced from Europe
Fraxinus americana	American Ash	Oleaceae	Native
Hamamaelis virginiana	Witch Hazel	Hamaelidaceae	Native
Hydrangea arborescens	Hydrangea	Hydrangeaceae	Native
Juglans nigra	Black Walnut	Juglandaceae	Native
Ligustrum vulgare	Privet	Oleaceae	Introduced from Europe
Lindera benzoin	Spicebush	Lauraceae	Native
Liriodendron tulipifera	Tulip Poplar	Magnoliaceae	Native
Maclura pomifera	Osage Orange	Moraceae	Introduced from Southern US
Menispermum canadense	Moonseed	Menispermaceae	Native
Ostrya carpinus	Hop-hornbean	Betulaceae	Native
Parthenocissus quinquefloia	Virginia Creeper	Vitaceae	Native
Pinus strobus	White Pine	Pinaceae	Native
Polygonum cuspidatum	Japanese Knotweed	Polygonaceae	Introduced from Asia/Invasive
Prunus serotina	Black Cherry	Rosaceae	Native
Prunus spp.	Cherry spp.	Rosaceae	Native
Quercus alba	White Oak	Fagaceae	Native
Quercus rubra	Red Oak	Fagaceae	Native
Quercus spp.	Black/Red Oak	Fagaceae	Native
Robinia psuedoacacia	Black Locust	Fabaceae	Introduced from Southern US
Rosa multiflora	Multiflora Rose	Rosaceae	Introduced from Asia/Invasive
Rubus spp.	Blackberry, Raspberry	Rosaceae	Native
Sambucus canadensis	Elderberry	Caprifoliaceae	Native
Sassafras albidum	Sassafrass	Lauraceae	Native
Smilax sp.	Greenbrier	Similaceae	Native/Introduced
Tilia americana	Basswood	Tiliaceae	Native
Toxicodendron radicans	Poison Ivy	Anacardiaceae	Native
Tsuga canadensis	Hemlock	Pinaceae	Native
Ulmus americana	American Elm	Ulmaceae	Native
Viburnum dentatum	Arrow-wood	Adoxaceae	Native
Vitus sp.	Grapevine	Vitaceae	Native/Introduced

Table 5. Species Site C

List of species identified in woody vegetation survey. Font color indicates status (Black=native, blue=introduced, red=introduced & invasive).

Species Name	Common Name	Family	Native/Introduced/Invasive
Acer negundo	Box Elder	Aceraceae	Native
Acer rubrum	Red Maple	Aceraceae	Native
Acer saccharum	Sugar Maple	Aceraceae	Native
Ailanthus altissima	Tree of Heaven	Simaroubaceae	Introduced from Asia/Invasive
Aralia spinosa	Devil's Walking Stick	Vitaceae	Native
Betula allegheniensis	Yellow Birch	Betulaceae	Native
Betula spp.	Birch	Betulaceae	Native
Carya cordiformsi	Mockernut Hickory	Juglandaceae	Native
Catalpa spp.	Catalpa	Bignoniaceae	Introduced from Southern US
Celastrus orbiculatus	Oriental Bittersweet	Celastraceae	Introduced from Asia/Invasive
Celtis occidentalis	Hackberry	Ulmaceae	Native
Cornus florida	White Flowering Dogwood	Cornaceae	Native
Creatagus spp.	Hawthorn	Rosaceae	Native
Forsythia spp.	Forsythia	Oleaceae	Introduced from Europe
Fraxinus spp.	Ash spp.	Oleaceae	Native
Hamamaelis virginiana	Witchhazel	Hamaelidaceae	Native
Juglans nigra	Black Walnut	Juglandaceae	Native
Ligustrum vulgare	Privet	Oleaceae	Introduced from Europe
Liriodendron tulipifera	Tulip Poplar	Magnoliaceae	Native
Lonicera spp.	Honeysuckle	Caprifoliaceae	Introduced/Invasive
Lonicerna japonica	Japanese Honeysuckle	Caprifoliaceae	Introduced from Asia/Invasive
Malus coronaria	Crabapple	Rosaceae	Native
Menispermum canadense	Moonseed	Menispermaceae	Native
Morus spp.	Mulberry spp.	Moraceae	Introduced from Southern US
Ostrya carpinus	Hop-hornbeam	Betulaceae	Native
Parthenocissus quinquefloia	Virginia Creeper	Vitaceae	Native
Pinus strobus	White Pine	Pinaceae	Native
Polygonum cudpidatum	Japanese Knotweed	Polygonaceae	Introduced from Asia/Invasive
Prunus serotina	Black Cherry	Rosaceae	Native
Quercus alba	White Oak	Fagaceae	Native
Quercus prinus	Chestnut oak	Fagaceae	Native
Rhamnus frangula	Buckthorn Alder	Rhamnaceae	Introduced from EurAsia/Invasive
Rosa multiflora	Multiflora Rose	Rosaceae	Introduced from Asia/Invasive
Robinia psuedoacacia	Black Locust	Fabaceae	Introduced from Southern US
Rubus oderatus	Purple-flowering raspberry	Rosaceae	Native
Rubus spp.	Raspberry, Blackberry	Rosaceae	Native
Sassafras albidum	Sassafrass	Lauraceae	Native
Syringa vulgaris	Lilac	Oleaceae	Introduced from Eurasia/Invasive
Toxicodendron radicans	Poison Ivy	Anacardiaceae	Native
Tsuga canadensis	Hemlock	Pinaceae	Native
Ulmus spp.	Elm spp.	Ulmaceae	Native
Viburnum dentatum	Arrowwood	Adoxaceae	Native
Vitus spp.	Grapevine	Vitaceae	Native/Introduced

Table 6. Abundance and Diameter

Percent abundance and average diameter at breast height (dbh) of woody species in three areas sampled. Diameter at breast height was measured for overstory trees only.

Species	Common Name	% Abundance	Average Dbh (cm)	% Abundance	Average Dbh (cm)	% Abundance	Average Dbh (cm)
Acer platanoides	Norway Maple	-	-	-	-	4.2%	11.9
Acer rubrum	Red Maple	-	-	1.0%	-	-	-
Acer saccharum	Sugar Maple	18.2%	22.6	24.0%	22.9	-	-
Amelanchier sp.	Serviceberry	-	-	2.1%	-	-	-
Betula allegheniensis	Yellow Birch	6.8%	-	1.0%	-	-	-
Carpinus caroliniana	Musclewood	-	-	1.0%	-	-	-
Carya sp.	Hickory	-	-	3.1%	15.6	-	-
Celastrus orbiculaus	Oriental Bittersweet	-	-	-	-	1.1%	-
Celtis occidentalis	Hackberry	-	-	-	-	1.1%	-
Cercis canadensis	Redbud	2.3%	-	1.0%	-	-	-
Craetagus	Hawthorn	-	-	-	-	2.1%	-
Euonymus atropurpureus	Winged Wahoo	-	-	1.0%	-	-	-
Forsythia cv.	Forsythia	-	-	-	-	1.1%	-
Fraxinus americana	American Ash	6.8%	52.9	9.4%	-	2.1%	-
Gleditsia triacanthos	Honey Locust	-	-	-	-	1.1%	-
Juglans nigra	Black Walnut	-	-	-	-	2.1%	23.2
Ligustrum vulgare	Privet	-	-	-	-	1.1%	-
Lindera benzoin	Spicebush	-	-	6.3%	-	-	-
Liriodendron tulipifera	Tulip Poplar	2.3%	102	-	-	-	-
Lonicera sp.	Honeysuckle	-	-	-	-	1.1%	-
Lonicera japonica	Japanese Honeysuckle	-	-	-	-	1.1%	-
Morus rubra	Red Mulberry	-	-	-	-	5.3%	34.1
Ostrya carpinus	Hop-hornbeam	-	-	3.1%	15.4	-	-
Parthenocissus quinquefolia	Virginia creeper	2.3%	-	3.1%	-	2.1%	-
Pinus resinosa	Red pine	-	-	-	-	2.1%	-
Polygonum cuspidatum	Japanese Knotweed	-	-	-	-	19.0%	-
Prunus serotina	Black Cherry	9.1%	39.2	13.5%	25.6	3.2%	-
Quercus alba	White Oak	-	83.4	6.3%	46.5	-	-
Quercus prinus	Chestnut oak	4.5%	-	-	-	-	-
Quercus rubra	Red Oak	15.9%	51.6	8.3%	57.7	1.1%	75.8
Rhamnus frangula	Buckthorn Alder	-	-	-	-	1.1%	-
Rhus typhina	Staghorn Sumac	-	-	-	-	8.4%	-
Robinia psuedoacacia	Black Locust	-	-	-	-	16.6%	22.6
Rosa multiflora	Multiflora Rose	-	-	1.0%	-	-	-
Rubus spp.	Blackberry & Raspberry	2.3%	-	-	-	1.1%	-
Tilia americana	Basswood	4.5%	52.5	1.0%	-	-	24.5
Ulmus americana	American Elm	2.3%	-	3.1%	-	3.2%	47.6
Viburnum spp.	Viburnum	-	-	1.0%	-	1.1%	-
Vitis spp.	Grape	4.5%	-	1.0%	-	9.5%	-

V. Synthesis of Findings

5. 1 Application of data to zoning

The maps and texts in section II Context are strictly intended as narrative background for discussions about the remnant and recovering ecosystems as well as the social-cultural need for open space. The Hillsides ecology team believe that these elements of our report are essential to the moral and ethical discussions that attend zoning discussions but are not part of the legally defensible package that we were charged with developing.

The maps and texts in Section III Decisions are intended as primary material for parcel based zoning decision making. The materials are first developed and grouped to explicate the relative values and intent of the analysis that underlies the data. The "Parcel Identifer" is a data base tool – that is easy to use and actuate. It provides detailed information about the relative dangers, "threats to public safety" that are inherent to parcel soils and the availability or adjacency of infrastructure services that make develoment possible. Both conditions are essentia components to the rational decision making that must attend the development, conservation or preservation of steep hillside properties.

5.2 Application of data to development guidelines

The field work on the three selected sites provide us with baseline knowledge about nature in the city. This information can be used to set development guidelines, for instance:

The following species occur on sites sampled, they could be considered primary native species to be protected at a specific breast height diameter and recommended species for infill landscaping.

Development guidances could be written in such a way that species and vegetative habitats could be protected. The Plant Community Types are identified in Appendix A. The complete list of native specie can be culled from vegetation table 1, table 2 provides a list of herbaceous species.

Occurring on all three sites	Occurring on two of three sites
American Ash	**Sugr Maple**
Black Cherry	**Yellow Birch**
Read Oak	**Redbud**
Basswood	**Virginia Creeper**
	White Oak
	Blackberry Raspberry
	American Elm

VI. Appendix

The SER Primer on Ecological Restoration.
The SER Science & Policy Working Group, May 2002, www.ser.org

James Aronson (France), Andy Clewell (USA), Wally Covington (USA), Jim Harris (UK), Eric Higgs (Canada), Richard J. Hobbs (Australia), Dennis Martinez (Indigenous Peoples), Marc A. Matsil (USA), Carolina Murcia (Colombia), John Rieger (USA), and Keith Winterhalder (Canada).

Section 2. Definition of Ecological Restoration
Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

Section 3. Attributes of Restored Ecosystems
This section addresses the question of what is meant by "recovery" in ecological restoration. An ecosystem has recovered - and is restored - when it contains sufficient
biotic and abiotic resources to continue its development without further assistance or subsidy. It will sustain itself structurally and functionally. It will demonstrate resilience
to normal ranges of environmental stress and disturbance. It will interact with contiguous ecosystems in terms of biotic and abiotic flows and cultural interactions. The nine attributes listed below provide a basis for determining when restoration has been accomplished. The full expression of all of these attributes is not essential to demonstrate restoration. Instead, it is only necessary for these attributes to demonstrate an appropriate trajectory of ecosystem development towards the intended goals or reference. Some attributes are readily measured. Others must be assessed indirectly, including most ecosystem functions, which cannot be ascertained without research efforts that exceed the capabilities and budgets of most restoration projects.

1. The restored ecosystem contains a characteristic assemblage of the species that occur in the reference ecosystem and that provide appropriate community structure.
2. The restored ecosystem consists of indigenous species to the greatest practicable extent. In restored cultural ecosystems, allowances can be made for exotic domesticated species and for non-invasive ruderal and segetal species that presumably co-evolved with them. Ruderals are plants that colonize disturbed sites, whereas segetals typically grow intermixed with crop species.
3. All functional groups necessary for the continued development and/or stability of the restored ecosystem are represented or, if they are not, the missing groups have the potential to colonize by natural means.
4. The physical environment of the restored ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory.
5. The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent.
6. The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with

which it interacts through abiotic and biotic flows and exchanges.
7. Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible.
8. The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem.
9. The restored ecosystem is self-sustaining to the same degree as its reference ecosystem, and has the potential to persist indefinitely under existing environmental conditions. Nevertheless, aspects of its biodiversity, structure and functioning may change as part of normal ecosystem development, and may fluctuate in response to
normal periodic stress and occasional disturbance events of greater consequence. As in any intact ecosystem, the species composition and other attributes of a restored ecosystem may evolve as environmental conditions change.

Other attributes gain relevance and should be added to this list if they are identified as goals of the restoration project. For example, one of the goals of restoration might
be to provide specified natural goods and services for social benefit in a sustainable manner. In this respect, the restored ecosystem serves as natural capital for the accrual
of these goods and services. Another goal might be for the restored ecosystem to provide habitat for rare species or to harbor a diverse genepool for selected species. Other possible goals of restoration might include the provision of aesthetic amenities or the accommodation of activities of social consequence, such as the strengthening of a
community through the participation of individuals in a restoration project.

Section 10. Relationship of Restoration to Other Activities
Ecological restoration is one of several activities that strive to alter the biota and physical conditions at a site, and are frequently confused with restoration. These activities include reclamation, rehabilitation, mitigation, ecological engineering and various kinds of resource management, including wildlife, fisheries and range management, agroforestry, and forestry. All of these activities can overlap with and may even qualify as ecological restoration if they satisfy all criteria expressed in Section 3 of this document. Relative to other kinds of activities, restoration generally requires more postinstallation aftercare to satisfy all these criteria.

Rehabilitation shares with restoration a fundamental focus on historical or pre-existing ecosystems as models or references, but the two activities differ in their goals and strategies. Rehabilitation emphasizes the reparation of ecosystem processes, productivity and services, whereas the goals of restoration also include the re-establishment of the pre-existing biotic integrity in terms of species composition and community structure. Nonetheless, restoration, as broadly conceived herein, probably encompasses a large majority of project work that has previously been identified as rehabilitation.

The term reclamation, as commonly used in the context of mined lands in North America and the

UK, has an even broader application than rehabilitation. The main objectives of reclamation include the stabilization of the terrain, assurance of public safety, aesthetic improvement, and usually a return of the land to what, within the regional context, is considered to be a useful purpose. Revegetation, which is normally a component of land reclamation, may entail the establishment of only one or few species.
Reclamation projects that are more ecologically based can qualify as rehabilitation or even restoration.

Mitigation is an action that is intended to compensate environmental damage. Mitigation is commonly required in the USA as a condition for the issuance of permits for private development and public works projects that cause damage to wetlands. Some, but perhaps relatively few, mitigation projects satisfy the attributes of restored ecosystems listed in Section 3, and thus qualify as restoration.

The term creation has enjoyed recent usage, particularly with respect to projects that are conducted as mitigation on terrain that is entirely devoid of vegetation. The alternate term fabrication is sometimes employed. Frequently, the process of voiding a site causes sufficient change in the environment to require the installation of a different kind of ecosystem from that which occurred historically. Creation that is conducted as supervised
engineering or landscape architecture cannot qualify as restoration because restoration initiates ecosystem development along a preferred trajectory, and thereafter allows autogenic processes to guide subsequent development with little or no human interference.

Ecological engineering involves manipulation of natural materials, living organisms and the physical chemical environment to achieve specific human goals and solve technical problems. It thus differs from civil engineering, which relies on human-made materials such as steel and concrete. Predictability is a primary consideration in all engineering design, whereas restoration recognizes and accepts unpredictable development and addresses goals that reach beyond strict pragmatism and encompass biodiversity and ecosystem integrity and health. When predictability is not at issue, the scope of many ecological engineering projects could be expanded until they qualify as restoration.

Section 11. Integration of Ecological Restoration into Larger Programs

Ecological restoration is sometimes only one of many elements within a larger public or private sector enterprise, such as development projects and programs for watershed management, ecosystem management and nature conservation. Project managers of these larger undertakings should be aware of the complexities and costs involved in planning and implementing ecological restoration. Cost savings can be realized by careful coordination of restoration activities with other aspects of a large program. For this reason, project managers will benefit by recognizing ecological restoration as an integral component of a program. If this is done, the restorationist can contribute substantively to all aspects of the program that impinge on restoration. Moreover, the restorationist will be in a position to ensure that all ecological restoration is well conceived and fully realized. In this manner, the public good is served.

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An Ecological and Physical Investigation of Pittsburgh Hillsides
PHYSICAL REPORT to the City of Pittsburgh Hillsides Committee

Built Form and Urban Character of Pittsburgh Hillsides

Final Report
November 30, 2004

Prepared in cooperation with Allegheny Land Trust for the City of Pittsburgh Hillsides Committee
Funded by The Heinz Endowments

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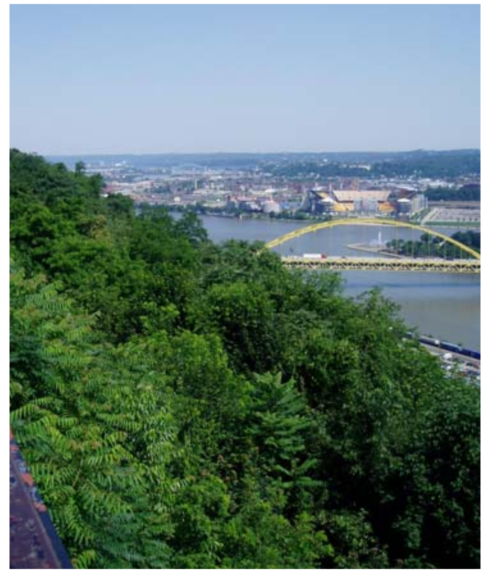
1.0 INTRODUCTION

PROJECT DESCRIPTION AND GOALS

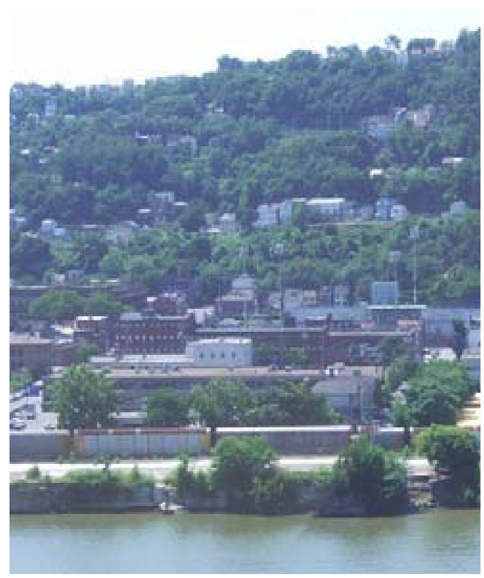
The hillsides of Pittsburgh are one of its defining characteristics, perhaps second in importance only to its rivers. They are a remarkable natural resource, interlacing and complementing the densely constructed built fabric of Pittsburgh neighborhoods with dense woods. Steeply sloped land in Pittsburgh occupies approximately one-fifth of the area of the city. Most of it is covered by natural vegetation and some is exposed rock. For various reasons, very little of this land is "developed"-that is, occupied by buildings or other man-made features. However, the slopes are not preserved or protected in their natural state although they provide aesthetic, environmental, recreational and other public benefits. Just as the rivers and the flood plain flats along the rivers were once valued only for their industrial use, the hillsides were once exploited for their timber and coal. Today, we are looking for an appropriate balance between the value of this land for development and its importance to the community as a natural environment.



Fort Pitt Bridge from Mt. Washington

This investigation of the ecological and physical environments is intended to assist the City of Pittsburgh Hillsides Committee with its deliberations and recommendations regarding the future use of Pittsburgh's hillsides. While a number of opinions have been voiced about the regulation of hillside development, there has been little research on the character or function of the hillsides. One of the goals of this project is to provide an informed framework for establishing coherent public policy.

Informed public decision-making and establishing an appropriate policy toward hillsides involves an understanding of their many contributions to the viability of the city (functional, economic, form-giving, aesthetic, and social), as well as the liabilities they impose (hazards and costs). This is a multi-disciplined challenge. The investigation brings together expertise in the environment, ecology, geology, urban design, and landscape design fields. Legal and economic expertise has been added to provide firm grounding to the investigation's recommendations.



South Side and the South Side Slopes as seen from Uptown

All recommendations and evaluations documented in this study are conceptual in nature and do not suggest engineering solutions. This study is also not intended to contain recommendations for specific private property or properties and any recommendation that might be implied is unintentional.

South Side Slopes from Monongahela River

FOCUS OF THIS REPORT

This report focuses on the relationship between Pittsburgh's hillsides and its built form and how the natural characteristics inform and shape the built environment. The report also addresses implications and offers recommendations for future hillsides development. The ecological, economic, and legal perspectives of hillsides development are the focus of other reports.

Houses on South Side Slopes

Because so much of Pittsburgh is on sloped land and development has occurred on almost all types and degrees of sloped hillsides, the built form team concluded that the physical investigation needed to be limited to only those hillsides where it was assumed that development would have its greatest impact. Utilizing a slope classification system contained in the Soil Survey of Allegheny County, Pennsylvania (1) that correlated soils, slopes and engineering considerations, it was thought that the limitation should begin with hillsides of 15% and greater slope, which initiate "moderate" severity of engineered development. After mapping these areas it was discovered that these slopes covered too much of the developed city and did not provide sufficient differentiation. Further investigation determined that slopes 25% and greater, which still cover a significant portion of the city, were more relevant, contained a quantity of developed parcels, and corresponded with referenced "severe" engineering conditions based on soil types. The report differentiates between the two classifications in its recommendations, however the hillsides of 25% and greater slope provided the underlying structure for the city-wide and for the hillsides-focused analysis.

METHODOLOGY

This is a study of the built form characteristics of Pittsburgh's hillsides and, in particular, those types of development that should be encouraged in the future. It seeks to establish legal validity for the recognition of these characteristics based on a rationally demonstrated relationship between them and the physical form of the city, to provide the underpinnings for their economic value in their relationship to open space, and to establish guidelines for development based on established patterns. By recognizing the various aspects of value that hillsides provide, they can be defined as an "asset" worthy of protection and restricted development.

At the city-wide scale, the physical setting is studied from its overall development impact on the settlement patterns, the spatial structure of the city, how its neighborhoods are defined, the relationships to views, and the types of development patterns that can be distinguished. At the localized hillsides scale, typical hillside development prototypes are identified which are recognizable and repeated throughout Pittsburgh. From these findings, two development strategies are recommended: redirecting development and restricting development. Three study sites, indicative of typical hillside conditions, are studied, and the use of the development prototypes is tested.

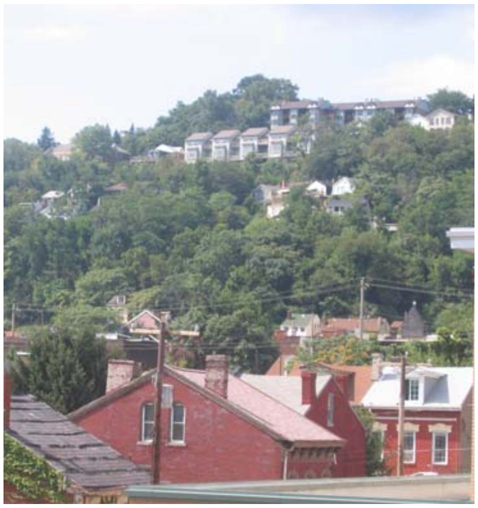
The report utilizes descriptive observations of the built form, identification and application of prototypical patterns, and development precedents from other hillside ordinances as the basis of the investigation and recommendations. GIS database material from the City of Pittsburgh and Allegheny County has been used to generate, document, or illustrate information. The report relies on the physical environment's documented characteristics and its recognizable patterning as the basis for its analyses and recommendations.

12th and Pius Streets looking towards Downtown

PARTICIPANTS

The study was conducted under the direction of the Allegheny Land Trust and funded by The Heinz Endowments. 3 Rivers 2nd Nature focused on the ecological aspects, Perkins Eastman on the built form, Stephen Farber on economics, and Cyril Fox the legal perspective.

The Perkins Eastman team included Stefani Danes, Jennifer Jeffers, Arch Pelley, and Stephen Quick.



Perry South overlooking the rooftops of Central North Side

TERMINOLOGY

Hillsides: The term "hillsides" is used throughout this report to describe a general hillsides setting. The term describes a physical context, including its natural features, that differs from flat land. Technically, Pittsburgh is not comprised of hillsides but of "slopes," however the term hillsides is an expression understood widely and which appears in typical hillsides zoning ordinances.

Slopes: Pittsburgh's geographic form is an eroded plain rather than folded or uplifted hills. An eroded plain results in steep slopes, produced through a gradual subtractive geological process, instead of an uplifting process. "Slopes" is the appropriate terminology for describing the angled slant of a landform, the area it comprises, and the characteristic face of a hillside. The top of a slope is its "crest" and the bottom of the slope is its "foot" or "toe".

These terms are used in this manner throughout the report.

Mt. Washington "Saddle" as seen above Liberty Bridge

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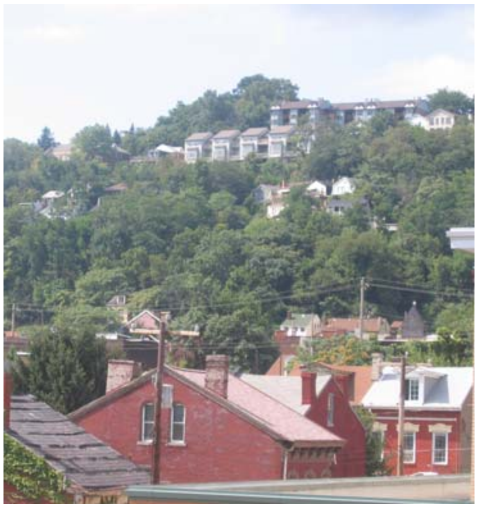

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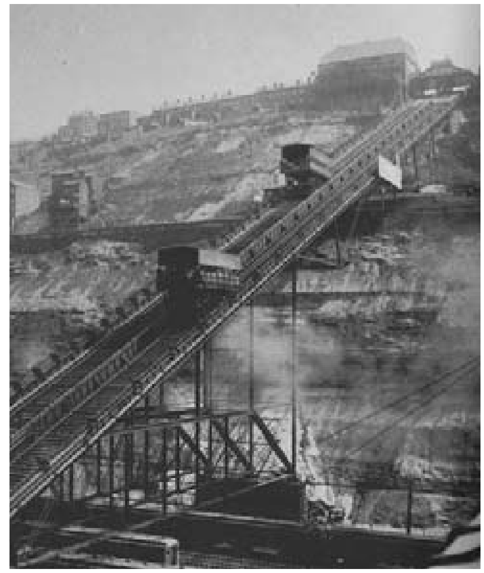
Mt. Washington “Saddle” as seen above Liberty Bridge

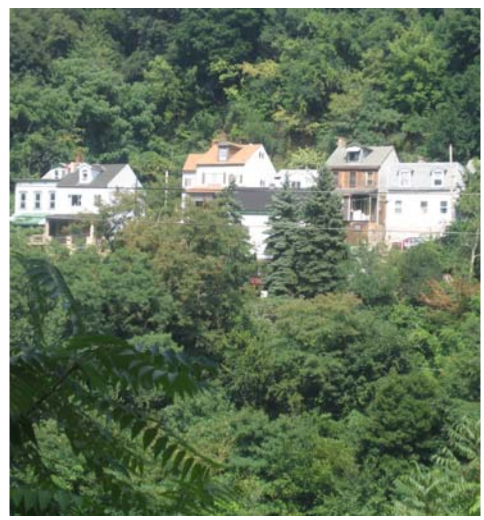
STRATEGIC QUESTION

Over the last several decades, many cities in the US have recognized that public policies regarding hillsides can be employed as a strategic tool for urban development. Cities such as Denver, Colorado, San Clemente, California, and Burlington, Vermont created policies to guide their fast-paced growth into efficient settlement patterns. Towns in New England enacted policies to increase economic vitality by enhancing their historic character or protecting recreational amenities.


Bigelow Boulevard circa 1905

Pittsburgh is not facing growth pressure and has no shortage of vacant or underutilized land. High vacancy rates have been avoided only by demolishing housing, closing schools, and abandoning commercial property. Pittsburgh's shortage is in people and businesses to occupy the property already developed and to provide a healthier tax base for the city.

The strategic question for Pittsburgh is how to make its steep slopes a means of attracting people and businesses to redevelop and revitalize its existing urbanized areas.


Spring Hill houses as seen from Fineview

Historically, Pittsburgh's hillsides, because they were inaccessible and smoke-covered, were not highly valued development sites. Today, steep slopes can attract development because of good views or natural surroundings. But they do not lend themselves to development easily. They impose serious development constraints and exact added costs, such as extra engineering, grading, deep foundations, or high retaining walls. Costs to the public can include the extension of expensive subsurface infrastructure, the upkeep of streets cut into the slope, and the mitigation of erosion.

Hillside construction or even just re-grading can, in turn, impose other less tangible costs on the city. For instance, because many of the steep slopes in the city are highly visible, even insignificant, ordinary or banal construction is instantly a landmark feature that can spoil the beauty of a wooded slope. The loss of recreational resources or songbirds diminishes the city's ecological vitality, its quality of life, and its capacity to attract new resources.

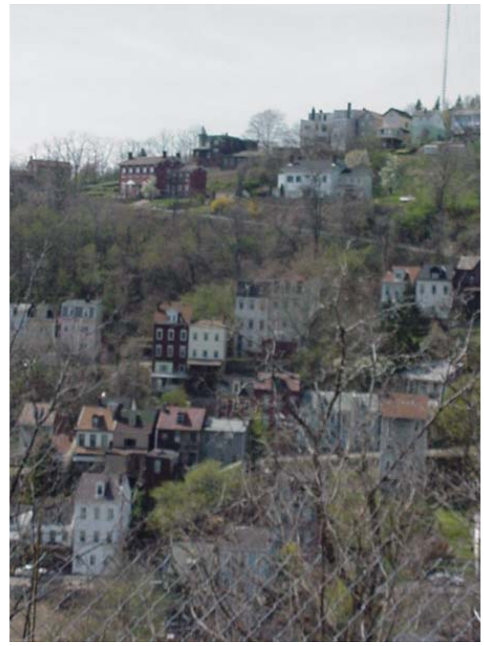
Strategically, for the purpose of Pittsburgh's revitalization, what is the "highest and best use" of hillsides? In a society where cities vie for people and businesses, how does Pittsburgh increase its competitive advantage? When and where does private construction distract from-rather than contribute to-the overall economic value of the city? What types and extent of construction should be permitted?

2.0 A COMMON VISION: FUNDAMENTAL PRINCIPLES

The City of Pittsburgh has formally adopted in its Environmental Performance Standards an affirmation of the benefits of the hillsides to the city, a commitment to preserving those benefits, and the need to develop the operational mechanisms to do so:

> "The city's natural resources and sensitive environmental areas, steep forested hills, prominent ridges and rivers are major contributors to Pittsburgh's distinctive character and high quality of life. Provisions should be intended to protect sensitive environmental areas from adverse development impacts. Provisions should be developed that are intended to:
>
> - Encourage the protection of steep slopes, riparian corridors, and other natural resources, while promot ing economic development;
> - Promote the public health, safety, and welfare of the residents of the city; encourage high quality develop ment and orderly community growth; and
> - Conserve and stabilize property values."

(*from Environmental Performance Standards - Zoning Ordinance*)



Houses on Spring Hill seen from Troy Hill

With this policy as its core principle, the Steering Committee has articulated the following statement, which provides an expanded definition of the value of hillsides in Pittsburgh and a statement of the purposes that the recommendations in this study are to address. The principles here are the basis for a common Vision for the future of the hillsides. It was drafted by the consultant team and reviewed and modified by the Hillsides Steering Committee.

Hays from South Side Flats along Monongahela River

PITTSBURGH'S IDENTITY AND CHARACTER

As stated above, "The city's natural resources and sensitive environmental areas, steep forested hills, prominent ridges and rivers are major contributors to Pittsburgh's distinctive character and high quality of life."

Pittsburgh's wooded slopes stand out distinctly from its dense urban fabric. The slopes often form green "walls" at the ends of streets (view corridors) or across the river (panoramas). They create an unmistakable context for images of Pittsburgh's built environment.

Pittsburgh is known for its neighborhoods. It is the hillsides between neighborhoods as much as the neighborhoods themselves that give rise to this identity. Hillsides form the edges and boundaries of Pittsburgh's neighborhoods and districts and create natural (landscape and topographic) separations. The strong contrast between the natural slopes and the built environment gives legibility to individual neighborhoods and a clear distinction between them.

Implications:
Development that would blur neighborhood edges or diminish the natural zone that separates neighborhoods should be discouraged.

The Point and Hill District beyond

PUBLIC REALM

Pittsburgh's public realm, the environment that is experienced by the public, is shaped by its rivers and the spatial "channels" they have cut into the plateaus. Steep hillsides bound and connect flat terraces (once river beds) over 200 feet of elevation. This unusually architectonic setting is an aesthetic asset that is unsurpassed and should be protected.

Downtown seen from Elliot

Implications:
Because hillsides shape the public realm, any use or development of hillsides should be considered as occurring within the public realm, not at its edges or outside of the public realm.

Tops of hillsides and plateau edges are visually dominant elements of the public realm and should be especially well protected.

NATURAL RESOURCES

The natural resources of this region have begun a process of incredible recovery that needs to be recognized, nurtured and supported wherever it is possible. Wooded hillsides are an integral and important part of the natural ecosystems, the green infrastructure that provide no-cost services and aesthetic value to our region. The natural slopes contribute to the quality of water and air and the maintenance of the food chain.

West End from Point State Park

Implications:
Make the best use of natural resources to maintain the integrity of the natural ecology and the economic functioning of urban life.

HISTORIC QUALITIES

Pittsburgh's development patterns have been shaped by the natural topography into distinctive neighborhood districts, differentiated uses, and contrasts in building scale. The history of the city's settlement is evidenced through the preservation of these form-giving features. Reminders of earlier ways of life are seen on slopes today, including stairs, foundations of inclines, and old stone retaining walls.

Steps at South 18th Street in South Side

Implications:
Recognize and respect historic hillside artifacts, places and patterns.

CONNECTIONS AND ACCESS

Duquesne Heights from Route 51 South

Natural connections between ecological areas are necessary to maintain continuity of the natural environment, which is directly related to the sustainability of forest vegetation and wildlife

Implications:
Connections between valleys and plateaus should be sensitive and appropriate to the natural environment, including minimizing impacts to the hydrology, forest cover, and hillside stability. Re-grading of steep slopes for purposes of access or development should be discouraged.

Hillsides should not be used for major vehicular means of access between plateaus and flats. Other vehicular connections between developed areas of hillsides require sensitivity to the natural environment.

DEVELOPMENT

Development on hillsides has greater potential to impact the health, safety, welfare, environmental, and aesthetic values of the Pittsburgh community and needs to be regulated more carefully than development on flatter land. Hillside development should recognize that preservation, conservation, limited, and as-of-right development that are more restrictive than development in other parts of the city are appropriate responses to these values and are to be considered a form of development.

Houses on South Side Slopes

Implications:
"Development should occur in such a manner as to protect the natural and topographic character and identity of (hillside) areas, environmental resources, the aesthetic qualities and restorative values of lands, and the public health, safety, and general welfare by ensuring that development does not create soil erosion, silting of lower slopes, slide damage, flooding problems, and severe cutting or scarring." (New H District Site Development Guidelines - Zoning Ordinance)

"Responsible development should complement the natural and visual character of the City." (New H District Site Development Guidelines - Zoning Ordinance)

Hillside development should reinforce and extend the existing urban fabric, rather than introduce new scattered development sites. Encourage rehabilitation and development of infill sites before building on new "greenfield" sites.

Hillside development should respect the shape of the existing terrain. Building footprints on slopes should be minimized. Grading should be minimized and shaped to complement the natural topography of slopes.

ECONOMIC AND ECOLOGICAL SUSTAINABILITY

Respect for the ecology of hillsides contributes to the economic well-being of the city and its residents. Inappropriate development burdens residents and taxpayers with higher costs: landslide prevention or remediation, erosion, water pollution, and aesthetic and cultural degradation.

Implications:
Natural vegetation and surface contours should not b significantly disturbed by development. No stormwater runoff should be permitted.

Hillside development should not be subsidized when there are other less-impact locations available that benefit the community or neighborhood as a whole. Development of hillsides should be constrained by the comparative costs of infill development along the existing infrastructure grid.

Development should also be constrained by a rigorous analysis of natural and cultural forms and functions of a site.

Strip District and Lawrenceville viewed from Troy Hill

3.0 VALUING THE HILLSIDES

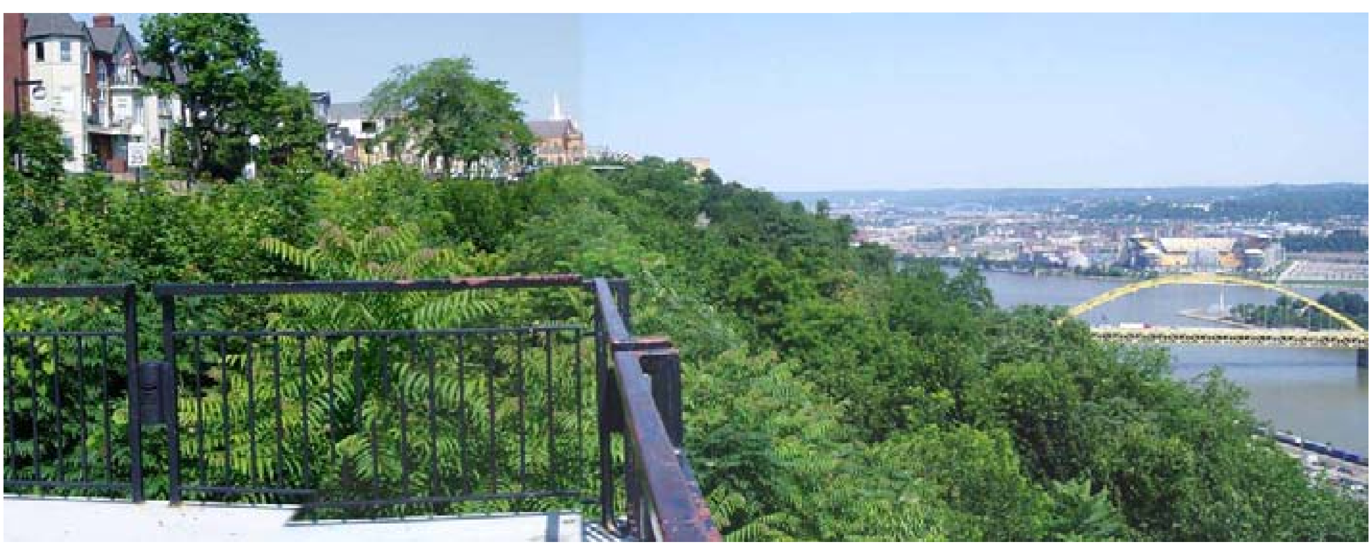
In order to assess the appropriateness of developing hillsides, we need to re-examine the conventional framework for considering the value of natural environments. The concept of value is discussed in detail in Stephen Farber's paper, "Hillside Slopes and Valuation", which should be understood as the context for this Section.

Duquesne Heights from Point State Park

Economic Value

There is extensive documentation of the economic value of natural open space in cities. Such space provides:

1. An attraction to business investment (ranked first among relocation factors of small businesses in 1997 survey; examples from Austin, Boston),
2. A generator of increased property values: Studies have shown that proximity within ½ mile of urban open space adds up to 5% to value of property. An increasing number of homeowners willing to pay more to live near open space--one study discovered a 300% increase in residents' willingness to pay higher prices for property near open space over ten years in Denver. Open space in San Francisco is estimated to add $5-10 million in annual property tax revenue.
3. An attraction to residential investment, including new population
4. A catalyst for revitalization: Natural features are powerful "place-making" resources, around which can be used to stimulate private development in nearby areas, such as in deteriorating neighborhoods.
5. A source of recreation and tourism: Protected natural resources can be developed as the basis for local economies, providing both revenue and jobs.
6. A safeguard of human health and safety: natural slopes and other open spaces reduce the cost of mitigating pollution, floods, landslides, etc.



The Point from Mt. Washington

Hazelwood as seen from South Side

Functional Value

More recently, the functional value of natural spaces in the city has been recognized. Among the general population, however, the functioning of ecosystems, their importance to urban life, and the ecological function of urban open space is generally little understood and therefore under-appreciated. Urban forests, or tree-covered areas such as Pittsburgh's hill-sides, mitigate heat build-up, clean the air, prevent erosion, provide for water absorption, and support animal habitats. As described in the "Natural Systems" report, they are vitally important to the overall ecosystems of a city.

Social Value

Natural spaces in the city also serve social purposes, such as:

1. Recreational, fitness, adventure uses
2. Relief from density (a nineteenth century idea realized in great urban parks)
3. Common resources for populations that lack private amenities
4. Resources that maintain a higher amenity lifestyle at low cost--attract younger population
5. Features that improve the viability of low-income neighborhoods (provided that security is addressed)

Steeply sloped land in Pittsburgh occupies approximately one-fifth of the area of the city. For various reasons, very little of this land is "developed"--that is, is occupied by buildings or other man-made features. Most of it is covered by natural vegetation and some is exposed rock. How much of this land should be built on? If so, to what extent should intervention be regulated or restricted? Should any of it be protected as a public resource? How can Pittsburgh derive the greatest value from its steep slopes?

Land in the city is typically either privately or publicly owned. In terms of economic value, private property is assessed at a higher value to the extent that it is "improved", or built upon. The more intensely it is built up, the greater value it has. Public regulation of private property is, among other things, a means of limiting the private benefit that would otherwise impose undue costs on neighbors or the public. The city benefits from private construction through the structure of property tax: the more intensively built the more the property owner benefits from the land, the more property taxes he pays. Since property tax is the city's major source of revenue, cities conventionally encourage the "improvement" of land. Unimproved property has little value.

Conventionally, public property exists for the purpose of providing access and utilities to private property, to provide basic services (such as public education or criminal justice), or to hold resources in common, for the public good. Public land does not generate revenue for the operation of government. It is generally assumed that land should be privately owned unless there is a reason to hold it publicly. Public property is assessed at "no value" because it does not produce revenue for the taxing bodies. Yet it is clear that public property, even public open space, adds value to the city and is valued by city residents. Similarly, unimproved private property may bring more to the city than tax revenue. We begin this study by trying to understand more comprehensively the value of Pittsburgh's steeply sloped land, to define more accurately its "highest and best use".

South Oakland viewed from the Birmingham Bridge

RE-VALUING PITTSBURGH'S NATURAL ENVIRONMENT: ADOPTING A NEW MODEL


Houses in Spring Garden

The goal of Pittsburgh's public policy regarding its physical form: to integrate the construction of built environments and the cultivation of natural environments into a single system that provides for a good and sustainable quality of life--that is, a quality of life that can be supported without leaving cost to be paid for by others or future generations. Problems generated by the city must be solved within the city, not imposed on the planet. The purpose of our public policy is to make Pittsburgh more environmentally and socially healthier, a civilizing place in which to live.

"As ecology has now become the indispensable basis for environmental planning in the larger, regional landscape, so an understanding of the altered but still functioning natural processes within cities becomes central to urban design. The conventions and rules of aesthetic values have validity only when placed in context with underlying bio-physical determinants. Design principles, responsive to urban ecology and applied to the opportunities the city provides through its inherent resources, form the basis for an alternative design language." (Michael Hough, Cities and Natural Processes)

Finding a good fit means integrating human with natural processes at a fundamental level.


Banksville from I-279 South

The task of urban design is to make the most of opportunities, reestablishing the concept of multi-functional, productive and working landscapes that integrate ecology, people, and economy. Such a concept would envision an integrated framework for environmental and spatial elements to produce food, moderate micro-climate, sustain resources needed for life, and improve quality of life.

The conventional "non-organic" model of urban settlement is premised on a fundamental dichotomy between humanity and nature, embedded in our culture, our concept of "development", and our patterns of production. This model has led to an alienation of our urban society from nature and the misuse of our resources. A new and better model looks to re-integrate them, creating a holistic framework for improving and sustaining the quality of city life. This model, according to Michael Hough, introduces new principles of design:

1. Process and change. All intervention--design or maintenance--is part of an ongoing and more powerful natural process of change. It is expensive and fruitless to attempt to design an ideal, unchanging landscape. The beauty of natural landscapes (in the many states of an evolutionary process) is different from our culture's formal conception of beauty.

2. Economy of means. We should practice the "principle of least effort". From minimum resources and energy, maximum environmental, social, and economic benefits. Do things small, cumulatively, since the impacts on an inter-connected system are not likely to be perceived at the time, and avoid large-scale mistakes. Ideally, look for small solutions that address multiple problems--solve for pattern.

3. Diversity. Environmental diversity contributes to health and safety: resilience. It adds to choice and interest. Diversity of habitats, supporting more species, is therefore more resistant to disaster. As beautiful as the elm-lined streets of nineteenth century towns were, the aesthetic was not sustainable.

4. Localize. Indigenous plants and materials are more readily integrated into the functioning of the local ecosystem. It is an economical approach.

5. Connectedness. All environments are inter-connected and inter-dependent. Land in city is part of a regional watershed. The increased ambient temperature of the city creates new habitats. Urban energy flows, which are as much as 100 times natural rates of flow and the immense "waste" production of cities, put great stress on the ecosystems that sustain life.

6. Visibility. We've used technology to insulate ourselves from nature and natural forces. The invisibility of the natural world has allowed us to be uninformed about it, and that ignorance is ultimately very costly. Enhance the sensory vitality of environment and make visible the "processes that sustain life": supply of water, electricity, processing waste, producing food, etc.

Rooftops in Elliot

7. Environmental literacy: "constant and direct experience assimilated through daily exposure to, and interaction with, the places one lives in" to "see nature whole" (John Fowles, Harpers, 259:1554, Nov. 79) nature removed from direct experience is abstract, and that attitude leads to disaster

COMPARING COSTS AND BENEFITS

To begin, we will reconsider the assumption that "undeveloped" slopes in the city are of little or no value. What value do "undeveloped" steep slopes add to city?

"Property values" generally refer narrowly to the monetary value of the property as a marketable commodity. By this definition, the construction of buildings or other "improvements" increases value. "Improved" property has higher value than "unimproved" property. This approach has traditionally de-valued natural environments in cities, especially informal, "wild" environments, which do not seem to serve any obvious function.

However, looking more closely, such improvements can create liabilities that may considerably outweigh the asset and revenue value of the improvements. A broader interpretation of value is needed for a more accurate and comprehensive assessment of the value of hillsides--developed and undeveloped--to the city. A consideration of value must therefore introduce both the potential losses in value through development and the increases in value through preservation of natural state.

The chart on the nextpage lays out a comparison of the potential benefits and costs associated with built and natural slopes. In general these effects and the differences between them are increased as slope increases.

Church on South Side Slopes

BUILT SLOPE

POTENTIAL BENEFITS

Increase in property tax revenue
Access improvements
Private property maintenance
Enhancement of Pittsburgh built character
New buildings suited to contemporary uses

POTENTIAL COSTS

Erosion
Degradation of water and air through loss of vegetation
Landslides and flooding hazards
Structural instability
Premium cost of installing, maintaining and repairing public infrastructure--wasting limited public resources
Destruction of visual quality or coherence of public realm--diminishing city's economic competitiveness
Costs of human services that offset property tax revenues
Diminishment of property values (and tax revenues) of other impacted properties

The "Saddle" from P.J. McArdle Roadway

NATURAL SLOPE

POTENTIAL BENEFITS

Recreation
Views from distance and
Experience at close range
Climatic temperance
Good quality air and water
Lessened risk of natural/man-made disasters
Contribution to property values of nearby residential development
Economic development through attraction of new residents and visitors to city
Related tax-base enhancement

POTENTIAL COSTS

Opportunity cost: lack of added tax revenues

The issue in setting policy, therefore, is to find a proper balance between permitting development on slopes and maintaining slopes as natural environment. While it may have been assumed that Pittsburgh stands to gain economically from the development of the hillsides, the city may face increased costs and the potential loss of a strategic asset by allowing private development of these resources. To understand more broadly the value of the hillsides, their role in defining the character of the city should be understood. This begins with a consideration of what makes Pittsburgh a distinctive place.

4.0 PITTSBURGH'S URBAN FORM

The problem of "placelessness", the disappearance of natural and cultural differences beneath a veneer of familiar but mass-produced landscapes, is increasingly endemic in the United States and has produced a widespread sense of boredom and discontent (Ritzer 2000). Cities that pattern themselves after suburbs or other cities (especially the trendy "successes") are likely to become just another placeless imitation and lose whatever authentic identity they once possessed. Pittsburgh's identity, which is unusually distinctive, is its strategic resource in the competition for population and economic enterprise.

An authentic sense of place is deeply rooted in the natural and cultural processes that have shaped it. To understand the role of the hillsides in Pittsburgh's identity, it is necessary to understand Pittsburgh's urban form, especially the characteristics that make it unique. The major factors are its geomorphology (its natural land form), settlement patterns, its spatial structure and texture, its neighborhood identity, and its views and vistas.

South Side Flats and Arlington

GEOMORPHOLOGY

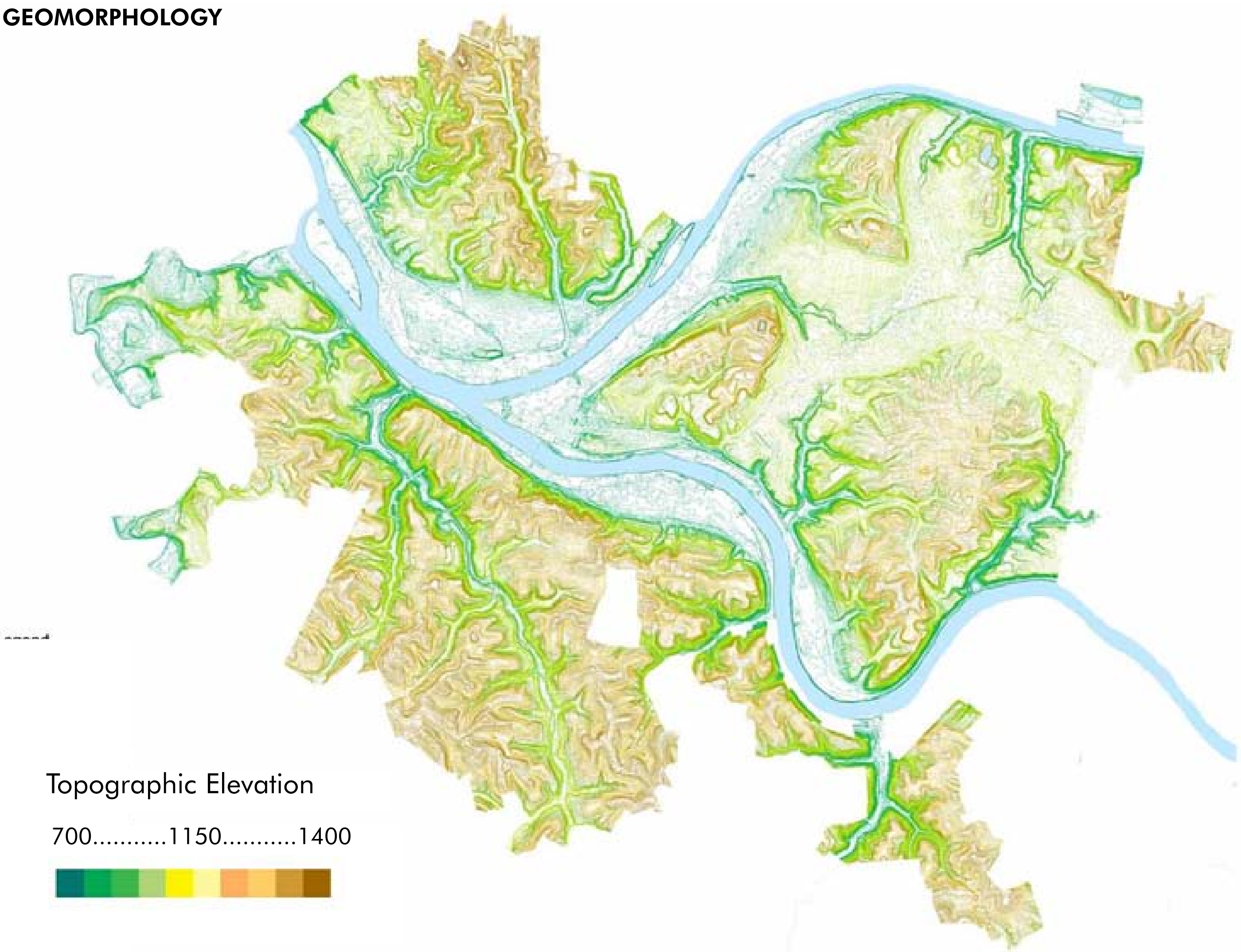
Geologically, Pittsburgh is sited on the Allegheny Plateau, once part of the bed of a huge inland lake. Its slopes and valleys were formed by an erosion process rather than by folding and uplifting. It is the flow of water that links Pittsburgh's distinctive geographical features: the rivers and the slopes. This geography significantly influenced Pittsburgh's settlement patterns and the strong neighborhood pattern of today. Very few cities have as dramatic a natural geography or as form-giving a natural landscape.

The flat areas of the city are terraces that were once lake or river bottoms. These flat terraces have historically been developed for large-scale uses, such as mills, factories, rail lines, institutional campuses, or downtown commercial development. The Golden Triangle, Oakland and East Liberty downtowns are on terraces.

The slopes are not the gentle folds of New England towns or the dramatic tilted planes of the west. They are steep "walls" of river corridors incised into the flat plateau, more like the Palisades of the Hudson. While many of the

West End Bridge and Elliot from Central North Side

GEOMORPHOLOGY



edges have been worn away over time, the slopes typically meet the flat terraces at sharply defined angles. The upper edges, such as along Mount Washington, are some of Pittsburgh's most highly visible skylines.

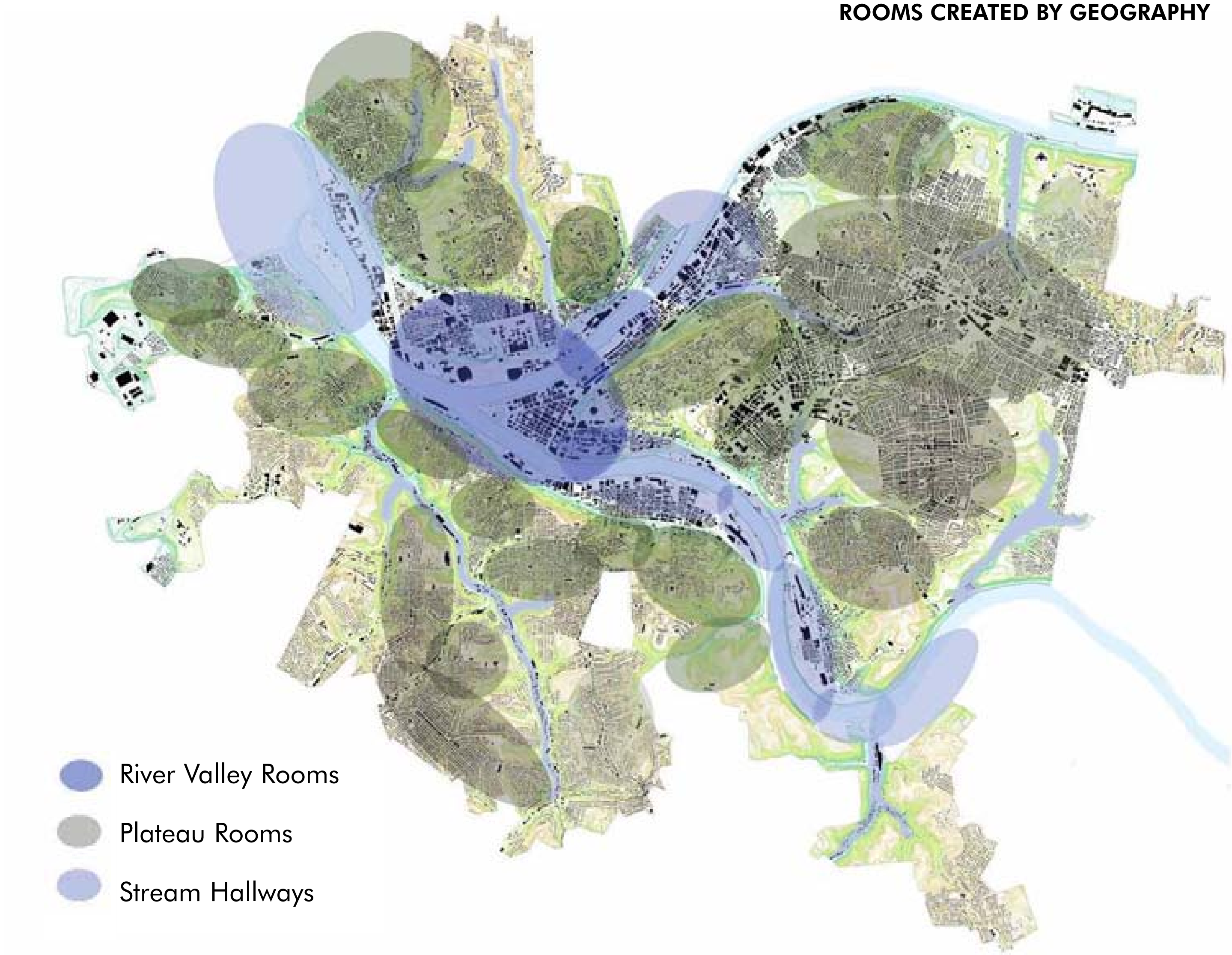
Pittsburgh's three-part geography (North Hills, East End, and South Hills) is defined not only by the rivers, but also by the shape of the land. The East End, for example, is different from other areas of the city because a large area from Homewood to Oakland was an ancient river plain that ran through the center of the East End. The South Hills represent the clearest erosion of the upper plateau into steep ravines, as illustrated by the Saw Mill Run valley. The North Hills is both river bed and eroded plateaus.

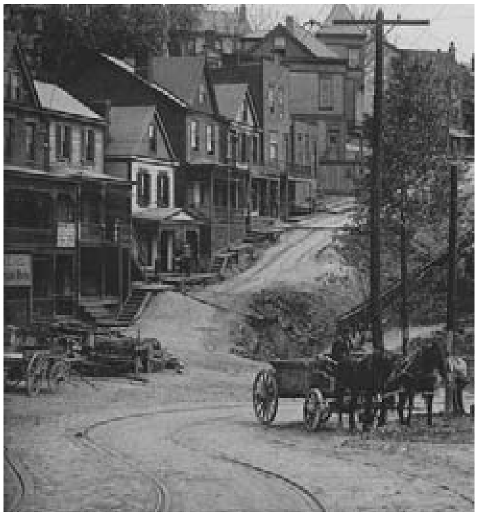
Pittsburgh's geographical form creates large spaces or outdoor "rooms" connected by corridors or "hallways" with flat terrace floors and steeply sloped walls. There is a series of connected rooms that run down the river valleys. Narrow corridor-like ravines are cut back into the interior plateaus. These could be described as "hallways." The largest of these river rooms occurs around the confluence of the three rivers and encompasses a portion of the North Side. The second of these great rooms is the central area of the East End. Plateau rooms are separated from one another by these corridor hallways, and with the exception of the large room created on the ancient riverbed in the East End are small neighborhood-sized rooms. The pattern is a combination of various sized rooms connected by corridor hallways.

Pittsburgh's slopes are one of the city's most important assets. Except for some neighborhoods in the East End, almost all of Pittsburgh's residential development is on sloped land. They provide neighborhood boundaries, dictate our transportation systems, provide most of the open space within the city, and form the backdrops and frames for views and vistas. Other than the rivers, the slopewalls are the dominant natural features that create Pittsburgh's "sense of place."

Sources: City of Pittsburgh GIS

ROOMS CREATED BY GEOGRAPHY





Horse drawn carriage on South 18th Street, circa 1911

SETTLEMENT PATTERNS

The settlement of Pittsburgh occurred from the late 18th Century through the early 20th Century, when the present urban form of the city was substantially established. The city showed significant growth during the second half of the 19th Century, as Pittsburgh figured prominently in the Industrial Revolution. The settlement patterns were greatly influenced by Pittsburgh's natural topography. Until the mid 19th Century, settlement was clustered at the Point and at other landings along the rivers, which provided the best means of long-distance transportation. Early development was on the flattest areas of the city as well as the slopes that bordered these areas which were not too steep for residential development. The Hill District, Polish Hill, the Southside Slopes and areas of Lawrenceville were the earliest slopes to be developed. The flood plain "flats" were developed for mills and manufacturing, surrounded by dense residential development.

With rapid population growth, housing appeared on the lower slopes, and inclines connected neighborhoods on higher land to the factories below. In general, however, the slopes were impediments to access and high terraces remained largely undeveloped until mid-20th Century. Early photographs of Pittsburgh from the mid-19th century show the hillsides stripped bare of vegetation due to logging and coal mining. (Smith 1990) For years, the steeper slopes were left denuded, while the less steep slopes were eventually covered with the dense fabric of neighborhoods. Most of

HISTORIC SETTLEMENT PATTERNS

1795 - Trading / Military Outpost

1818 - Villages / Mercantile Economy

1835 - Villages / Early Manufacturing

1818 - Villages / Mercantile Economy

1872 - Industrial Growth & Urban Consolidation

1885 - Residential / Civic Development

1895 - Northward Expansion & Infill

1907 - Expansion South West Slopes

1926 - Southward Expansion

these hillside developments were in close proximity to the factories and mills along the river making it convenient for the residents to travel to their jobs. Towards the end of the 19th Century, settlement in the hillsides waned as development moved towards the valleys and upper plateaus to the north and south of the city. With the advent of the streetcar and eventually the automobile, development spread out rapidly from the city core. (Bell 2001) The hillsides became less significant deterrents to development as flatter land was now more accessible. With the availability of land, low-density suburban growth included little or no development of the surrounding slopes of these areas. Those settlement trends created such familiar patterns as cul-de-sac subdivisions and commercial strips.

Today, the slopes that are the most natural are those in areas developed after 1895, while the slopes that have densest traditional development were those developed before 1855. It is important to note that in the East End of Pittsburgh many of the sloped areas became city parks. Slopes in the early urbanized areas that are now wooded have vestiges of foundations, streets, and inclines.

Sources: Historic maps in the University of Pittsburgh's map archives, dating from 1795. A complete list of the map sources is included in an appendix.

Perry Hilltop, circa 1935

Pius Street on South Side Slopes, circa 1936

PITTSBURGH'S SPATIAL STRUCTURE

The spatial structure of a city is what provides its perceptual legibility. The concept of environmental "legibility" was introduced by Kevin Lynch in his book, The Image of the City. This important book was the first to establish how the urban scale and complexity of a city is understood and defined by its inhabitants. Lynch developed the theory that the most livable cities have a discernable spatial structure that allows people to understand and navigate their environment. (Lynch 1960)

The five elements of spatial structure are defined as the following (Lynch 1990).

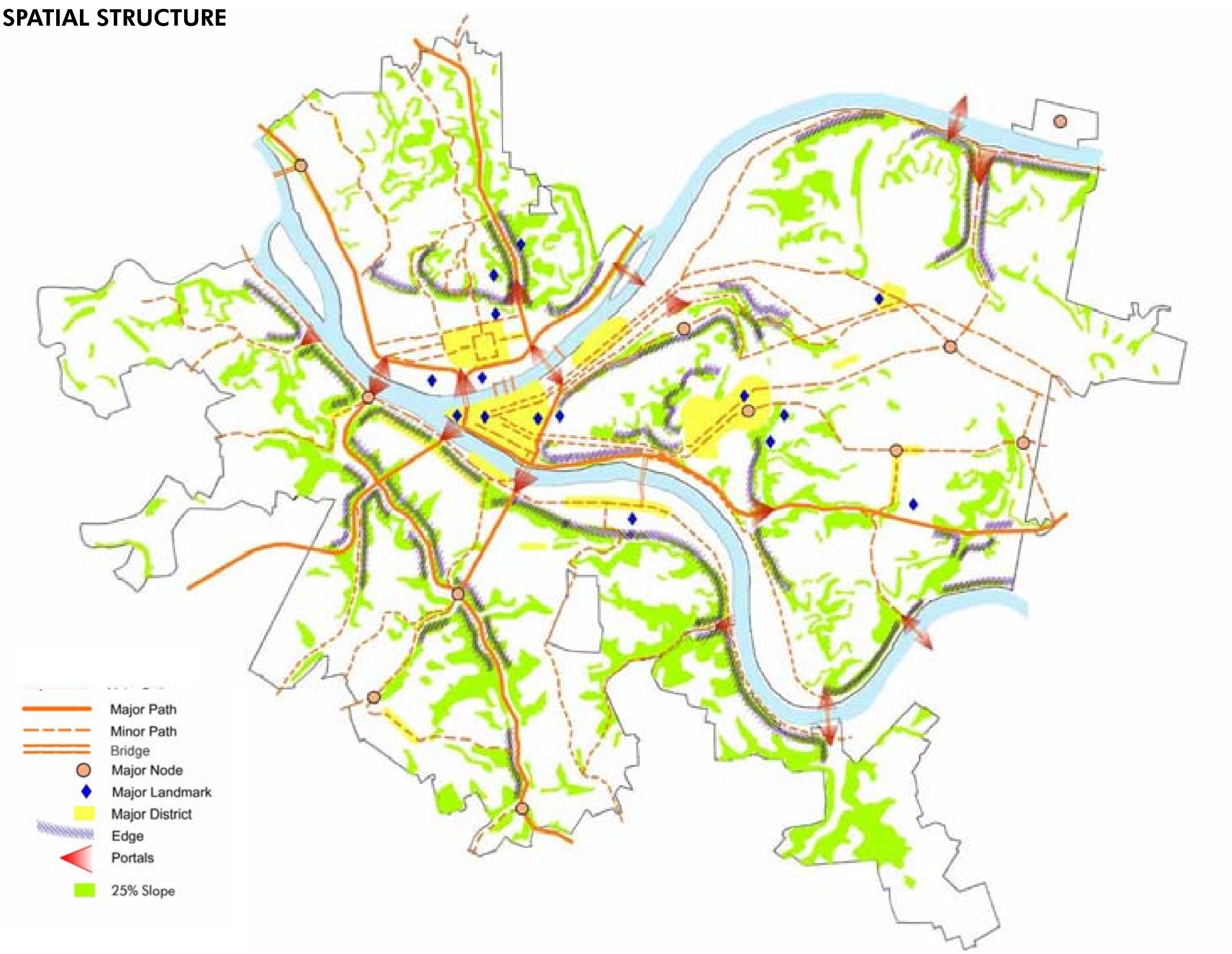
Paths: Paths are the channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals or railroad.

Edges: Edges are the linear elements not used or considered as paths by the observer. They are boundaries between two places. Highways are edges to those who are not traveling on them.

Districts: Districts are the medium-to-large sections of the city, which the observer mentally enters "inside of", and which are recognizable as having some common identifying character. Neighborhoods are the most common districts.

Nodes: Nodes are points or specific places in a city into which an observer can enter and which are the intensive foci to and from which he is traveling. Street intersections and public plazas are nodes.

SPATIAL STRUCTURE



Downtown skyline from I-279 North

Landmarks: Landmarks are another type of point-reference, but in this case they are perceived as objects the observer does not necessarily enter.

In addition to Lynch's elements, a unique Pittsburgh element, "portals", was created for this analysis. Similar to nodes in concept, a portal is a threshold in the urban landscape, the point at which a sense of arrival happens when traveling in the city. Typically a portal occurs at a significant geographic transition point, such as when a large river valley is entered from a tunnel or where a major path along a stream corridor meets the river valley. At those memorable points, the view of the traveler changes suddenly from a tight enclosed space to a broad panorama of the city and the slopes beyond.

While Pittsburgh lacks a singular organizing system, such as an orthogonal street grid, it has a unique "mosaic" character different from other cities studied by Lynch. Most American cities are dominated by a system of paths, whether a street network or a highway system. Pittsburgh's strongest features are its districts and edges. Densely-built neighborhoods constitute distinct and identifiable places in the mosaic, often separated by contrasting open space. Each district tends to have its own grid and edges. Discontinuity is inherent in a mosaic structure, which reinforces the identity of local places at the expense of larger-scale connections.

At the scale of the city, the elements that provide continuity in Pittsburgh are the rivers, highways, and steep slopes. Major arterials, following the topography, generally parallel the slopes. The slopes also divide neighborhoods from each other, sometimes wrapping neighborhoods with a continuous band of wooded land. In sum, the hillside slopes, which parallel major paths, define edges, reinforce districts, and form portals, are arguably the most important single element in the legibility of the city.

Sources: The paths, nodes and portals were mapped from Pittsburgh DCP base maps and the City's GIS database of built form.

OPEN SPACE

Pittsburgh's distinctive character arises largely from the contrast between its densely settled urban districts and the natural green spaces that divide and connect them. Open space in Pittsburgh is wooded and mostly on sloping ground. Much of the open space is on hillsides which, because of their slope, are not advantageous for development. The slope makes the open space highly visible, creating Pittsburgh's green "walls" that, in one place, may form a panoramic backdrop to tightly-knit neighborhoods or in another location, enclose a narrow hollow or create a dramatic focal point at the end of a street.

Because of the city's topography, the green slopes wind around and between neighborhoods. They follow rivers and major roads, and as the edges of small tributaries and streams, they create green "fingers" that penetrate deep between the densely built areas. They make visible the terraces that step up from the river flats. Interrupted by occasional buildings and streets, the green slopes are nevertheless remarkably continuous considering that this continuity was neither created nor protected by deliberate planning.

Only 1025 acres or roughly 13% of the natural slopes are designated as public open space. Some of the most steeply sloped land in the East End is in the three public parks, Schenley, Highland, and Frick. Panther Hollow is an example of significant slopes that are not protected by any designation and are the focus of recurring contention over development plans. On the north side, Riverview Park offers dramatic views through its sloping woods. Other than formal park space, 200 plus acres of slopes is designated as greenway land. Greenways are undeveloped land on which private development is limited, but not prohibited. They provide an opportunity to develop trails and other low-impact public amenities, but must be reserved as undeveloped land banks until such amenities can be afforded.

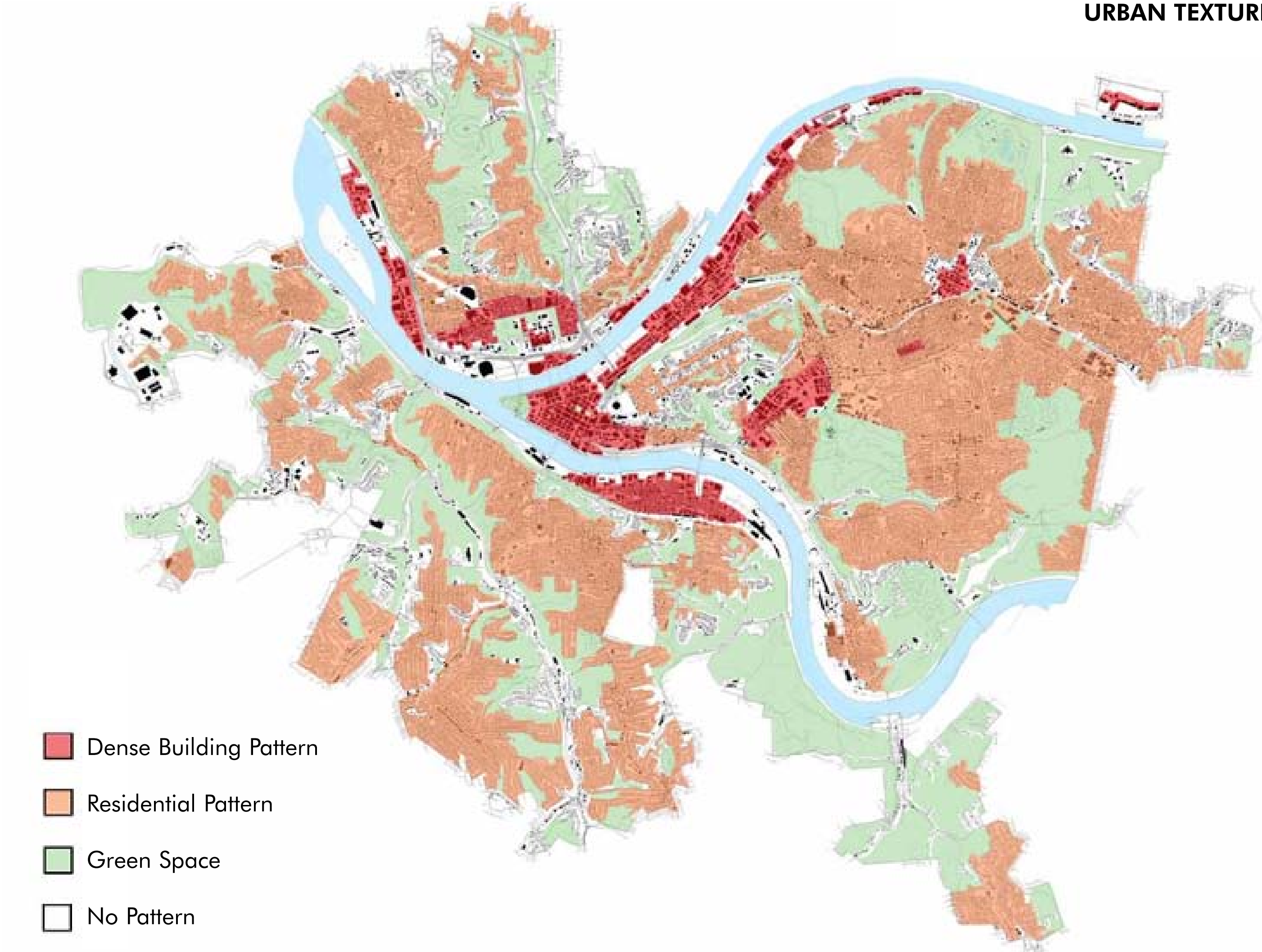
Hillside open space is comprised of a mosaic of properties, owned by both private and public entities. Not surprisingly, almost 25% is owned publicly, whether because it was never purchased for private development or because it was reclaimed for failure to pay taxes. Public control of prominent, highly-visible hillsides will require assemblage of property and in some instances purchase of property from private owners.

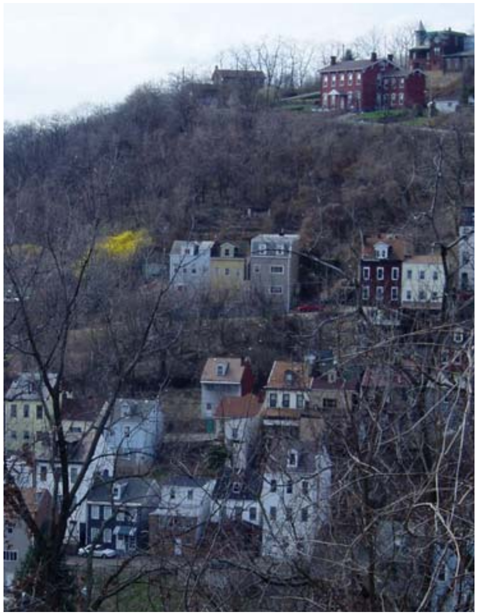
URBAN TEXTURE

The "texture" of a city describes the effect of the buildings and open spaces as if seen from a great distance. Large buildings and large open spaces create a large-grain texture, such as in industrial parks. The texture of Pittsburgh's residential neighborhoods is fine-grain. The texture can therefore be very different even for the same density of development. Large natural areas, such as parks, create a distinct contrast to a fine-grain built fabric. Streets and blocks define the scale and pattern of the built fabric.

The densely built fabric of the city contrasts to the natural open spaces and woodlands within the city. In Pittsburgh, local neighborhoods have their own texture and are easily distinguished from each other and from the natural areas that often separate them. In between the well-defined built and natural areas there sometimes exists sporadic development, which does not exhibit any orderly pattern. This occurs where new development at a larger scale has been inserted or where significant disinvestment has destroyed the historic urban texture.

URBAN TEXTURE





Houses on Spring Hill

The areas with larger footprints are easily distinguished from areas of finer grain texture. Building footprints in the city of Pittsburgh were mapped (GIS City of Pittsburgh) and grouped with similar footprints to form areas of legible texture and show continuity of urban form in the city. This visual analysis identified blocks that could be easily recognized without regard to any mapped streets or parcels. These areas were shaded to help visually demonstrate where they exist. Tree cover and open space was also mapped and shaded with a different color for contrast. Where random or sporadic development occurs, these areas have been left unshaded and represent the areas that are developed but lack legible texture.

When the analysis of texture is compared to the slopes, several conclusions can be reached. First, all of the areas of dense urban texture exist in the flatter, older sections of the city, such as Downtown, The Southside, the Strip, Oakland, Northside, and Lawrenceville. None of this dense development occurs on the slopes over 25%. Within the city there exist large continuous areas of steep slopes without development. Areas of development that have continuous urban fabric are primarily residential neighborhoods with buildings of small footprints. Dense industrial and commercial areas have tended to deteriorate or be replaced over time, leaving very little urban texture. A strategy of infill development would strengthen the coherence of urban texture where it has been weakened and create a stronger contrast to natural areas.

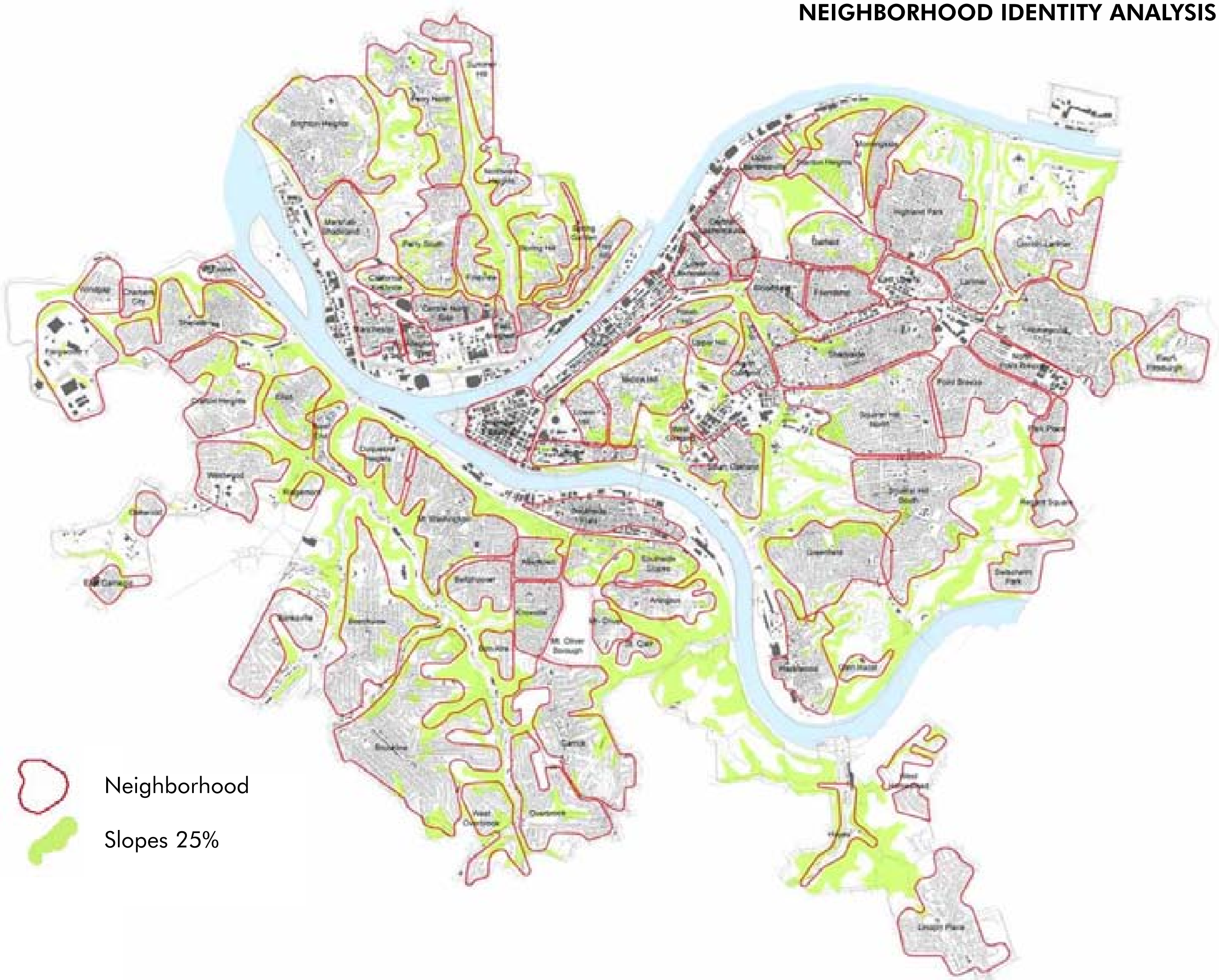
Sources: City of Pittsburgh GIS

NEIGHBORHOOD IDENTITY

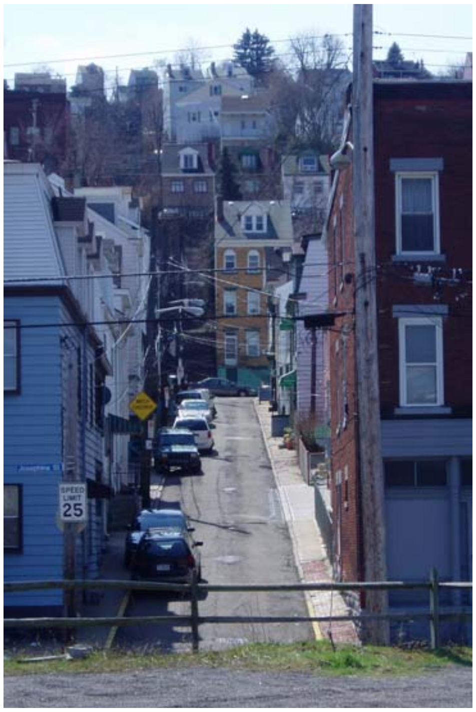
Neighborhoods are important components of American cities and are generally considered to contribute to their livability and quality of life (Keller 1968). Neighborhoods are not simply defined in physical terms, but are a complex interplay of social, economic, and physical factors. In some cities, neighborhoods are primarily known in terms of social relationships and may have very little physical definition. Grid cities in the Midwest and West, for example, tend to have weak physical neighborhood boundaries.

On the other hand, because of its terrain, Pittsburgh has physically distinct neighborhoods and has frequently been described as a "city of neighborhoods" (Smith 1990). The physical and social boundaries reinforce each other, resulting in "urban villages" that tend to be much more self-contained than in typical cities in the US. It is one of the distinctive characteristics that attract people to Pittsburgh. It also contributes to the social and economic sustainability of the neighborhoods, which offer small-scale pedestrian-oriented environments.

NEIGHBORHOOD IDENTITY ANALYSIS



Well-defined boundaries or edges help make neighborhood districts easily identifiable. They contribute to a neighborhood's sense of place. Neighborhoods with clear boundaries have a greater tendency to remain stable over time because these edges buffer them from outside influences and help them remain intact. While the slopes can be perceived as barriers to movement and transition within the city, they reinforce the city's strong neighborhoods by creating distinct edges. In Pittsburgh, where neighborhoods tend to be densely built, natural wooded slopes provide an especially distinctive neighborhood edge. To insure that Pittsburgh's neighborhoods continue to offer a uniquely attractive way of life, the slopes which form the boundaries of the neighborhoods should be reinforced, as well.



South Side Slopes from Josephine Street

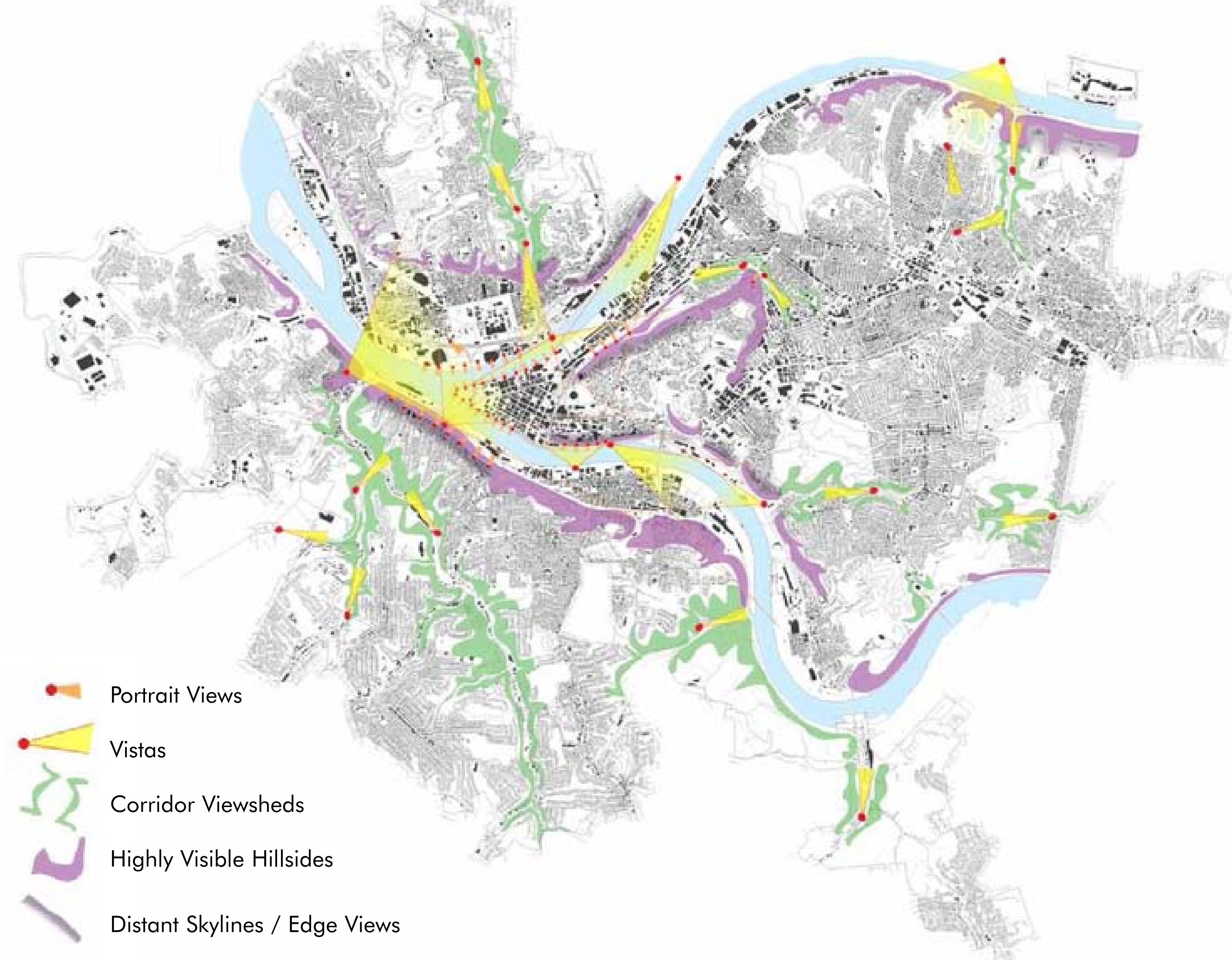
Neighborhood boundaries can be obvious or notoriously ambiguous (Guest and Lee 1984 in Population and Environment 71). The neighborhoods of Pittsburgh are perceptual and not always discretely defined by the residents of the neighborhoods or the city. The city has defined the neighborhoods largely on the census tracks established as early as the 1920 census. (GIS City of Pittsburgh) The census must also allow statistics to be collected for each neighborhood over time so they are locked in place. Consequently the changing perceptions of neighborhood districts by the residents that live there and the socioeconomic factors that continue to shape the neighborhoods can not influence these fixed city boundaries. In mapping the neighborhoods, this study began with the city designation and then modified the boundaries based on commonly held perceptions by city residents of where neighborhoods begin and end. In some cases neighborhood edges overlap, while in others clear distinctions can be made based on discernable boundaries.

Attempts to define the geographic extent of neighborhoods are complicated by the various ways in which neighborhoods are defined. It is generally agreed that the most useful and reliable definitions of boundaries are based on the perceptions of city residents (Cunningham and Kotler 1983). The City's published map of Pittsburgh's neighborhoods is based on census tracts, which is at best a crude approximation of neighborhoods (GIS city of Pittsburgh). The changing perceptions of neighborhood districts by the residents that live there and the socioeconomic factors that continue to shape the neighborhoods cannot influence these fixed boundaries. In mapping the neighborhoods, therefore, the boundaries are based on various research projects that recorded the definition of neighborhoods by city residents. In some locations neighborhood edges overlap (an example of low legibility), while in others the boundaries are unambiguous (high legibility).

The map of the neighborhoods, overlaid on the map showing slopes, clearly demonstrates that the slopes create the strongest boundaries for neighborhoods within the city. The steep slopes (those over 25%) fall into three discernable categories, the slopes outside the boundaries which are not part of the neighborhood but create a clear edge, the slopes at the perimeter of the neighborhoods, which reinforce the boundary and create an edge condition in the neighborhood, and the slopes within the neighborhood which are part of the fabric of the neighborhood. Based on the theory that distinct boundaries create the best neighborhoods, the slopes that help reinforce neighborhood boundaries should have the greatest protection from development.

Sources: City of Pittsburgh GIS, University of Pittsburgh School of Social Work research studies, Carnegie Mellon School of Architecture research studies

VIEWS AND VISTAS



VIEWS AND VISTAS

Views are significant in urban environment not only for their aesthetic value, but also for orientation and identity. Views of landmarks or distinctive features are important to enable residents and newcomers to find their way in the city, especially where there is no simple grid system. Distinctive views can also provide a city with a compelling image: a highly effective form of identity. Pittsburgh is well known for the view of the Golden Triangle from the Fort Pitt Bridge. It is perhaps Pittsburgh's most successful and nationally recognized "branding" feature. Other significant views include the view of Mt. Washington from Downtown and the view of the Point from Mt. Washington. Parkways lined with wooded slopes are distinctive and familiar sites in Pittsburgh: approaching the Fort Pitt Tunnel from the Parkway West, traveling through Schenley Park and Squirrel Hill on the Parkway East, or driving north through the East Street Valley.

Studies show Americans' consistent environmental preferences for views of natural landscapes (Nasar 1999). The scenic quality of landscape views is highly correlated with the "unspoiled" character of natural environments. The verticality of hillside slopes heightens their aesthetic impact because they occupy so much of the visual field. Solidly wooded slopes create Pittsburgh's "green walls", which terminate view corridors throughout the city as well as form backdrops for panoramic vistas.

Open spaces provide contrast to densely built urban fabric, which not only gives visual relief but allows for more compact higher-density development. Continuity of built form in contrast to natural form is a source of visual satisfaction (Arnheim 1978). It depends on contextual construction, instead of the construction of each building as a distinct object. Higher urban densities, which are related directly to the efficient use of public resources as well as contributing to urban character, are considered more livable when access to natural open space is provided. The density of Pittsburgh's neighborhoods is not oppressive because they are surrounded by open space.

This aesthetic component of the city's environment has already been identified in Pittsburgh's zoning code as View Corridors and Viewsheds. (City of Pittsburgh 2002) The "viewsheds" are a defining part of Pittsburgh's image for both its residents and its visitors. They are recognized in the zoning code as contributing to the aesthetic and cultural value of the city. In order to arrive at an objective study of the views, the arterial road intensities in the city were overlaid on the slopes. Resultant viewsheds and view corridors were identified. In analyzing the views, field reconnaissance

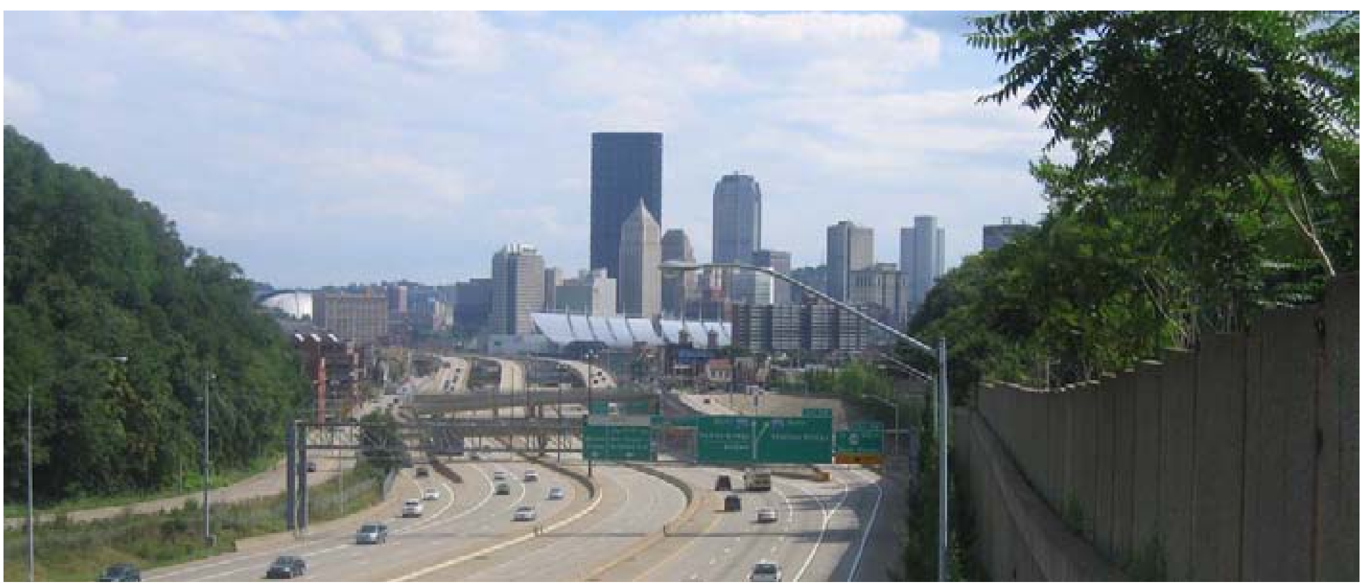
Approaching the Fort Pitt Tunnels on I-279 South determined where key views were seen while driving in the city and documented them in photographs. This included the portal views seen on the spatial structure map.

The views in corridors measure ¼ to ½ mile, while the views across the viewsheds average over one mile. The corridor views that are perceived more obliquely as the observer passes through the space have been mapped separately from the distant viewsheds that can be observed both directly from across the valley as well as obliquely from the road. Smaller internal stream valleys with slopes that are not viewed by very many residents or visitors were not mapped.

In addition to these viewsheds, it was recognized that the skylines occurring above the slopes comprising the distant viewsheds are also important. This is particularly true where a plateau sits above the slope and development on top of the slope crowns the view. This can be seen, for example, in the area of Mount Washington, Troy Hill, or Duquesne University. Therefore even though the development comprising these skylines is not within the steep slopes, the area of development closest to the slope needs to be assessed both for its impact on the view of the slope and for the opportunities it represents in views out over the slopes.

Slopes that are highly visible, due to exposure or to a relationship to a high-volume transportation corridor, are most critical to protect from development. Critical areas for protection include not only the face of the slope but also the crest line and, to a lesser extent, the land at the foot of the slope.

Sources: City of Pittsburgh GIS



View of Downtown from I-279 North

5.0 PITTSBURGH'S HILLSIDE DEVELOPMENT PATTERNS

Hillsides take on other context characteristics when they are studied as elements in their own right. Whereas the geomorphic qualities of the hillsides formed city-wide development patterns, the intermediate scale of the hillsides presents a more complex relationship of topography, development and open space. The topography informs where building can easily occur and sets the development patterns by plats and infrastructure.

Balancing built form with open space is more critical at this scale as the two interact with one another. Boundaries are formed or become ambiguous. Issues of continuity become more important. Context patterning becomes more discernable and understood. Anomalies that break patterns become obvious and how to control them becomes important.

Visual observations, cross-sectional studies, and plan studies revealed several common characteristics of the hillsides. Of most significance is the fact that there are distinct hillside development patterns caused by the steepness of the slopes that occur nowhere else in Pittsburgh. These patterns can serve as the basis for understanding where strong characteristics exist, where they are week and need reinforcement, and provide the fundamental basis for recommending future hillside development.

PROTOTYPES

Four hillside development types (prototypes) were observed to have identifiable and distinctive development patterns:

- No Development
- Developed Edges
- Ribbon Development
- Grid Development

Each describes an existing development type that is typical to hillside development. Common to all are two qualities: each has a distinctive relationship to the natural landscape and each can employed to continue development already in place. No judgment is made regarding their appearance qualities, only their appropriateness in terms of their ability to continue a pattern already in existence.

This section describes each of the prototypes in terms of their locations relative to the steepness of the slopes, views and vistas from the perspectives of viewing the hillsides and views from them, their relationship to adjacent neighborhoods, their infrastructure characteristics, their open space characteristics, their built development pattern, and representative and recognizable locations within the city.

Each of these prototypes is inherently reproducible and offer distinctive alternatives for future development that are within the character of Pittsburgh's hillsides.


Hays from railroad tracks

A fifth prototype, Scattered Development, where individual buildings are randomly located on hillsides, was also identified. However, its patterning qualities are poor. Scattered development does not continue a built fabric pattern. Scattered development is either a remnant of disinvestment or a singular action by a landowner often seeking separation and privacy from other development. Its "unplanned" nature does not allow for adequate control. This report's recommendations do not encourage scattered development.

PROTOTYPE A: NO DEVELOPMENT

"No Development" encompasses those slopes and hilltops that remain wooded and not developed. They appear as landscaped open space often forming edges to the river valleys and provide a landscaped backdrop to the built environment.

Steepness of Slopes: These hillsides are usually the steeper slopes averaging 25% and greater, and include cliffs and inaccessible wooded hillsides.

Views and Vistas: Trees form the skyline at the ridges and the hilltops are undeveloped. Usually, views are limited from the upper slopes because of the vegetation.

Relationship to Neighborhoods: These slopes generally have no relationship to any neighborhood. Where the abut neighborhoods they form strong boundaries and significant demarcations.

Infrastructure Characteristics: No Development hillsides have any streets or roads on the slopes. A railroad or occasional rail line may be located at the base along with very limited development. There is usually only minimal infrastructure available, except where major utility corridors, such as high transmission lines or major sewer trunk lines, cut across or down the slope. However, these utility corridors are not intended for localized development and do not service the slopes.

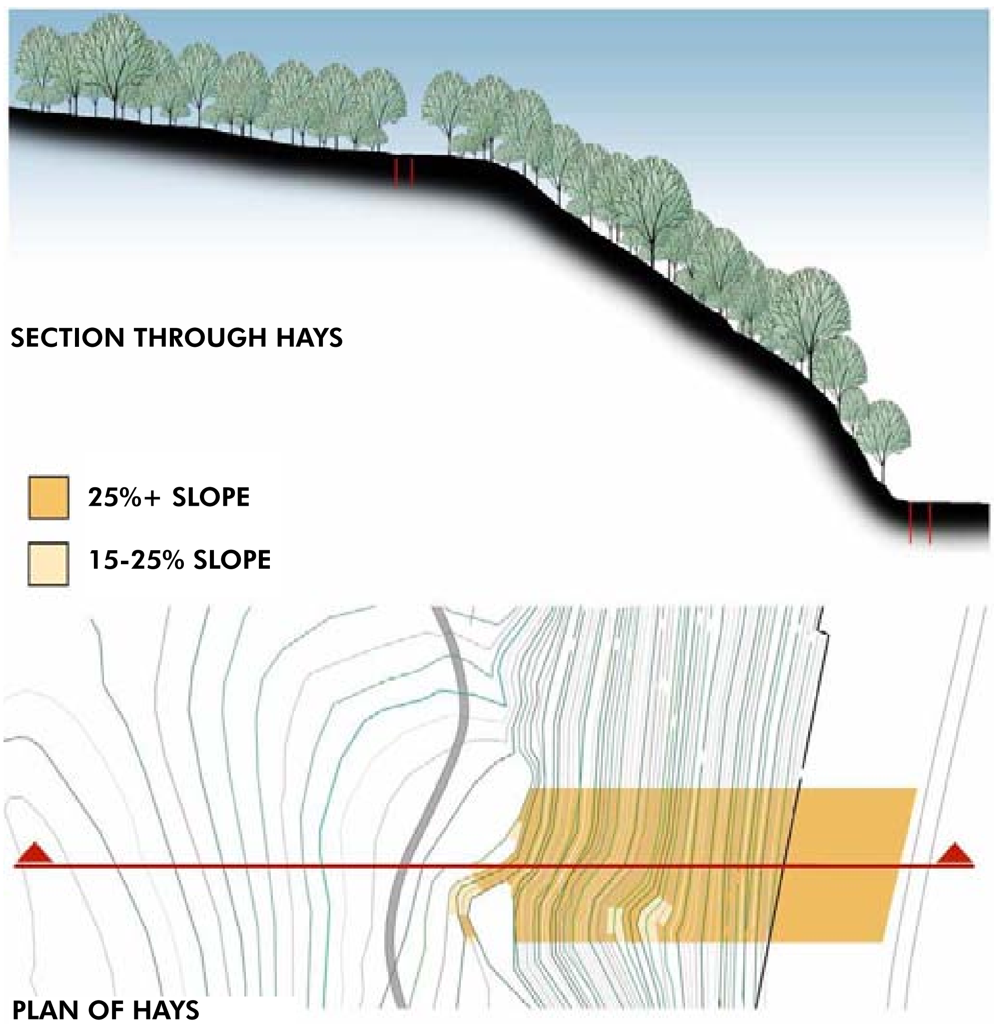

Hays from Monongahela River

Open Space Characteristics: The use of these slopes is predominantly open space. These hillsides constitute the most number of slopes designated Parks and Open Space, the PO District, in the Zoning Ordinance. Park areas are usually undeveloped for active recreation.

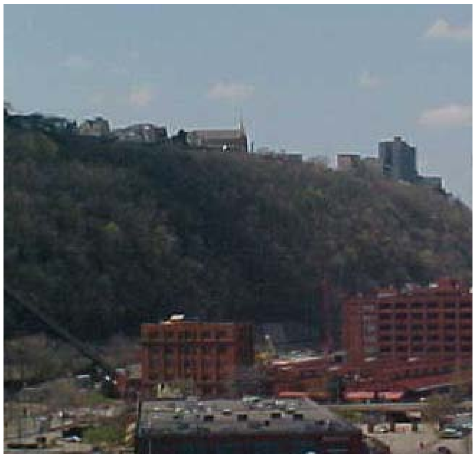
Development Patterns: The slopes are undeveloped. These hillsides are generally comprised of large parcels with few owners, most of it in public ownership. Due to their steepness, pedestrian paths and steps may be present. These undeveloped slopes are in the parts of the city settled after 1900.

Example Locations in Pittsburgh: Hays, Lower Washington Boulevard, Highland Park near the VA Hospital, the Greenfield area along the Monongahela, Frick Park, northern portions of the East Street Valley Expressway, Schenley Park along both the Parkway East and Panther Hollow, the Beck's Run Road area, Route 885 at Glass Run, and areas west of the Parkway West beyond the Fort Pitt Tunnel.

Hays from Becks Run Road



PROTOTYPE B: DEVELOPED EDGES


Mt. Washington from Uptown

"Developed Edges" occurs when both the top and bottom edges of the slopes are developed and the slopes remain as open space between. The remaining undeveloped and landscaped slopes may be narrow, but discernable, as development extends down from the top and up from the bottom where the slopes transition to a steeper profile, however most slopes of this type have large, undeveloped and wooded open spaces.

Steepness of Slopes: The slopes are frequently over 15%, with 25% slopes being the most prevalent. Within this prototype, hillsides vary from steep cliffs with slopes above 40% and plateau development above and below to less steep slopes of 25% with more gradual slopes at the tops and bottoms. The vertical distance from top to bottom of these slopes vary from a vertical drop of over 200 feet to as little as a 75 foot vertical drop. Hillsides with less than 75 feet of vertical open space do not meet this prototype's definition because the heights of bottom and top development would begin to obscure the open space.

Views and Vistas: The tops of buildings frequently form a skyline when viewed from higher elevations, with trees forming a visual infill of the built fabric at the top of the slope. Trees form the majority of the visual part of the built fabric when viewed from below, especially where slopes are more gradual. Views from the tops of cliffs, such as along the bluffs of the Boulevard of the Allies, are frequently more encompassing because fewer trees and taller vegetation occur on a cliff slope. Where a street or open space is at the top of a slope, vista views are the most accessible to the public.

Relationship to Neighborhoods: These green hillsides form distinct boundaries between neighborhoods. The greater the amount of vertical distance of the non-developed center of the slope the stronger the distinction of boundary.

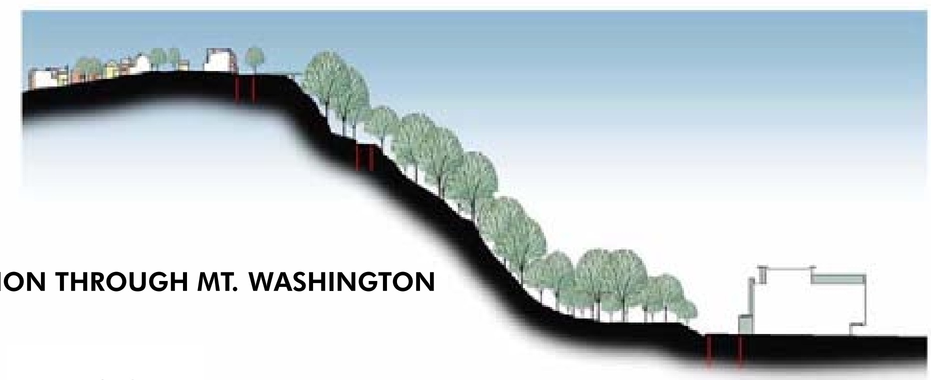

Troy Hill from North Side

Infrastructure Characteristics: Roads may traverse these slopes but are undeveloped and are narrow without sidewalks. They usually have guardrails as edges. Major roads frequently run along the tops and bottoms of these slopes. Where the vertical drop is limited, stairs may connect the upper and lower development and make connections to streets. Utility infrastructure is available at the tops and bottoms of this slope type, but not within the center open space areas.

Mount Washington from Monongahela River

Open Space Characteristics: Open space is continuous across the slope and scattered at the top or bottom of the slopes. Designated open space, such as parks, or greenways are prevalent, but not consistent, within this prototype.

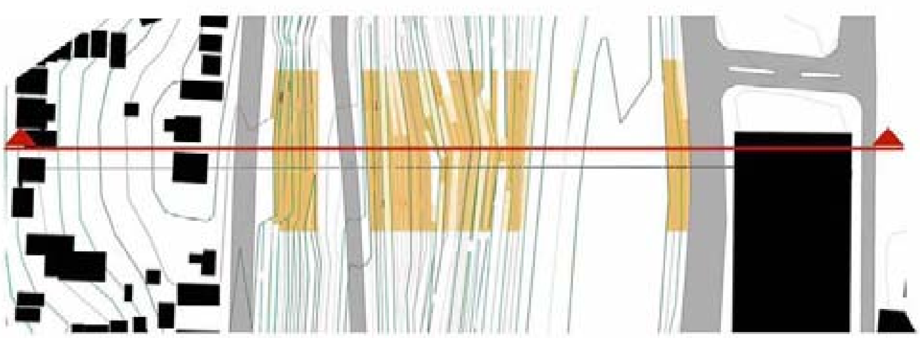
Development Patterns: Development occurs along the plateau at the top of the slope or spills down the less steep slopes at the crown of the slope. Development at the top and bottom will generally be larger in scale where there are plateaus of slope, with smaller-scaled development on the slopes themselves. Development at the bottoms of the slopes frequently occurs on the less-steep lower slopes that form the base. Streets may run across the



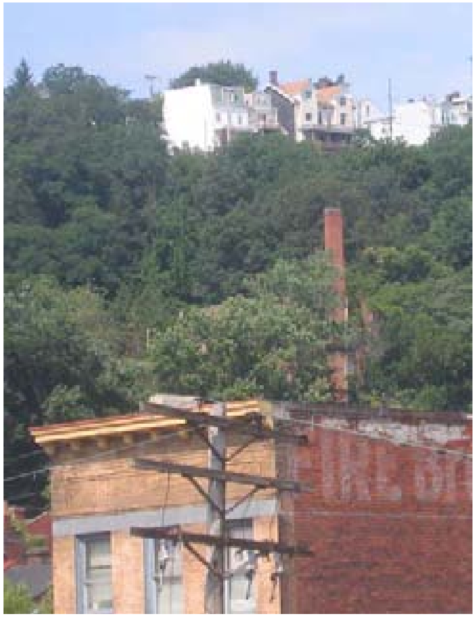
SECTION THROUGH MT. WASHINGTON

25%+ SLOPE

15-25% SLOPE



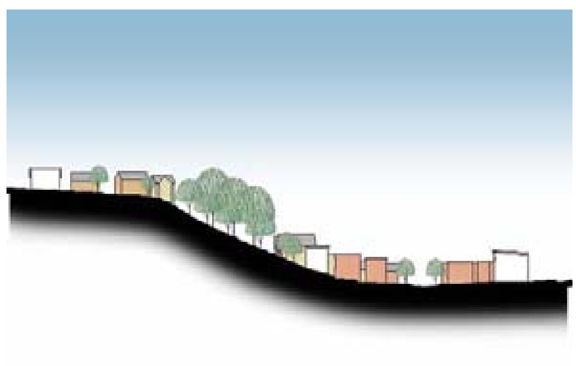
PLAN OF MT. WASHINGTON



Fineview from Central North Side

top of the slope or perpendicular to it and dead end as the slope becomes steeper; development forms the sharpest edge when the streets parallel the tops of these slopes, while the development pattern is scattered when the streets are oriented perpendicular. The parcels at the tops and bottoms of these slopes are typically lots of smaller size platted for residential uses, while many of the parcels on the slopes are larger in size and not subdivided. Some areas within this prototype were formerly developed but have experienced significant disinvestment.

Example Locations in Pittsburgh: The northern face of Mt. Washington, the hillside along Bigelow Boulevard, the Duquesne/Mercy/SoHo slope, Troy Hill, Stanton Heights above Butler Avenue, Bloomfield along the Busway, Panther Hollow along the Oakland side, West End above Carson Street, the backside of Duquesne Heights along Route 51, Beck's Run, the southern portion of the East Street Valley Expressway, portions of Spring Hill, the West End, Swisshelm Park, Liberty Avenue south of Route 51, Route 51 at Knoxville, Route 51 and Liberty at Brookline, Hazelwood/Greenfield, Upper Lawrenceville, Ohio River Boulevard, Northview Heights, Homewood, Perry Hilltop, Squirrel Hill above Fifth Avenue, Upper Schenley Farms/Herron Hilltop, and Fineview.



SECTION THROUGH SPRING HILL

PLAN OF SPRING HILL

PROTOTYPE C: RIBBON DEVELOPMENT

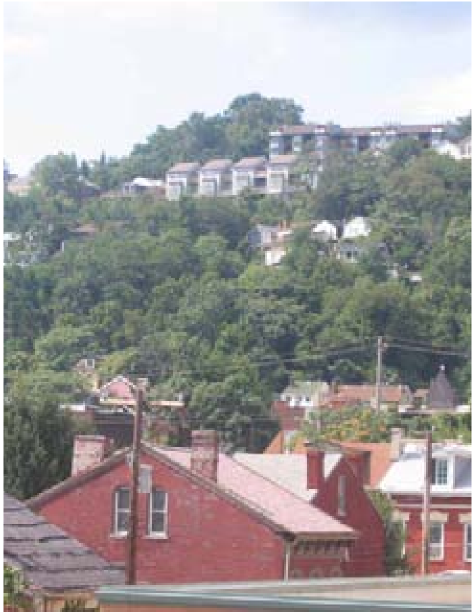
"Ribbon Development" occurs when a center section of a slope is significantly developed as a building corridor dividing the vertical hillside into two or, possibly, three bands alternating between structures and landscape. There may or may not be edge development at the top or bottom of the slope.

Steepness of Slopes: The slopes are typically between 15% and 25%. Where a road or street cuts across the steeper slopes, development generally does not occur in that portion. This prototype occurs mostly when there is a vertical drop of 150 feet to 200 feet. In areas of 15% or less slope some vertical ribbons of development will extend up slopes along streets located along valley bottoms.

Views and Vistas: Buildings form a continuous visual line when viewed from a distance. This development pattern is most visible during the winter months; however examples with a strong built development pattern are also visible during the summer. The best vista views occur from buildings, not the streets or public realm.

Relationship to Neighborhoods: Ribbon Development typically connects two neighborhoods with the "ribbon" not being clearly identified with either. Ribbon development may be more identified by street name rather than with the neighborhood at the top or the bottom of the slope.

Infrastructure Characteristics: The availability of streets and utility infrastructure has determined this prototype of development. Infrastructure is typically not available in the slope areas above and below the ribbon of development.



Perry Hilltop from Central North Side

Arlington Avenue along South Side Slopes

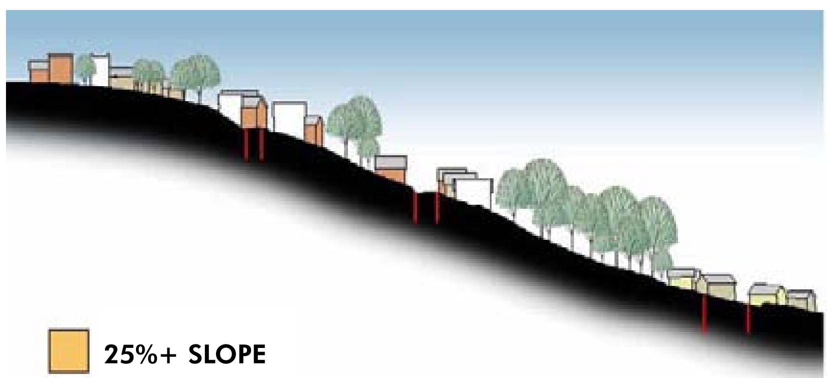
Spring Hill Houses from Fineview

Allentown Houses

Open Space Characteristics: Development forms a break in the continuous open space. Large areas of open space exist above and below the ribbon of development. Open space is small and scattered within the ribbon itself, except where the slopes are the steepest.

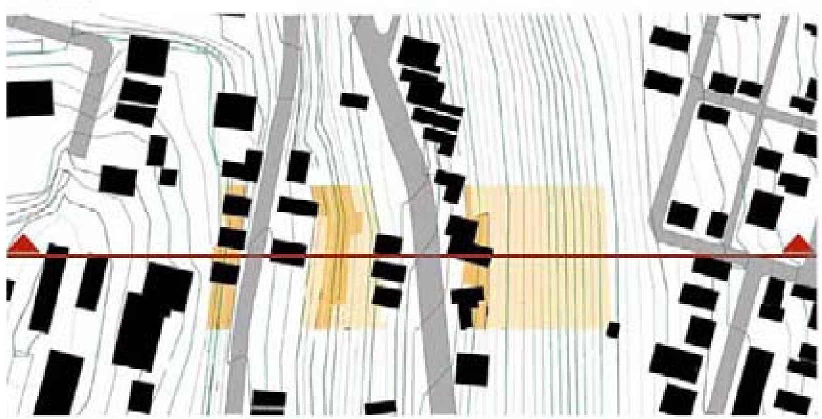
Development Patterns: Green hillsides are interrupted by strong linear development along a street or streets that follow the slope contours. Development is concentrated along the road crossing the slope. Narrow-width buildings step up smaller-scaled streets with little or no setback from the street. Rectangular parcels run perpendicular to the street and frequently extend into steeper slopes away from the street. Buildings on the upper side of the street are built into the slope and are typically higher and more visible, whereas buildings on the lower side extend down the slope and are often masked by trees. Building footprints are small in size and are typically 600 to 1,000 square feet. Buildings are, for the most part, individual structures with visible spaces between the buildings. Parking is an issue, particularly with the down-slope buildings. This prototype pattern is typically historical in context and frequently undergoing dis-

SECTION THROUGH PERRY HILLTOP



25%+ SLOPE

15-25% SLOPE

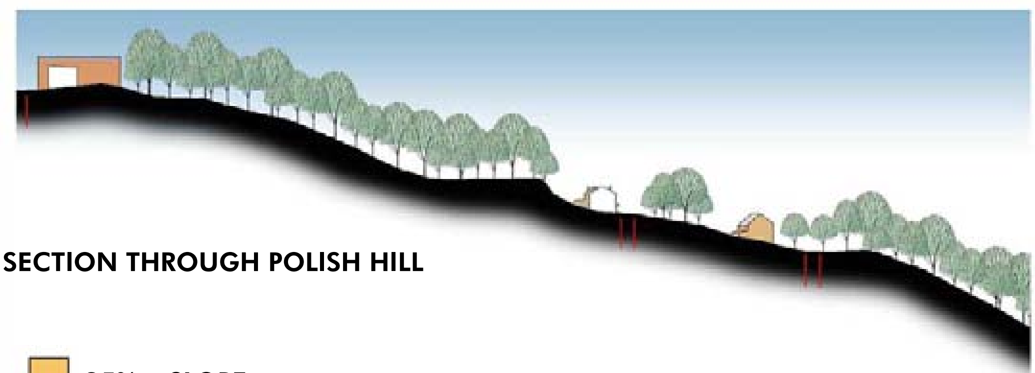


PLAN OF PERRY HILLTOP

investment. Disinvestment that has occurred and the subsequent vacant lots have helped relieve the parking problems.

Example Locations in Pittsburgh: These locations are similar to those of the Developed Edges prototype with corridor development along the roadway. Locations include Arlington Road on the South Side, 18th Street on the South Side, Sycamore Street in the Mt. Washington saddle, Dartmore Street in Carrick, Oswin Street in the West End, suburban Beechview, Clayton Street in Perry Hilltop, Carrick near Bon Air, Centre Avenue above Schenley Farms, Perry Hilltop, the edges of Polish Hill, and Spring Hill.

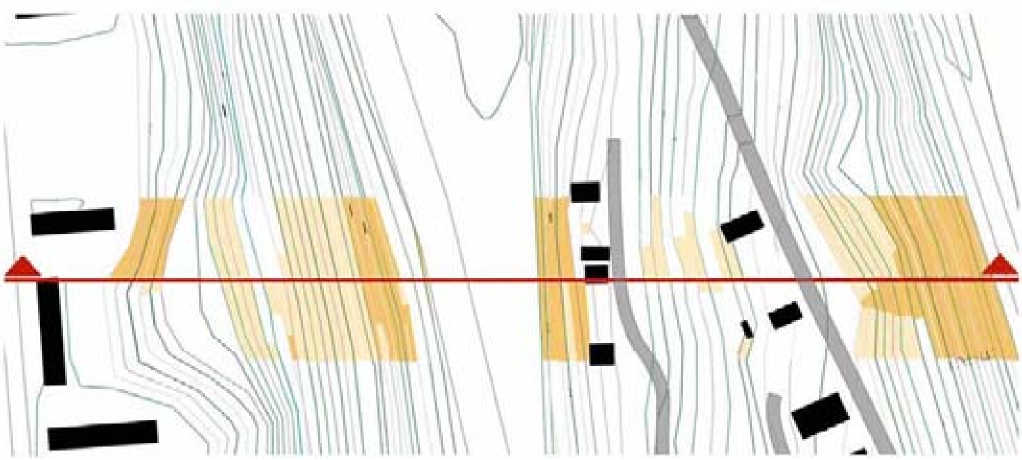
Spring Hill Houses seen from North Side



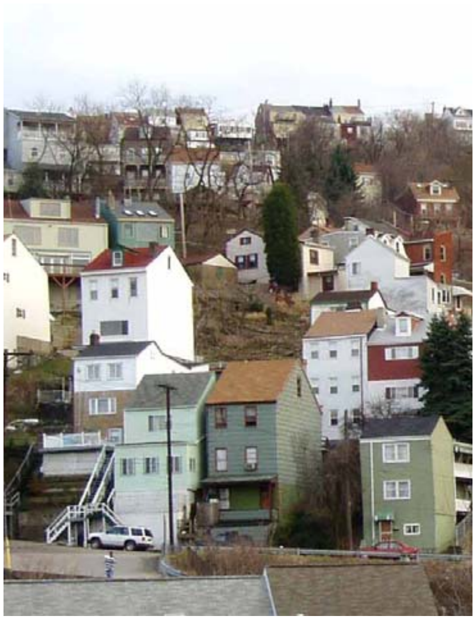
SECTION THROUGH POLISH HILL

25%+ SLOPE

15-25% SLOPE



PLAN OF SPRING HILL



Southside Slopes from South Side

PROTOTYPE D: GRID DEVELOPMENT

These slopes are basically developed from top to bottom. Limited interruptions, such as minor cliffs or small portions of 25% and greater slopes, are located within the "Grid Development" prototype, however they are minor and do not interrupt the overall pattern.

Steepness of Slopes: The slopes of this prototype typically are less than 25%, with significant portions of development built on more gradual slopes of less than 15%. Areas of 25% and greater are generally limited to short vertical rises of less than 40 feet and are subsumed within visual character of the built development.

Views and Vistas: Views of the hillsides are of small-scaled development stepping up the hillside and defining the slope. The slopes of this prototype are less steep and do not form a strong visual edge to the ridgelines. Smaller buildings appear to have an almost random pattern on the hillside when viewed from a distance, although a line of buildings can be discerned. Roof shapes and gables form the visual pattern. Separate buildings are visible with individual trees completing the visual pattern. The best vistas from these slopes are from the buildings themselves.

Relationship to Neighborhoods: This hillside development is a part of a neighborhood and there will be no distinct boundaries between the neighborhoods at the top and bottom of slopes.

Infrastructure Characteristics: Major streets are generally oriented horizontally to the topography. Stairs may connect horizontal streets on the slopes in place of streets running vertically up the hillside. Some major connect-

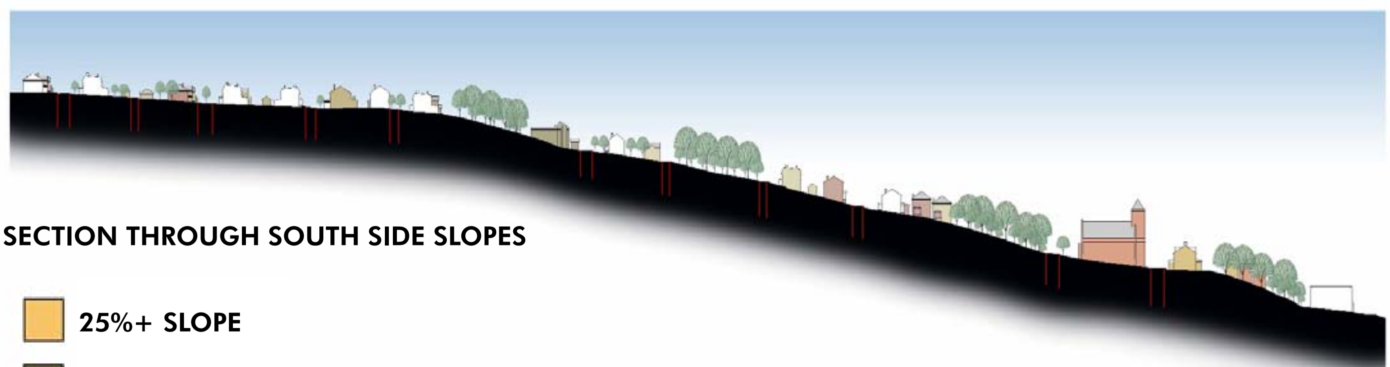
South Side Slopes from Uptown

ing streets will angle up the hillside connecting horizontal streets; a few vertical streets will extend up the slope to connect two horizontal streets. Sewer and water infrastructure is in place but of older vintage. Streets are frequently narrow and parking is an issue in these areas.

Open Space Characteristics: Public open space is limited to a few small city parks near the tops of slopes or on flat natural terraces within the development fabric. Open space around buildings consists primarily of yards or steep slopes and these do not form a continuous pattern.

Development Patterns: Buildings tend to have limited or no setbacks and tend to be immediately next to sidewalks or streets. The depth of the buildings will frequently involve a change in the number of floors from front to back of the building, with one less floor on the up-hill side along a frontage street or with the lowest level built back into the hillside. Parcels are generally rectangular in shape and the buildings are located perpendicular to the horizontal streets. Platted streets and parcels are typically present throughout this slope prototype. Vacant parcels are scattered and of smaller sizes. Building footprints on the slopes are small in size and are typically 600-1000 sf. Residential occupancy is the typical use. Buildings are, for the most part, individual structures with visible spaces between buildings. Buildings tend to be three to four stories in height on the downhill portions and two to three stories in height on the up-hill portions. These slopes were usually developed prior to 1895, are of older historic

South Side Slopes from Birmingham Bridge



SECTION THROUGH SOUTH SIDE SLOPES

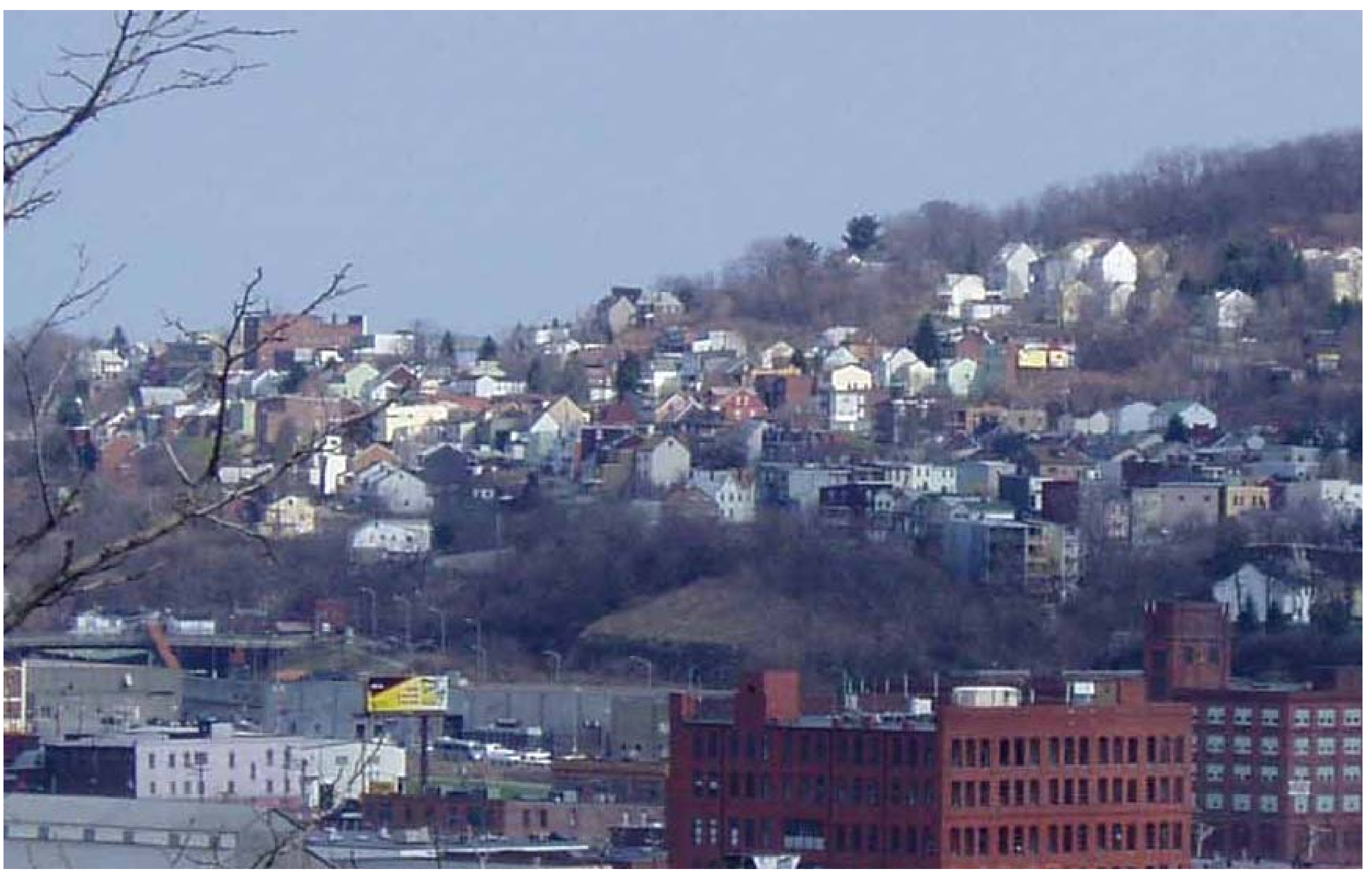
25%+ SLOPE

15-25% SLOPE

PLAN OF SOUTH SIDE SLOPES

development, and do not accommodate the automobile well. Parking is an issue in the densest development areas. In the best examples of grid development some disinvestment has occurred, but the fabric remains largely intact; some historical areas of the grid now appear as scattered development and the grid pattern of streets and parcels has been lost. At times in areas of disinvestment with streets and infrastructure still intact, the building pattern is not always visible in the summer because the buildings are beneath the tree canopy height.

Example Locations in Pittsburgh: The South Side Slopes at Mission Street, Upper Lawrenceville, Stanton Heights, portions of Eliot, Polish Hill, Herron Hill, Bloomfield, Lawrenceville, Upper Oakland above Fifth Avenue, and areas bordering West Liberty Avenue at Brookline.



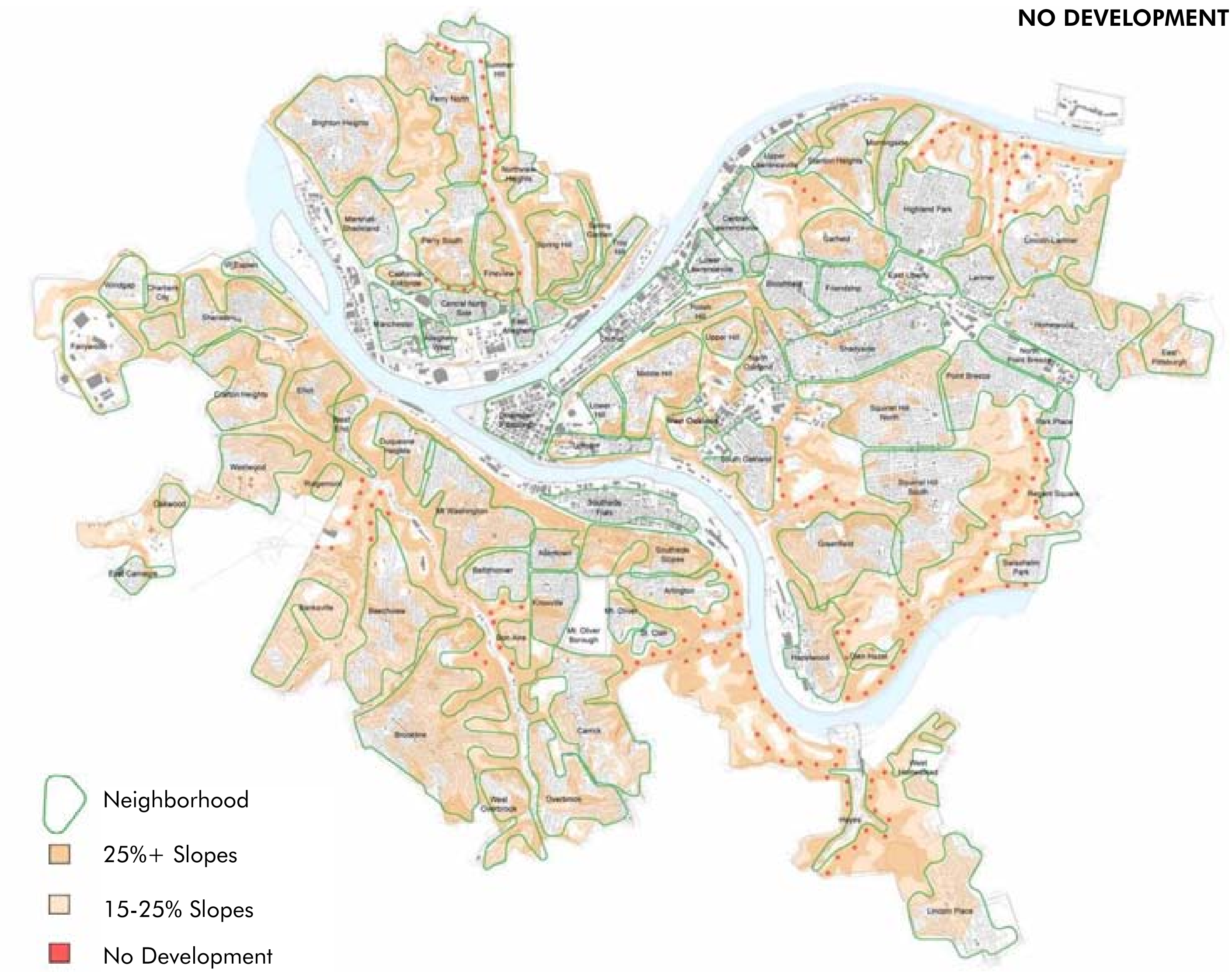
Houses on Polish Hill

MAPPING PROTOTYPE LOCATIONS

Locations of each prototype were spotted on the 15% and greater slopes as a demonstration of their repetitive nature and to gain an understanding of where they are most likely to occur.

In each case, there are multiple locations where each prototype exists throughout the city, demonstrating that each is easily recognizable and repetitious. The repetitious nature is important to establish that these are physical development and open space patterns and not merely individual circumstances or anomalies. The accompanying maps clearly show that each prototype exists in numerous locations and in varying physical settings, such as along major river bluffs as well as small-scaled valley corridors.

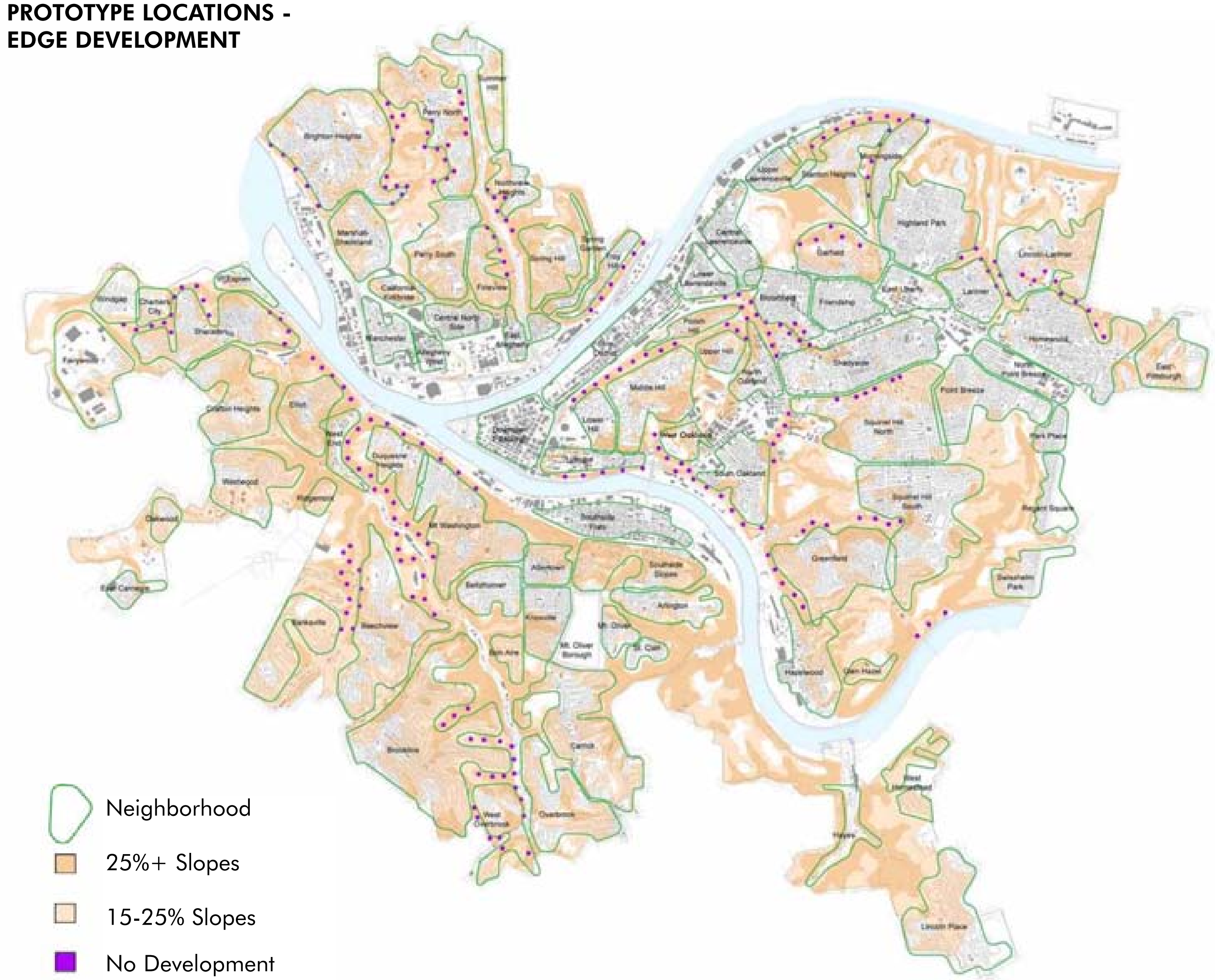
PROTOTYPE LOCATIONS - NO DEVELOPMENT



No Development prototype locations occur, generally, in the more undeveloped portions of the city and somewhat distant from downtown. River locations include the Hays and Hazelwood sections on the Monongahela River and Highland Park on the Allegheny. Corridor locations include the Parkway West near the Fort Pitt Tunnels and along the East Street Valley Expressway. Most of these locations are inaccessible.

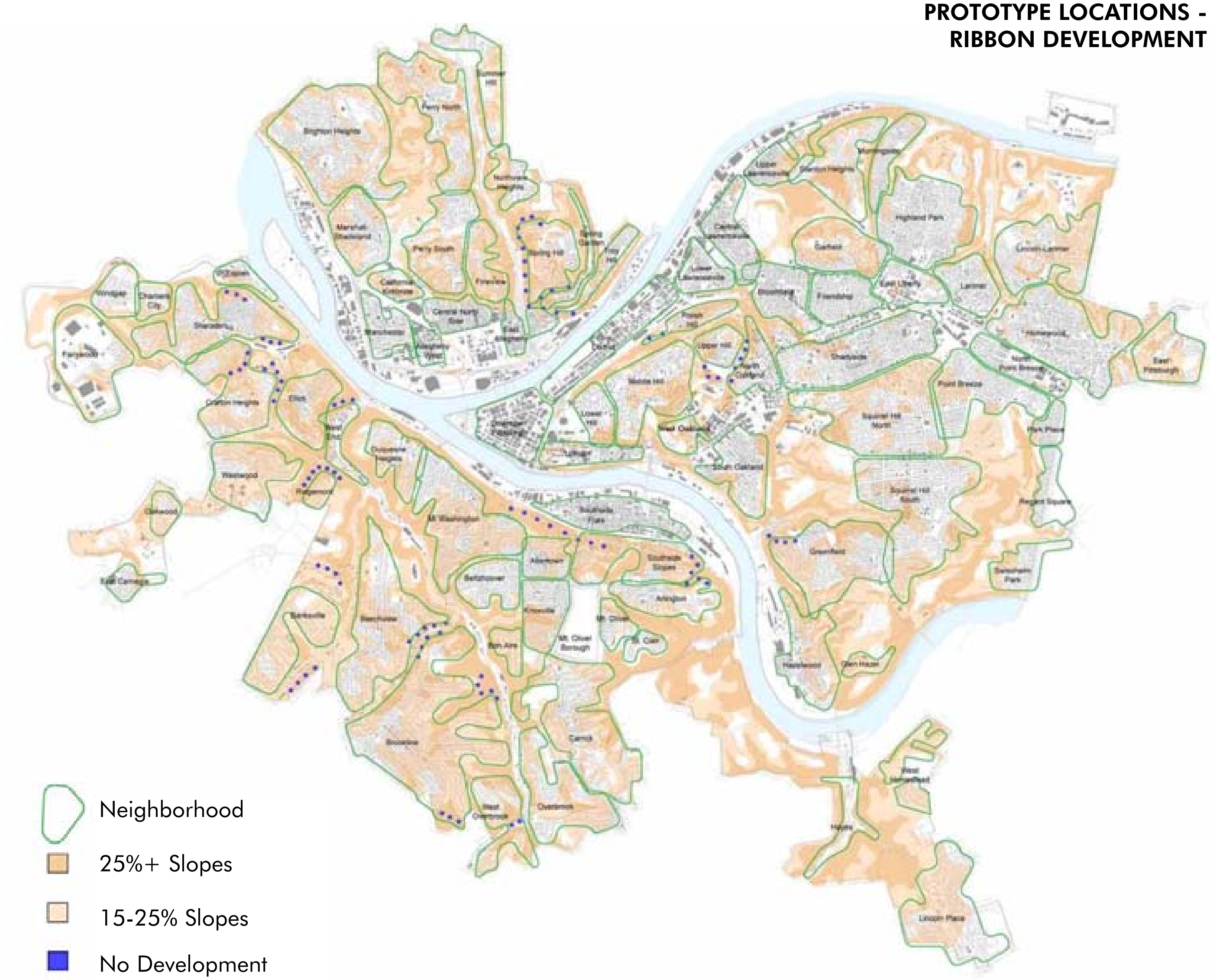
The Developed Edges prototype is the most ubiquitous of the four and the most characteristic of Pittsburgh's hillside development. This typology is located along most of Pittsburgh's arterials, rivers and major valleys. The hillside edges of the three rivers are developed with this pattern. In the interior and highly-developed urban areas of city this prototype describes the typical hillside development.

PROTOTYPE LOCATIONS - EDGE DEVELOPMENT



Ribbon Development occurs where connections are made between flat land development and plateau communities and, occasionally, within neighborhoods where the hillsides are terraced. Arlington Road on the South Side Slopes is the most easily recognized example. Ribbon development occurs wherever the slope percentage of the roadway is slight enough (below 12%) to provide safe passage up a hillside and the parcels and buildings are just large enough to allow for small-scaled residential buildings. Ribbon development formed from natural hillside terracing can be seen in Polish Hill, portions of the Hill District and the West End.

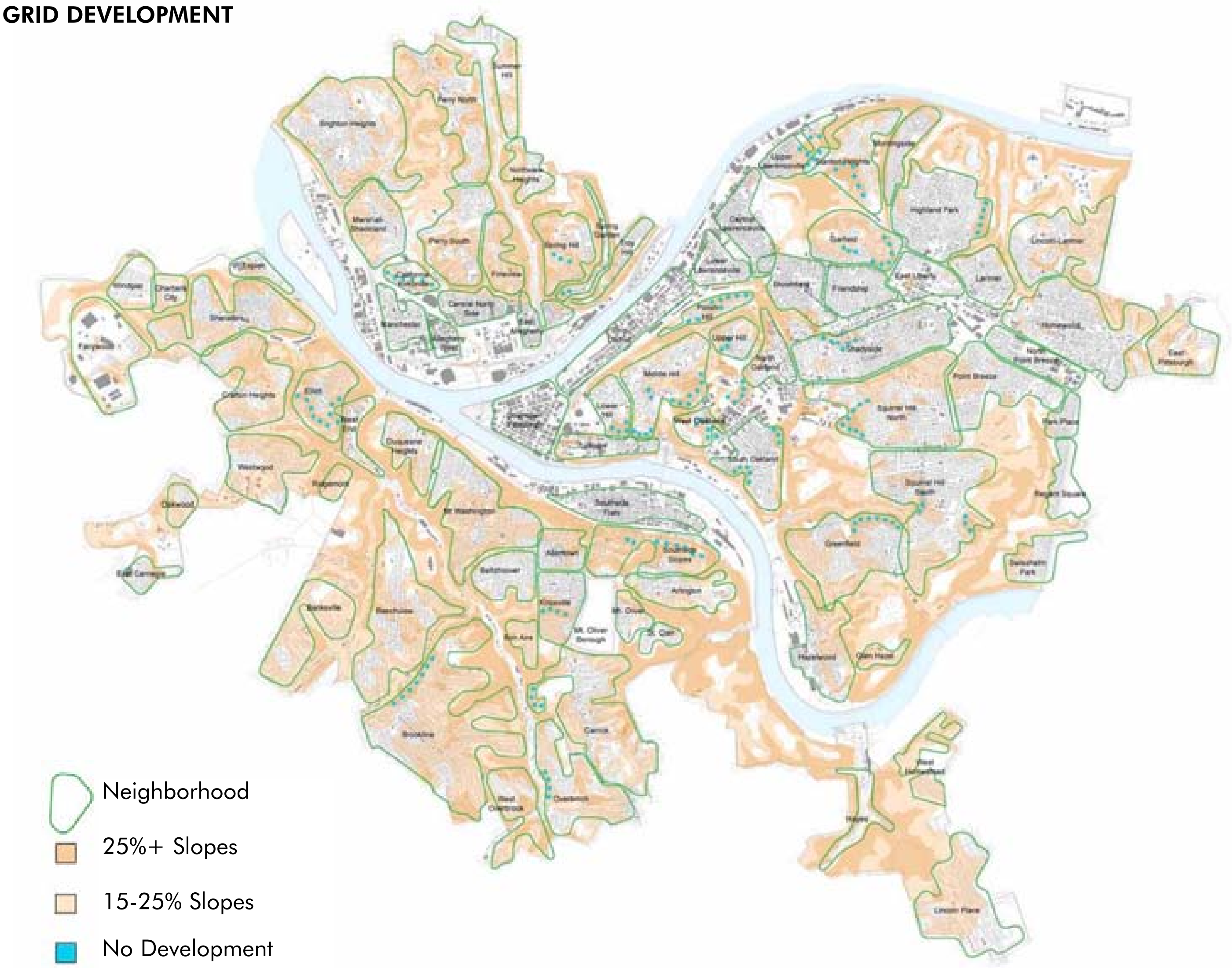
PROTOTYPE LOCATIONS - RIBBON DEVELOPMENT



Grid Development is the quintessential built-environment hillside. With its San Francisco-like quality of covering a hillside with a fabric of small-scaled buildings, this prototype is the one the public identifies as "Pittsburgh." The best example is the South Side Slopes. However, this prototype occurs where there is high-density development of the less-steep hillsides. Most locations are at the edges of dense neighborhoods.

The development patterns exhibited by these prototypes represent the most characteristic types of hillside development that bear future repetition. Each has a characteristic relationship between the built fabric and the natural landscape that allows for future continuation of the pattern type. Each is readily identifiable, follows certain "rules," and can be applied to future development where appropriate. They are not capricious examples, but describe the major types of hillside development

PROTOTYPE LOCATIONS - GRID DEVELOPMENT



within Pittsburgh. They describe the development character of Pittsburgh's hillsides.

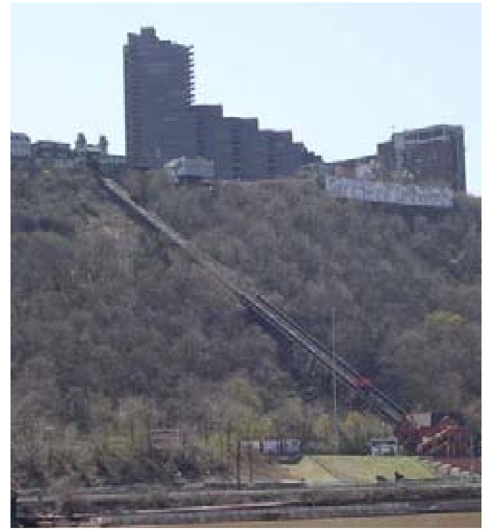
It is important to note that the natural landscape is the predominant hillside pattern, not development. Development always occurs in relation to this natural pattern and it is this relationship that describes the differences between the prototypes. This is a fundamental quality of Pittsburgh's hillsides and makes them different from, say San Francisco, and other cities with hillsides.

ANOMALIES

Anomalies occur when development breaks the characteristic pattern. Usually in the form of single structures, they are undesired because they are significantly different from their context. They are intrusions and uncharacteristic of their context. This is more of an issue on hillsides because they are so much more visible and distracting from the natural landscape.

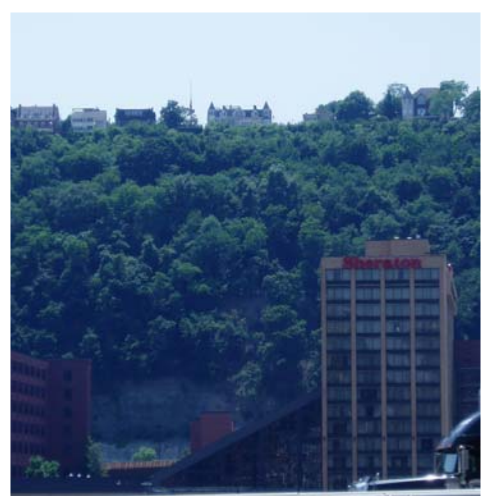
Tall buildings on hillsides are anomalies. Their large scale contrasts with the typical hillside building of small footprint and low height. Most hillside buildings are no more than three or four stories in height and do not extend higher than the tree tops. They exist "within" the tree canopy. High-rise buildings are significantly higher than trees, breaking the continuity of a natural ridge line or blocking views of a wooded hillside when located at the base of slopes. They also become anomalies when they are higher than their neighboring structures, which is particularly a problem when they occur along a ridge line. Mt. Washington across from downtown provides excellent examples of tall building anomalies, whether they are high rise buildings perched along the plateau top or cascading down the hillside from the top. Other examples are demonstrated in the next section of this report. Tall buildings on hillsides are not appropriate.

Wide buildings are a second type of anomaly. Wide buildings are a consequence of large-scaled, generally dense, development that tries to maintain a low building height. While a desired effect in established neighborhoods and high-density urban settings, wide buildings on hillsides break the small-scaled residential building context. Typical examples are attached townhouses on hillsides or an occasional institutional building. Attached townhouses, other than duplex units, are perceived as individual units by the public, but in reality they create a wide mass form when viewed on hillsides. Untypical are large-scaled residential buildings, such as 1000 Grandview that cascades down Mt. Washington. Other examples are demonstrated in the next report section. All, though, are disruptive to the typical hillside development pattern and are undesirable without provisions for openings between units of attached townhouses or spaces



Trimont Residence Tower

1000 Grandview



Sheraton Hotel

Houses on Perry Hilltop overlooking North Side

between building massing on larger structures. Openings or spacing should mimic the spacing between buildings of typical hillside development.

Color and materials can also become anomalies when they significantly contrast with their natural setting or their neighbors. White buildings and brightly-painted structures using primary colors stick out against the natural landscape. Materials that exhibit similar exhibitionist qualities, such as reflective glass or bright metallic sidings, likewise contrast with the natural environment. Many cities have recognized that "un-natural" colors and materials detract from the aesthetic appeal of their hillsides and strictly regulate their use. Some zoning ordinances describe materials and colors that may only be used and others list inappropriate qualities. Pittsburgh should consider similar regulations if maintaining a natural appearance is valued.

Anomalies are of more concern when they are highly visible by large numbers of people. Hillsides that form the walls defining the river valleys and the hillsides of heavily traveled valleys, such as the East Street Valley Expressway and Route 51, where they are easily visible from major arterials the most prominent locations where controls are more necessary. In areas where the valleys are narrow and viewing distances short, anomalies are more acceptable because they are viewed by fewer people and the shorter viewing distances render their contextual impact less severe.

6.0 RECOMMENDED STRATEGY: REDIRECTING DEVEVLOPMENT

Before discussing the regulation of development on slopes, it is necessary to discuss the importance of redirecting development to the non-sloped areas of the city. There are a number of compelling reasons for this policy.

Beechview from Route 51 South

First, a quick "snapshot" of Pittsburgh today:

The City of Pittsburgh occupies a total of 35,686 acres. Of that area, 4,239 acres (11%) is designated open space (parks, cemeteries, greenways). Parks comprise 7% of the city area; cemeteries occupy 3%; and greenways, 1%. Rights of way and other public spaces occupy 7,383 acres, which is approximately 20% of the city area, leaving 80% as private property.

There are over 2,000 acres of vacant property in the city. More than 16,000 properties are currently vacant.

Pittsburgh's greatest challenge is to restore its economic viability. Having lost more than half of its population over the last sixty years and the major sources of economic production, the city struggles to maintain a tax base and an acceptable level of public services. The city may have "bottomed out" in the last ten years, but it has yet to escape the downward spiral. Its most recent strategy has been to sell off its public assets. This would likely mean, among other things, encouraging increased private development of open space, especially publicly-controlled property. Ultimately, as in business, this would be a self-defeating strategy.

A more promising strategy is to recognize the assets that make Pittsburgh unique and attractive, and enhance those features for the purpose of increasing population and private enterprise. This is a strategy that has been pursued successfully by a number of increasingly affluent cities. In the competitive environment of American cities today, Pittsburgh must make itself a city of choice.

South Oakland and Greenfield from Monongahela River

Allentown and South Side Slopes

DEVELOPMENT OPPORTUNITIES

Disinvestment has left significant vacant land within existing neighborhoods and other developed districts. Derelict vacant sites generally detract from the livability and economic value of the surrounding area. They must be maintained in order not to create a nuisance or a health hazard. They represent a lost opportunity in terms of neighborhood open space or public revenue, if developed, from property taxes.

The sites that are serviced with existing infrastructure are more economical in terms of public expenditures. New public infrastructure, such as streets, curbs, sidewalks, lighting, and sewers, do not have to be extended. Replacement or upgrading infrastructure is far more economical and may be the responsibility of the property developer. If improvements are made by the City for infill sites, they are more likely to benefit other property owners in the vicinity.

Fineview from North Side

A policy of encouraging infill development over new "greenfield" development also saves the ongoing costs of extending the public infrastructure. The City is already unable to maintain its existing infrastructure, and any new revenue from property taxes should be applied to existing maintenance rather than to creating additional infrastructure that will require additional maintenance.

As presented in Section 3, there are significant costs and hazards (private) from developing on hillsides rather than on flat land. The public shares those costs, even private compensation, through increases in the costs of insurance, disaster relief, and public development review processes.

Pittsburgh will attract a new more affluent and educated population by strengthening its sense of place, its distinctive identity. Reinforcing the physical structure of the city, especially the "mosaic" quality of its neighborhood-based form, can be more economically advantageous than collecting taxes on a few new hillside buildings. Protecting and maintaining "unspoiled" green hillsides is as important as bringing new development to older deteriorated districts of the city.

Directing development to infill sites will reinforce and further the City's policy of strengthening pedestrian quality and scale and mixed-uses.

Green hillsides can be better used for ecological purposes (quality of air, storm water management, healthy living communities, etc) and recreational functions (walking, jogging, riding trails, bouldering, passive nature enjoyment) and education (related to ecology and geology, etc) and aesthetic amenity. Private development does not provide as many benefits as public use.

A number of initiatives would come from a clear public policy that identifies the strategic importance of the hillsides and regulates their development to make them a more effective tool for economic development. Such actions would include, for example, removing paper streets and property subdivisions from hillsides that should not be developed. High visibility slopes should be protected from development. Other initiatives are presented for consideration in Section 9 of this report.

Houses in Spring Hill

7.0 RECOMMENDED GUIDELINES: HILLSIDE DEVELOPMENT

The recommendations contained in this section pertain to the impact of hillside development on the urban form of the city. They refer specifically to the nature and location of buildings and the characteristics of the public realm that supports them. There is some overlap with ecological recommendations as physical and ecological issues are often intertwined.

This study recommends that hillside development regulations be adopted and mapped. Mapping should extend 100 feet beyond designated hillside slope areas to also include the crests and toes of the respective slopes.

The recommendations here are intended as guidance for the design of those regulations, to be developed later. They are not intended to serve as "design guidelines." Design guidelines, although helpful in defining good quality development on hillsides, are not enforceable or necessarily equitably applied. Pittsburgh's hillsides are too significant an asset not to be rigorously controlled.

On the other hand, the recommendations are not formulated as zoning regulations and, although stated in a positive or declarative manner, need to be set into a proper zoning and subdivision framework.

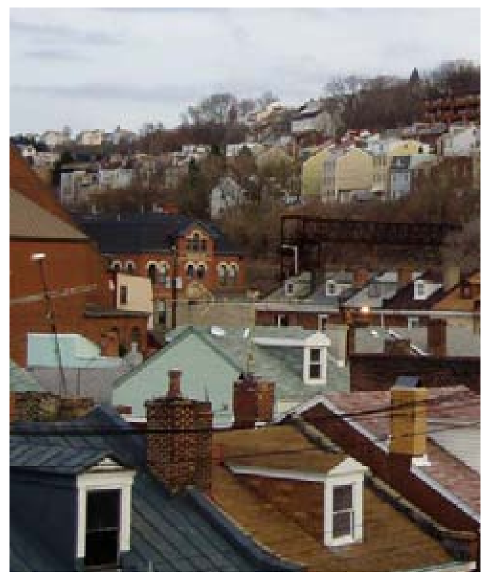
The recommendations are arranged from more general goals and policies to specific building and lot recommendations. They are also categorized into public realm and site-specific recommendations to assist in clarity.

GENERAL GOALS AND POLICIES

Many cities have developed special regulations for hillside development that recognize the hillsides' importance to the natural environment, their sensitivity to development, and the costs that development may impose on the public and their quality of life. These hillside regulations are always preceded by a statement of the relationship of the hillsides to the respective city and establish general goals and policies related to their development. What is interesting is their commonality and the universal quality of the principles they express.

They are also applicable to Pittsburgh in guiding its hillside development. This section sets forth goals and policies for Pittsburgh, consistent with the principles articulated by the Hillsides Steering Committee, as stated previously in Section 2. This description distinguishes between general goals for hillside development and overall policies that provide the basis for regulations.

Houses in Lower Lawrenceville



Houses on South Side Slopes overlooking rooftops of South Side Flats

Houses on Pius Street in the South Side Slopes

General Goals

Maintain the essential natural characteristics of Pittsburgh such as major land forms, vegetation and wildlife communities, hydrologic features, scenic qualities and open space that contribute to a sense of place.

Reinforce the image of Pittsburgh as a city which is shaped largely by and integrated with its natural surroundings, particularly in areas where natural features help to define the urban edge.

Retain the integrity of predominant views of hillsides, both of and within, to maintain the identity, image and environmental quality of Pittsburgh.

Ensure that hillside development is designed to be sensitive to the existing terrain and other significant natural land forms or features.

Encourage compact and appropriately-scaled development, screened by trees where possible, in hillside areas where development is allowed to occur.

Policies

Significant natural systems and resources associated with hillside environments, including ridgelines, vegetation and wildlife habitat, special geological features, natural drainage watercourses, steep slopes, and important historic or cultural features shall be maintained.

The visual character of hillsides shall be maintained, recognizing the importance of the exposure of hillside development to public views and the importance of providing panoramic views from the hillsides.

The right to live in Pittsburgh's hillside areas goes concurrently with the responsibility to build in an environmentally sensitive manner.

PITTSBURGH CHARACTERISTICS THAT GUIDE DEVELOPMENT

As developed earlier in this report, there are certain features of Pittsburgh and its hillsides that significant in guiding the recommendations. These qualities are general in nature and set the context for the recommendations. They form the foundation and assumptions for the recommendations.

Hillside Development Patterns

The slopes are the walls of the river and stream valleys that shape the city. They are also the "greenbelt" boundaries that distinguish one neighbor-

Perry Hilltop

hood from another. These ribbons of landscape are characteristic of Pittsburgh and their length, depth, and height differentiates Pittsburgh from other cities. In a few instances, such as the South Side Slopes, the built form up the slope creates a continuous fabric, similar to that of San Francisco. These generally occur as large parches of tightly-built fabric and in some instances as a ribbon across the slope. The previous section on Pittsburgh's Hillside Development Patterns provides an in-depth analysis of these "prototypical" patterns.

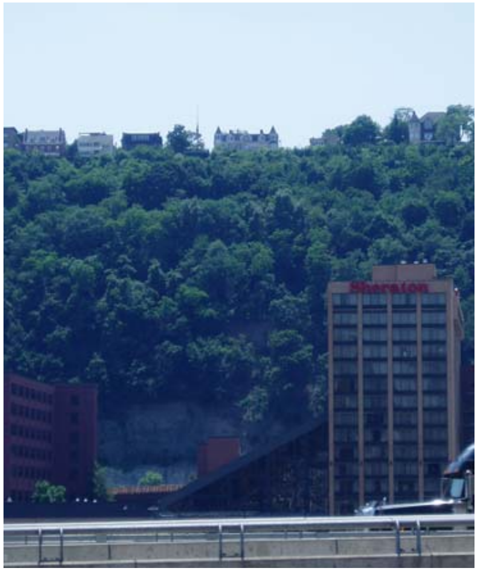
In addition to the patterns themselves, it is the continuity of the wooded slopes that is the distinguishing factor. For without this continuity Pittsburgh would be a "patchwork" of landscape without hierarchy or sense of place. The continuity of natural slopes, not just particular slopes, is a feature that should be preserved.

Recommendation: **Maintain and create ecological landscape corridors into and around the built form, including "bridging over" development when necessary, to maintain Pittsburgh's landscape and reinforce the city's characteristic balance between the landscape and built environment.**

Recommendation: **Encourage the completion of existing development edges to strengthen the continuity of the built form, rather than build on new or formerly-developed parcels elsewhere on a slope. Streets that parallel the crest or foot of a slope make stronger edges than other streets, as well as provide public access to views and the natural environment. Buildings that face onto these parallel streets make strong edges.**

Recommendation: **Encourage infill development on existing and vacant parcels where possible to reinforce the built fabric and strengthen the differentiation from the natural open space. Seek to intensify existing neighborhoods and in the process minimize infrastructure construction and public maintenance.**

Houses on Sycamore Street in Mt. Washington



Mt. Washington from Monogahela River

Arlington Avenue and Allentown

Visibility of Slopes

Pittsburgh's green slopes and its rivers are the city's most distinctive natural landmarks and distinguish Pittsburgh's public realm from other cities. Maintaining their visibility is at the very heart of maintaining Pittsburgh's unique "sense of place."

Views and vistas are a consistent factor in contributing to Pittsburgh's character. Hillsides, in particular, are always in constant view no matter where one is situated. Hillsides often are the primary view and at other times form the background of localized views. They also provide the setting for vistas up and down the river valleys. Views can be panoramic or quite narrow and close-up. These various "viewpoints" should be recognized in the development recommendations as not all views are equal, nor are they equally desired.

Hillside recommendations should recognize that these different "viewpoints" suggest different degrees of development regulation because of a development's visibility. Buildings that are in constant public view because of their location on a highly visible hillside are candidates for more restrictive controls than buildings located in a narrow valley corridor and viewable only to local residents.

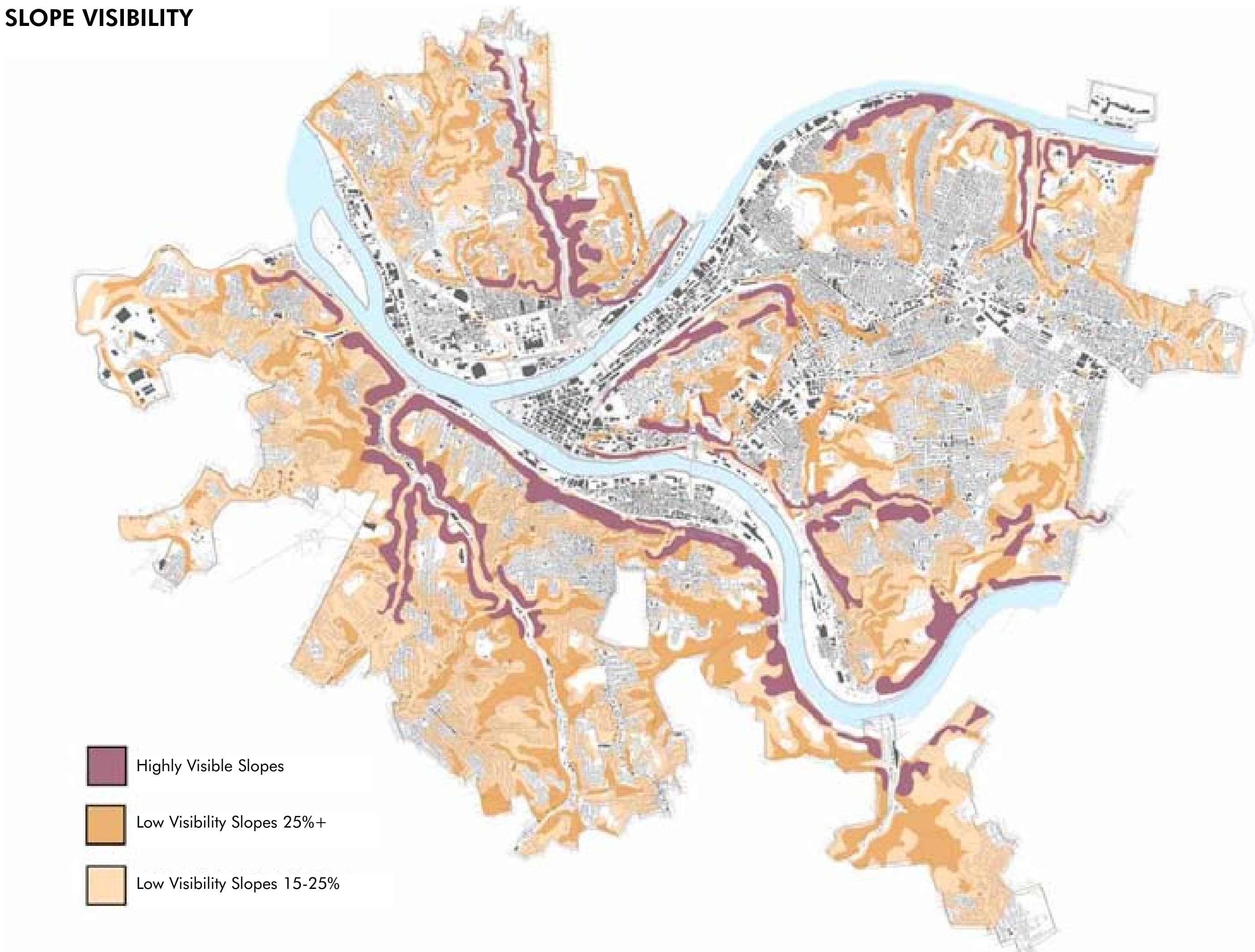
Recommendation: **Two degrees of hillside development visibility are recommended, Highly Visible and Less Visible. Hillsides should be mapped according to their visibility.**

Highly Visible slopes are critical to the character of Pittsburgh. Highly visible hillsides are those seen from greater viewing distances, particularly from river valleys and along highly traveled paths. These are generally hillside slopes of 25% and greater, although in some cases slopes between 15% to 25% share these qualities. They should be either highly restricted in terms of development or preserved in their natural state.

On Less Visible slopes, development should be allowed, but subject to more stringent development standards than development on flat land. Less Visible slopes are generally those that form finger valleys away from highly traveled paths, distant hillsides beyond highly visible slopes, and continuations of steeply sloped hillsides that level off into plateaus. Generally less visible slopes are in the 15% to 25% slope classification, however some slopes 25% and greater exhibit these characteristics.

The accompanying Visibility map illustrates an initial attempt at demarcating Highly Visible and Less Visible hillsides. Further study and refinement are recommended before adoption.

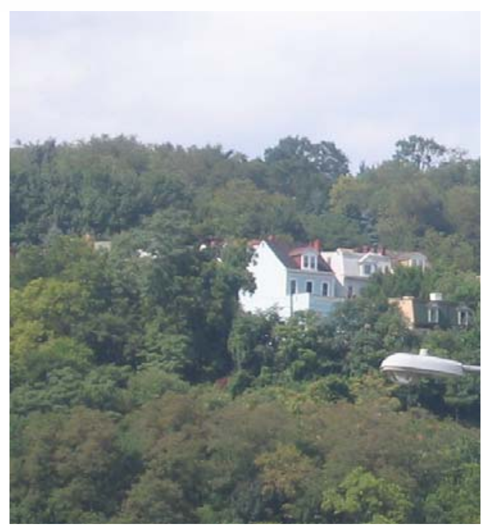
SLOPE VISIBILITY



Preservation of Natural and Unique Features

Pittsburgh's development has settled into the natural environment, generally respecting nature's features and settings. This is not a common quality or typical of a mid-sized American city, particularly where the tendency has been to overcome nature with the built environment, such as the street grid of San Francisco. In fact, Pittsburgh's strong natural landscape has generally precluded widespread and large-scale development because of the inherent hazards, difficulties of construction, and cost of developing on slopes.

Recommendation: **Rather than a policy that encourages development to override the environment, development should respect and reinforce the natural features of Pittsburgh and preserve its unique qualities. Among these are:**



Rooftops of Fineview seen from I-279

Mt. Washington's "Saddle"

- **Its geological features: dramatic bluffs, river and stream valleys, flat terraces, and escarpments.**
- **The native trees and plants of Western Pennsylvania.**
- **The native habitat.**

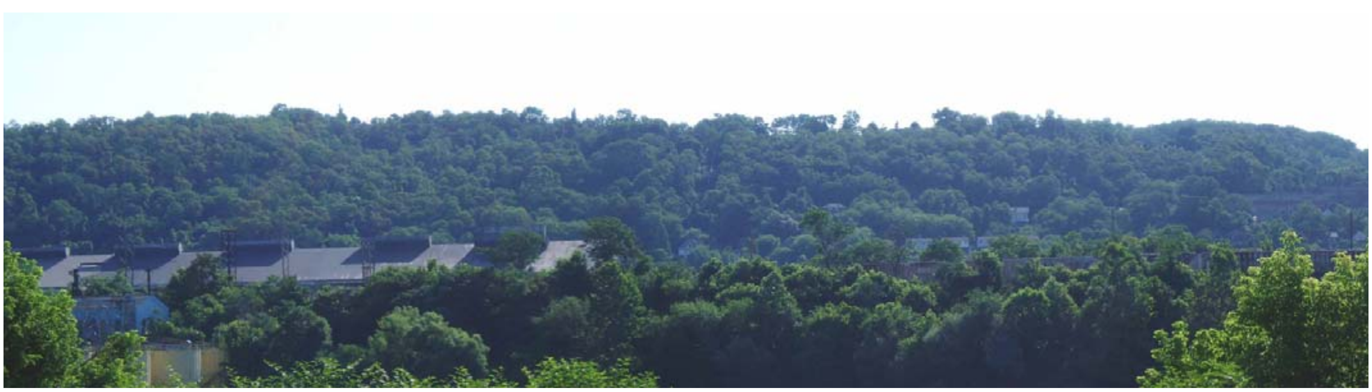
Slope Crests

Crest edges occur when there are significant changes in slope, especially at the edges of terraces. These are also distinctive features of Pittsburgh's landscape. Natural and developed crests occur throughout Pittsburgh and both types can be desirable. Skyline edges are most acceptable when natural tree lines are continuously maintained and where development occurs within the tree line so that the line of trees, or landscape, is maintained. Anomalies, such as tall buildings, wide buildings, or development of a different pattern or scale interrupt the ridgeline and the continuity of the natural and built fabric. Private development, such as an apartment building or an office building, takes on an inappropriate visibility and significance in the city when it is featured as an isolated building on the skyline.

Recommendation: **Maintain the natural crest edges wherever possible. Prohibit clear cutting of trees at crest edges.**

Recommendation: **Where development occurs on crest edges, restrict building heights so that buildings appear to be "within" the tree line or tree canopy. Where development has already occurred, new development should match the existing in terms of scale and profile so long as the existing development conforms to the patterns and other development recommendations suggested.**

Recommendation: **If new streets are created at tops of slopes, locate them between development and the crest to create a public edge. Position buildings on the upland portion of the lot and away from the crest of a hill to maintain a clear sense of the hillside brow in a natural condition when viewed from major roadways and other off site public viewing places.**



Greenfield from Monongahela River

Portals

One of the most famous urban scenes in America is the view of the Point from the Fort Pitt portal. Portals are a distinctive feature of Pittsburgh's natural and man-made landscape and should be considered unique assets worthy of preservation. Natural portals occur where valleys enter larger watershed valleys and where larger watershed valleys enter the river valleys. Man-made portals are tunnel entrances and bridges. Portals mark entrances to a different landscape, and their perceptual impact is dramatic and often occurs as a "surprise". Development immediately adjacent to natural portals and tunnel entrances diminishes the visual impact of the portal.

Recommendation: **Prohibit development within 600 feet of designated tunnel portals. This seems to be the typical distance of private development from tunnel entrances. Land at the entrances is publicly owned and usually extends 600 to 800 feet horizontally from the actual entrance. A distance greater than 600 feet is desired, if achievable.**

Recommendation: **Prohibit development within 1,000 feet of a designated valley portal. Because these portals are larger in scale than tunnel entrances, the non-development distance should be larger. 1,000 feet is somewhat arbitrary, although it is the general distance most development now steps back from these valley portals. Further investigation of this distance requirement is recommended.**

Recommendations for designated portals are shown on the accompanying Visibility map.

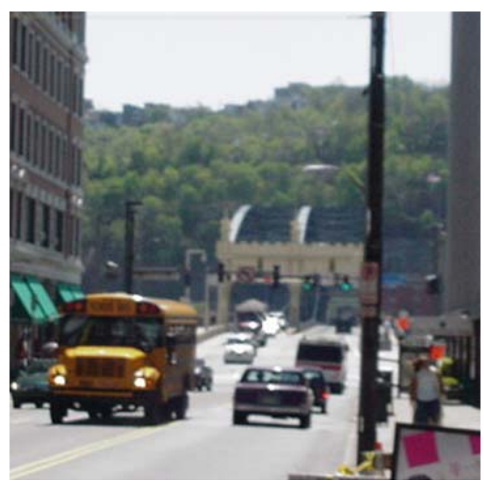
BUILDABLE SLOPES

Prohibiting development on moderate and steep slopes is common throughout the country, particularly as a public health, safety and welfare issue. Restricting development on slopes involves many factors other than hazard or engineering concerns. Many hillside ordinances restrict development on the basis of percentage of slope. Some ordinances restrict development on slopes that average as low as 5% and prohibit development beginning at 15%. Most, however, limit development beginning at 10% or 15% and prohibit development on slopes averaging 25%, 30%, and 40% and higher.

In Pittsburgh, three other factors contribute to the equation. First, for all practical purposes, flat land in Pittsburgh includes all slopes up to 15%. Secondly, Pittsburgh's edges of flat terraces do not appear as significant crests when slopes are under 25%. And, thirdly, some slopes are more vis-

Fort Pitt Tunnel South Entrance

Liberty Bridge and Tunnel Entrance



Smithfield Street Bridge

ible than others, and development has a larger public realm impact on these slopes.

Houses on Arlington Avenue

Recommendation: **Limit development on slopes with stable conditions as follows:**

- **No development restrictions, other than typical zoning regulations, on slopes of 0% to 15%.**
- **Restrict development on slopes of 15% to 40%.**
- **No development on slopes of 25% to 40% within High Visibility designated areas. Exceptions would be infill sites where no hazardous conditions exist.**
- **No development on slopes of 40% and greater.**

See "Existing Pittsburgh Standards" below for comparison to existing provisions in the Pittsburgh Zoning Code.

Location by Characteristic Development Pattern

As presented in Section 5, new development should conform to one of Pittsburgh's four prototype hillside development patterns. Each prototype is defined by the location as well as the type of development:

No Development: The entire hillside zone should be preserved as natural landscape, with no buildings on the slope, at the crest, or at the foot of slopes.

Developed Edges: Buildings should be located only along the crest or foot of the slope, and conform to applicable regulations.

Ribbon Development: Buildings would be permitted at the crest and foot, and on infill sites along a designated street along the face of the slope.

Grid Development: Buildings would be permitted on infill sites within an existing grid of streets on the face of a slope, as well as at the crest or foot.

No scattered site development would be permitted on slopes over 15%. Development would not be permitted on any site that would require extension of street or sewer.

Houses on South Side Slopes

Soil and Geotechnical Conditions

Developing in hazardous areas may expose the public to conditions that threaten health, safety and welfare. Development should not occur where any hazardous condition exists, irrespective of the degree of slope or other site features.

Soil conditions are a significant factor, but when there are stable soils, the engineering of foundations become more significant concerns. Soils stud-

Houses on Polish Hill

ies of Allegheny County cite moderate engineering concerns beginning at a 15% slope and significant engineering concerns at 25% and above slopes (21, 22).

Recommendation: No development should be permitted where it would have an adverse effect on the health, safety, or welfare of any person regardless of slope percentage. Generally, these involve environmental hazards such as stability of soils, high water tables, and hydrologic hazards. See the Ecological report for further information on environmental hazards.

Use of Existing Infrastructure

Development on hillsides should occur only where the public infrastructure supports it. Limiting the extension of infrastructure is a powerful tool in regulating and shaping development patterns. In general, extending the infrastructure is not recommended, not only because of the cost but also because of its impact on Pittsburgh's physical character.

Existing development served only by stairs presents access and safety issues. These "streets," while charming and picturesque, are difficult to access, create safety issues during inclement weather, and are difficult to maintain. While it may be acceptable and even aesthetically advantageous to permit the development of infill sites on stair "streets" to strengthen an existing pattern, it is generally unwise to encourage any extension of such development beyond infill.

Recommendation: **Prohibit development on vacant parcels served only by steps, except for infill locations.**

Recommendation: **Do not extend street and utility infrastructure beyond existing locations.**

Recommendation: **Restrict the location of buildings in relation to infrastructure to maintain existing development patterns. See site specific recommendations later in this section.**

Stormwater Retention on Site

Soil permeability is an important factor in the management of the city's hydrological system. The intent of hillside regulations should be to contain storm water and erosion at the source, rather than downstream. "Daylighting" stormwater is being adopted in Pittsburgh as in other major metropolitan areas to remediate the problems caused by combined storm/sewer systems. Daylighting requires permeable soil and, if necessary, allowing surface runoff to flow into existing streams. The hazard of excessive runoff was clearly demonstrated in recent flooding. We understand that recent city and state regulations are requiring that, in addition to restricting the increase of impermeable surface, all stormwater be absorbed immediately or retained for gradual on-site absorption. If a site is adjacent to an existing stream, permission may be granted to allow a certain amount of excess stormwater to flow directly into the stream.

The management of stormwater is both more challenging and more critical as slope increases. The permeability of steeply sloped land is essential to minimizing erosion and flooding hazard, as well as protecting the quality of water. This is an important reason to prohibit development on any slope greater than 40% and to significantly restrict development on slopes greater than 25%. Paving on slopes greater than 25% is the most detrimental type of development and should be restricted to public rights of way. Any parking on such sites should be provided within the building and included in the building envelope restrictions.

GENERAL HILLSIDE DEVELOPMENT GUIDELINES

Existing Pittsburgh Standards

Where the existing regulations and standards are consistent with these recommendations, they should remain in force. It is recommended that changes, in the form of amendments, should be made to the existing texts and maps, rather than by introducing new legislation. The city's various standards should be made consistent with an overall hillsides policy.

Current zoning regulations include the following. Pittsburgh's H and PO Districts restrict development to slopes 30% and less and regulate hillside development beginning at 20%. In the Environmental Performance Standards, in Chapter 915.02, development is restricted on slopes greater than 15% and prohibited on slopes 40% and greater. The Riverfront Overlay District regulates construction on slopes in excess of 25% and prohibits construction on slopes in excess of 33%.

Use

Traditional development on Pittsburgh slopes, except for a few exceptions, has been residential and generally small in footprint. Other occasional uses are generally neighborhood-serving: recreational, schools, religious buildings, and cemeteries. Commercial and industrial uses, which require large footprints, are found on either flat land or on slopes that are less than 10%.

Anomalies do occur, such as the restaurants and larger-scaled residential buildings at the crest and sometimes on the face of Mt. Washington. However, these disrupt the established development patterns where they occur and appear as "object" buildings. They are out of character in Pittsburgh and should not be repeated.

Open space has potential recreational and health value, whether it be an active or passive use. Most people value open space when they have access to it, either directly such as parks and trails or indirectly in terms of views. Consideration should be given to allowing restricted recreational use on slopes of 25% and greater so long as it does not disturb the ecological environment.

Recommendation: **On slopes greater than 15% allow only residential uses as-of-right. Other uses, such as institutional, religious and cemeteries, should be by conditional use only and highly regulated to fit the context. Other uses should be prohibited.**

Recommendation: **Restrict permitted residential uses to one- or two-unit buildings. Townhouses as well as apartment buildings should be prohibited.**

Recommendation: **Allow public use of hillside open space for passive recreational use, such as hiking, where ecologically appropriate.**

Recommendation: **Consider permitting certain agricultural uses, such as orchards.**

Density

Controlling the density of development is a powerful tool and must be used judiciously to guide development. Residential density in Pittsburgh varies by neighborhood. Pittsburgh's older neighborhoods, mostly on flatter land, are denser than the newer neighborhoods south of the Monongahela River.

In most cities, density decreases as the slope of land increases. Almost all ordinances reviewed follow this logic. For example, one ordinance restricts land capacity (density) by 50% when the slope exceeds 15% and by 75% when it approaches 25% (14). Pittsburgh does not exhibit this pattern. Pittsburgh's hillside development is usually and extension of its neighborhood density, both in terms of lot size and building massing.

Recommendation: **Development on slopes, either as developed edges or ribbons, should match the local neighborhood density rather than conform to an across-the-city standard.**

Building Locations

Locating development on sloped sites requires greater consideration and skill than flat land locations. It is important that buildings appear to sit within the landscape, maintain the continuity of the landscape, and, in critical locations, not extend above the heights of trees. The location of structures on slopes is more critical, as those that do not follow established development patterns are more visually intrusive.

Disturbance of the land is a significant factor and small footprint and vertical structures are desired over long and low buildings. In addition to height limits, size and spacing between structures must be defined so that long buildings are not allowed to disturb the landscape pattern.

The relationship between buildings and streets is also important. In fact, regulating the distance between the structure and the public right-of-way can have a greater impact on maintaining the development pattern than any other yard requirement.

Recommendation: **Keep infill and edge development as close to existing development as possible, consistent with local density.**

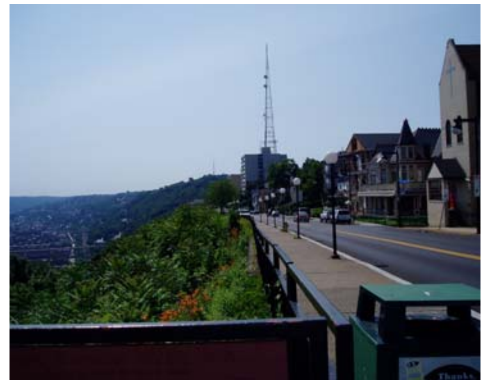
Recommendation: **Dwellings should be placed far enough apart to reveal views of the hillcrest.**

Recommendation: **Existing trees should be preserved so that vegetation provides a backdrop to the structure. Except where new infill buildings are located within a grid or ribbon development, buildings should be seen against retained vegetation rather than the sky.**

Recommendation: **Set maximum setback distances from roads on hillside sites.**

Public Realm and Rights-Of-Way

The public realm encompasses the spaces between buildings visible to the public at large. On flat land sites it generally encompasses the space between the faces of buildings on a street and includes the front yards, porches, as well as the street and sidewalk space. Back yard spaces are normally considered private and not part of the public realm. The public realm on hillsides sites, though, is more pervasive. Because of the visibility of hillside sites and the pubic "viewability" of hillside buildings, the public realm also includes the back yards and all the space around a structure. There is very little private realm space on hillsides. The public realm has no ownership boundaries, for the space can be in public and private ownership.



South Side and Allentown from Mt. Washington

Rights-of-way and easements are the spaces and pathways in public or private ownership that provide the infrastructure to support private development. Rights-of-way are generally the public streets. Easements may be driveways, front or rear yards, or other locations where utilities run either below grade or above, such as high tension power lines.

Recommendations for rear and side yards, also within the public realm on hillside sites, are covered in the site- and building-specific recommendations later in this section.

Streets

Hillside development requires different street considerations than on flat lands. Streets are generally narrower to minimize hillside disturbance and to minimize impervious surfaces. They are also more costly to construct and maintain. Access is a significant concern, particularly in icy and poor weather conditions.

Recommendation: **The maximum street grade should not exceed 12%, which is consistent with good planning standards (23).**

Recommendation: **Hillside street design should minimize grading by aligning streets with the topography, running roads along natural ridges or valleys and working with existing grades where possible. Consider reducing or splitting street sections to minimize grading.**

Recommendation: **Generally reduce the width of street improvements, reduce sidewalk widths and use common driveways to minimize impact.**

On-Street Parking

Parking is always problematic on hillside sites. Prudent public realm design requires that streets and driveways be minimized to reduce their impact, thus limiting the possibilities for typical on-street parking. It is always best to limit on-street parking and place it onto the development site in a controlled manner.

Recommendation: **Allow for parking on only one side of hillside streets, if at all.**

Recommendation: **Parallel parking can be eliminated to reduce road width in critical areas and then provided for in off-street bays or community parking lots at more suitable locations.**

Street Lighting

SStreet lighting on hillsides can be dramatic or offensive depending on the context. A ribbon of lights extending diagonally up a long hillside is a good orientation and way-finding device when linking public uses at the bottom of a slope with its top. In residential settings, however, regular spacing of street lighting, other for its continuity, is artificial against a landscape background and would appear to be out of place. The quality of the light source (lamp) is more critical than the spacing between fixtures.

Recommendation: **Maintain a minimum of street lighting in hillside areas dominated by landscape. Locate street lights only at all intersections and where necessary to reduce traffic hazards. Continue the existing street lighting when extending development patterns.**

Recommendation: **Shield street lights from off-site views, except when specifically desired for connectivity and way-finding reasons.**

Street Trees

As with street lights, regularized spacing of street trees can also be disruptive to hillside development. Hillsides and slopes are naturally vegetated and trees are randomly spaced. Regularizing the planting pattern is not conducive to a slope context or continuity of the landscape pattern.

Recommendation: **Street trees should be installed in random patterns in hillside areas. Any trees that are provided should be native or similar to natives and should be arranged in natural-appearing clusters.**

Utilities

Off-site utilities can easily become eyesores on newly developed hillsides.

Recommendation: **Utility housings for transformers, control points and other utility housings should be located as to minimize their visual impact and should be safely screened with fencing and vegetation. No utility housings should be permitted in front yards.**

Recommendation: **New hillside development of more than one parcel or**

one building should be required to bury all utility services, such as electrical and telephone lines.

Recommendation: **Prohibit cell phone towers, commercial antennas and similar structures within 500 feet of slopes 25% and greater.**

Creeks, Streams and Rivers

Generally it is good practice to build at some distance from daylighted water courses to minimize erosion and maintain the natural habitat. Pittsburgh has few exposed creeks and streams and development has generally "managed" this functional feature of the ecological system. Where hillside daylighted watercourses exist, they should be encouraged and maintained in their riparian state. They serve to maintain water quality and control storm water runoff in addition to their natural beauty.

Recommendation: **Build no closer than 100 feet to daylighted watercourses on hillside sites.**

Recommendation: **Allow no stormwater runoff off site, except directly into an adjacent creek or stream.**

SITE-SPECIFIC DESIGN

Lot Size

A review of hillside ordinances revealed that there is no consistency of hillside lot sizes and lot widths. Minimum lot sizes ranged from 3,200 square feet in Pittsburgh (13) and twice the size of flat land parcels in another city to between 4,500 square feet and 40,000 square feet (8, 11, 15). Some cities contend that large lots minimize the impact of development, either by spacing structures at some distance from one another or allowing for higher density clustering maximizing open space. Unless building massing

Strip District and Middle Hill

(height and bulk) is severely restricted, large lots encourage larger structures. In Pittsburgh, this has led to many of the hillside buildings we refer to as anomalies. These taller and massive structures violate the context of their immediate environment and disrupt established patterns. Pittsburgh recognized this several years ago when the Hillside District minimum lot sizes were changed from 30,000 square feet to 3,200 square feet. However, even 3,200 square feet is somewhat arbitrary because Pittsburgh's hillside parcels are not uniformly sized.

When it comes to lot width there appears to be more consistency with other cities, but only in terms of establishing minimum widths, not maximums. 90 foot and 100 foot minimum lot widths (8, 11) tend to encourage larger lots and are consistent with those cities with larger lot size requirements.

What may be more important than overall lot area is lot depth. The ability to place a structure at some distance from the front lot line can result in a pattern of isolated buildings dotting the hillside and may encourage flag lots, where the bulk of the lot is behind other properties and connected to the street only by a driveway.

A better strategy for regulating lot sizes and widths on hillsides would be to replicate the typical neighborhood lot and building pattern to maintain consistency.

Recommendation: **Maintain lot sizes and dimensions based upon the prevailing neighborhood context.**

Recommendation: **Control building placement on hillside properties.**

Houses on South Side Slopes

Building Siting

Locating a structure on a hillside parcel requires a higher degree of sensitivity than simply meeting setback requirements. The relationship to infrastructure and the landscape are more critical. As with development locations, care must be exercised on a building-by-building basis.

As a general strategy it is best to locate hillside buildings close to street lines and adjacent infrastructure. This will discourage a scattered-appearing development pattern and minimize the impact on infrastructure needs.

Recommendation: **Site the building on the least sensitive portion of the site, as close to the street as possible, to preserve natural landforms, geological features, and the landscape.**

Recommendation: **Orient parcels and buildings toward views and vistas at right angles to contour lines. Maintain the typical Pittsburgh building face to street relationship the same as on flat land parcels.**

Recommendation: **Buildings sited to maximize views at the expense of vegetation should be denied. Exposure of the building should be no more than 50%.**

Recommendation: **Set back at least 50 feet from cliffs, ridges, and hilltops so that the structure does not appear to be perched on the edge.**

Recommendation: **On uphill sites, buildings should build to front lot lines to reduce hillside grading disturbance.**

Recommendation: **On downhill sites, buildings should minimize the front yard setback to reduce building massing hanging over the slope. Private rear yard space can be provided with a small yard, terrace, or deck.**

Open Space

Open space on hillside parcels contributes to the landscape continuum of the hillside landscape. When open space is regulated on hillside sites, most ordinances increase the amount in proportion to the degree of slope, with the higher-percentage sloped sites requiring more open space. The minimum open space noted in other codes was 25% (7), with the majority requiring between 50% and 80% (12, 20). For residential and recreational uses, open space is not a critical factor as lot coverages are generally small and, if the context recommendations are followed an open space requirement is not needed. Open space on hillsides should remain in its natural state and only minimal intrusions made for patios and decks.

Recommendation: **Regulate open space by controlling building footprint and placement on the site.**

Recommendation: **Provide yard space between lot lines for trees and natural vegetation and to space buildings from one another.**

Recommendation: **Open space should remain natural to the greatest extent possible, with the majority tree covered.**

Site Grading

Site grading and excavation on hillsides can have a serious detrimental impact. Controls on site grading are perhaps the most highly regulated element in hillside development ordinances across the country. The intention should always be to minimize soil and landscape disruption by restricting grading, impervious paving, and building footprint.

It is good practice to minimize the building footprint and place it "lightly" onto the site, maintaining natural contours to the greatest extent. To this end, some ordinances regulate the amount of grading disturbance allowed on individual parcels. Terracing of lots and terracing of hillside tops and natural benches should be limited, as should extensive use of retaining walls, as these are "un-natural" land forms.

Pittsburgh's H and PO District regulations limit vegetation clearing to no more than 10% of the lot area or 2,400 square feet, whichever is larger (13). Other codes are more restrictive by regulating grading disturbance; one ordinance restricts disturbance to 40% on slopes of 15% to 20%, 30% to slopes between 20% and 25% slope, and 20% for slopes 25% and greater plus 10% for construction of driveways with approval (15).

One of the greatest threats to hillsides is re-grading caused by road construction or widening projects. The City should take an active role in preventing massive hillside damage by PennDOT.

Recommendation: **On slopes of 15% to 25%, limit site grading to the minimum necessary to provide for building and parking. Regulate the maximum area of allowable site disturbance.**

Recommendation: **Grading should preserve the natural shape of the land, especially at the horizon so as not to result in artificial terrace effects. Prohibit terracing for a large building or paving. Discourage uniform stair-stepping of building pads, unless it continues an existing building pattern.**

Recommendation: **Sharp angles at the top and toe of cut and fill slopes should be prohibited. When slopes cannot be rounded, vegetation should be used to alleviate a sharp, angular appearance. A round and smooth transition should be made when the planes of man-made and natural slopes intersect.**

Recommendation: **Some codes are explicit in their maximum slope and heights of cut and fill, which should be considered. Good practice indicates:**

- **2:1 maximum cut slope adjacent to the public right-of-way with the guarantee that landscaping and maintenance of all slopes outside the right-of-way be maintained (18).**
- **3:1 maximum unretained slope (11).**
- **4 foot maximum height of unretained fill on slopes of less than 20% and 6 feet on slopes 20% and greater. Excess fill or cut to be contained by retaining walls or hauled off site. Maximum height should not exceed 8 feet in any combination (cut and retaining or fill and retaining) (11).**

Recommendations for maximum disturbance require further engineering study. On slopes of 25% or more, the property developer should be required to provide an engineering study for all proposed re-grading.

Stormwater Control

With Pittsburgh's serious stormwater capacity conditions, retaining storm water on site is now, or will soon be, required by the Pittsburgh Water and Sewer Authority. In general, minimal site disturbance is the recommended solution.

Recommendation: **Establish minimum stormwater retention, detention and infiltration requirements following PWSA/DEP standards/guidelines, as applicable. One hillside ordinance requires a minimum of 2 hours based on a 10-year storm and released at a controlled rate equal to the runoff rate generated by the site in its natural condition, with a maximum of 0.2 cubic feet per second per acre (11).**

Recommendation: **Daylight roof drainage systems on all buildings on slopes greater than 15%, however this is good practice regardless of slope.**

Recommendation: **Preserve natural entrance and outflow points. Drain swales should be designed to minimize their visibility; they should be angled along a slope rather than creating an abrupt 90-degree intersection with contour lines. Do not allow ponding of water above cut or fill slopes and divert surface water away from cut faces and sloping surfaces of a fill.**

Recommendation: **Control the amount of impervious material permitted. One hillside ordinance limits impervious surfaces, including roofs, to a maximum of 30% of the total lot area (11). Use pervious materials for driveways and patios instead of concrete and encourage wooden decks.**

Site Improvements

Many site improvements extend the impact of development beyond the structure. On hillside sites this can contribute to a more man-made appearance than may be desired. The relationship of hillside sites to the natural environment should be more closely regulated than flat sites.

Recommendation: **The driveway should not be the predominant feature of a front yard. Generally, driveways should be eliminated by locating parking adjacent to the right-of-way. Shared access to parking should be encouraged.**

Recommendation: **Free-standing walls integral to a structure should be of the same material and design as the structure. Their maximum height should not exceed 6 feet, however a 4 foot height is recommended.**

Recommendation: **Retaining walls should be designed with smooth, continuous lines that conform to the topography. Maximum wall height at the base of slopes along roadways should not exceed 5 feet in order to avoid a contained, channel-like effect. Retaining wall structures holding back grade to accommodate a patio or terrace should conform to the natural hillside profile as much as possible. Retaining walls over 10 feet high should be prohibited, however a maximum of 5 feet or 6 feet above final grade is recommended. Multiple parallel walls should be designed to be part of a tiered or terraced retaining wall system and conform to the above height recommendations.**

Site Vegetation and Landscape Design

Permanent scarring of hillsides can easily occur unless strict landscaping regulations are imposed. Landslides, erosion, clear-cut or denuded landscapes are unacceptable consequences of lax landscaping standards.

The interface between development and open space and internally between structures on slopes is critical to blending architecture and landscape. Edges should be designed to provide either partial or complete visual buffering and provide a transition from architecture to grade. Infill development should continue the pattern of building/landscape that has already been established. Where the tree canopy is to be preserved, new trees should be arranged in informal masses and placed to selectively allow views from the building while screening the structure. Plant materials should be placed in informal masses to help alleviate the impact of graded land forms. Shrubs should be randomly spaced in masses. Lawns should be discouraged.

Many cities and communities regulate tree replacement, including specifying tree caliper standards. Clear cutting of trees and vegetation to maintain views is unacceptable. It is important that hillside structures be surrounded and shielded by vegetation so that the landscape appears to be "natural" and continuous.

Recommendation: **Skyline planting should be used along developed crests and slope edges, including locations between buildings, to create a continuous treetop silhouette and provide either a backdrop or a setting for structures. In general, crest line trees should be taller than the structures so that the buildings are within the tree canopy.**

Recommendation: **Planting on the slope side of development should be designed to allow for controlled views out, yet screen and soften the architecture. In general, 50% screening of a building's view façade(s) is recommended. In grid development zones where edge planting at lower levels of a slope may block the view from parcels above, height restrictions on plant materials should be applied.**

Recommendation: **Restrict the removal of trees to avoid clear-cutting. Require replacement of all removed trees that are 6 inches in caliper to restore the site to its previous tree density before grading. 3 inch caliper trees should be the minimum size for new trees. Consider requiring that twice (2x) the total caliper of removed trees be required to restore the site, with any excess trees planted on publicly-owned land. Or consider requiring one tree per 150 square feet of natural area as required in Santa Clarita (18) and similarly required in other cities.**

Recommendation: **Allow only native tree planting on slopes 15% and greater. It is important to maintain visual continuity of these species and sustain fall colors.**

Site Lighting

Buildings on 15% and greater slopes should blend into the landscape even during the nighttime. In dense built-fabric situations, standard street lighting will generally provide enough nighttime illumination and additional lighting should be discouraged. Safety and security lighting should be shielded so as not to be visible from below. Avoid highlighting and washing buildings with light, except for specially- or publicly-designated structures, as they would otherwise appear as anomalies on the hillside.

Recommendation: **Shield all site lighting so that the light source (lamp) is not visible from 30% below the fixture.**

Recommendation: **Outside lighting should be muted and directed so that it does not spill over and onto neighboring (including downhill) properties. Follow IES standards documented in LEED guidelines.**

On-Site Parking

On-site parking generally results in driveways or parking pads that interrupt the natural vegetation and create more impervious conditions. While it is desirable to limit the storage of cars on hillside streets for safety and impact reasons, the automobile can be accommodated on site and the impact lessened so long as controls are applied.

Recommendation: **Parking should be provided within the envelope of hillside structures and, when not possible, by means of closely regulated open parking bays.**

Recommendation: **On sites with grades no more than 25%, allow a maximum of one exterior space per residential lot, no more than 20 feet deep of paving and located immediately adjacent to the street.**

BUILDING-SPECIFIC DESIGN

Building Massing and Footprint

Regulating building massing and footprints will maintain Pittsburgh's neighborhood development patterns.

Shelley Street on the South Side Slopes

The typical footprint of a Pittsburgh hillside residence ranges from 600 square feet to 1,000 square feet and then increases in size on flat land at the bottoms and tops of slopes. Pittsburgh's residential buildings are traditionally vertical in orientation to conserve energy and keep heating costs down, which has had the effect of minimizing the footprint's impact on the land. Different neighborhoods have different footprint traditions and these should be honored as well. Regulations should encourage the extension of established neighborhood patterns when extending development into hillside locations and look to regulate building widths in order to maintain the vertical tradition.

Pittsburgh is atypical of most cities with hillsides, where hillside regulations seek to develop in sympathy with the slopes by stepping buildings, creating numerous break-ups of the building mass, and orienting rooflines parallel with the contours (4, 19). In Pittsburgh, building in this tradition would be an anomaly, much the same way that tall and wide buildings break the context. Pittsburgh patterns are urban, not suburban or rural, and except for footprint size the typical hillside residence is not different from similar structures on flat land.

Recommendation: **Compact development should be maintained through small footprints and minimum setbacks, thereby minimizing grading and making development less obtrusive. Single buidings are preferred. Attached townhouses should be limited to duplex units on hillsides.**

Recommendation: **On slopes greater than 15%, require new development to match the existing neighborhood massing and footprint pattern.**

Setbacks

Pittsburgh's Hillside District setback regulations (13) are generally conducive to good hillside development. Basically an extension of the city's urban context zoning, latitude is available to the zoning administrator to continue existing patterns. As with building siting recommendations, setback requirements should look to work with the site and neighborhood context rather than impose uniform requirements.

Pittsburgh is fairly unique with this approach. Most cities, particularly those in the west, look to place structures at the centers of sites to maximize distances between buildings and, therefore, preserve open space in between: minimum front yards vary from 20 feet to 30 feet (8, 10, 11, 15); minimum rear yards vary from 15 feet to 25 feet (8, 11, 15); and minimum side yards vary from 5 feet to 20 feet (8, 11, 15, 19). Pittsburgh's minimum front yard is 0 feet and side yards are 5 feet, with no rear yard setback requirements (13).

To make the building placement regulations even stronger, maximum setbacks should be seriously considered. They are more effective.

Recommendation: **Place the building as close to the street as possible to preserve the natural terrain. Consider imposing 0 foot front yard setbacks or mandating continuation of adjacent existing setbacks on hillside sites where appropriate.**

Recommendation: **Maintain minimum side and rear yard setbacks as presently regulated.**

Building Height

Restricting building height is critical to making good hillside buildings, whether they are located at the foot, on the face, or along the crest of the slope.

As with large and wide building massing, tall buildings contrast with typical hillside development patterns and disrupt the visual integrity of the landscape far more than tall or large buildings on flat land. Mt. Washington is a good example of building heights disrupting the landscape by extending both above the typical crest line building and tree height or extending significantly down the face of the slope. A tall building is a tall building, whether it is many stories above the street grade or many basement stories below. Tall buildings at the base of slopes and in the middles of slopes break the continuity of the landscape background and appear taller than on flat land. This exaggeration of the impact is because of a hillside building's contrast with its landscape context and the continuity of that background. Hillside buildings are always "on view" and difficult to camouflage in a vegetated landscape.

Recommendation: **Restrict heights of buildings within 100 feet of slope crests to the height of the natural tree canopy or a maximum height of 35 feet or 2-1/2 stories facing a street and 45 feet or 3-1/2 stories at the rear when facing a downhill slope, whichever is lower, measured from the lowest elevation grade to the top of the roof ridgeline. Half to fully-exposed basements on the downside of the slope would constitute a full story. These restrictions appear in several hillside ordinances and are not unprecedented (2, 11, 15).**

Recommendation: **Restrict the heights of buildings at slope toes to a maximum height of 40 feet or 3 stories, whichever is less.**

Recommendation: **Do not locate high-rise buildings on slopes or within 100 feet of the foot of a hill. Site only on slopes less than 10%.**

Building Profile

The shape of the building, although not as important as massing and height, is nonetheless important in maintaining hillside compatibility. Most hillside ordinances, particularly those in the West, mandate the breakup of massing to create smaller-scaled profiles and limit rooflines to a parallel orientation with respect to the natural contours (16). However, this tradition is not a Pittsburgh development tradition. Urban profiles, with simple massing, dormers and gables, and structures that meet the ground with solid walls are the predominant building design. A western hillside building with its structure supported on poles would be out of place in Pittsburgh.

Recommendation: **Proper scale is visually important and particularly so in high visibility slope areas. Limit the area of a single plane of façade to no more than 1,000 square feet so that the scale of the building is maintained generally consistent with the scale of a typical Pittsburgh residence.**

Recommendation: **On slopes greater than 15%, buildings should be required to have peaked or sloped roofs of at least a 4:12 profile. Flat roofs should be prohibited.**

Recommendation: **Orient buildings perpendicular to the street so that the view façade is the narrower façade of the structure.**

Color, Building Materials and Architectural Features

Typical zoning regulations do not address color or materials. On hillsides both are important features of buildings because of their inherent visibility and potential to contrast with the natural landscape. Pittsburgh's slopes are green in the summer and gray-brown in the winter. Bright colors and shiny materials make buildings stand out against these colors. They become anomalies even when they conform to all of the other regulations suggested in this study. Hillside design regulations should address these concerns.

Recommendation: **Colors of buildings should be selected to blend with the natural colors and hues of the surrounding hillsides. All exterior materials and colors, including roofs, walls and fences, should be predominantly muted earth and plant tones and should minimize contrast and glare. Roof colors should be of darker tones: browns, blacks, and dark grays. White and other bright colors should be avoided.**

Recommendation: **The maximum light reflectance of colors or materials used for building walls, trim, decks and architectural features**

should not exceed 60%. The light reflectance of exposed foundations, stone, brick, concrete and concrete block walls, including retaining walls, should not exceed 35%. Roofs should also have a 35% maximum reflectance.

House on Mt. Washington's "Saddle" Area

Recommendation: **Reflective coatings, such as chrome or reflective glass, are not appropriate on hillsides. Rough-textured, fire-retardant roof materials are recommended.**

Recommendation: **Windows should be subdivided into panes. Large expanses of glass on south-facing slopes should be avoided as all glass is reflective depending on the sun angle.**

Recommendation: **Architectural compositions should be vertical in nature. Horizontal façade patterns, particularly those with protruding horizontal bands, contrast with the typical Pittsburgh building type and should be discouraged.**

Recommendation: **Avoid using wide decks and other architectural features elevated on posts. Decks should be small-scaled and it is suggested they protrude no more than eight feet nor be wider than fifteen feet. Multiple decks are preferred rather than a single deck. Limit the extent of exposed undersides of buildings to 8 feet in depth and height of posts, when used, to 10 feet.**

Foundations

Good foundation design fit the building sensitively to its site. Foundation

Houses on Spring Hill

types that elevate the structure above the ground or create abnormal massing should be avoided.
Recommendation: **When building on slopes, a fully enclosed structure should meet the ground. Stilt-supported buildings should be prohibited.**

Recommendation: **The foundations of all buildings on 15% and greater slopes should be designed and certified by a professional engineer. The foundation's design should follow the natural contours of the hillside with minimal exposure. Avoid high foundation walls, but when necessary extend the building's siding material or veneer finish to within three feet of grade level.**

Rooftop Utilities

Antennas, satellite dishes, solar panels, and mechanical equipment call attention to hillside structures when placed on roofs. Some hillside communities prohibit rooftop antennas (5) and others restrict the use of solar panels when not integral with roofs (17). Consideration should be given to restricting their locations.

Recommendation: **Avoid rooftop utilities over one foot in dimension unless these appurtenances would be completely screened from view by solid architectural elements compatible with the building's profile and character. Rooftop utilities should not exceed the building height limitations.**

Houses on South Side Slopes

8.0 THREE TEST SITES

Three study sites were investigated in more detail to test development ideas and the recommendations. Several factors were considered in their selection:

- Examples of prototypical Pittsburgh slope conditions and patterns of development.
- The type of geography: edge, hill, or corridor slopes.
- Their potential for development pressure, either now or in the near future.
- Their location in Pittsburgh to achieve a good representation of typical hillside conditions.

The intention of this exercise was to look at hillside characteristics, test the application of the development prototypes, and understand where development and open space needed to be more carefully structured. The specific recommendations were tested to confirm the recommendations, not to apply them to specific parcels.

The sites selected by the built form team and the Steering Committee were:

Duquesne Heights: The south-facing slopes to the north of Sawmill Run Road (Route 51) from the West End to eastward of the Fort Pitt Tunnel entrance by Chatham Village. This site represents highly visible corridor slopes with heavily wooded hillsides. Much of the area is within existing Greenway or Parks and Open Space zoning designations.

Middle Hill District: The south- and west-facing slopes north of the Boulevard of the Allies from the western edge of SoHo, upper Fifth Avenue, to West Oakland and northward encompassing Aliquippa Terrace. This is a smaller area of wooded hilltop slope that contained historic development which experienced major disinvestment. This area has proximity to an area of Pittsburgh with little designated open space and has the potential for development pressure from nearby large institutions in Oakland and from the Pittsburgh Housing Authority.

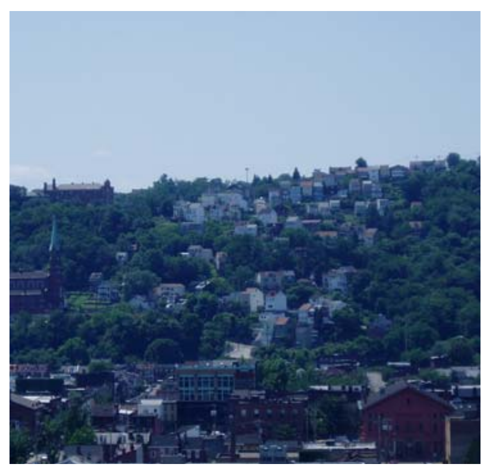
South Side Slopes: The north-facing slopes of the South Side extending from the eastern-most edge of Grandview Avenue on Mt. Washington eastward to encompass most of the South Hills slopes that front onto the Monongahela River. This is an edge slope condition with the strongest development pressure in Pittsburgh. The area has a range of development types from steep undeveloped slopes to dense residential urban fabric. The area includes the Mt. Washington saddle.

Each site was examined for the following:

- Steep slope locations, with 15% to 25% and 25% and greater slopes identified. The intent was to understand the continuity of these slope classifications and their relationship to one another.

Duquesne Heights

Middle Hill District



South Side Slopes

- Street locations, including paper streets and "stair" streets. Parcels not serviced by streets shows where development could occur.
- Hydrology, including surface water and sewer locations, to understand storm water conditions of the urban fabric.
- Ownership patterns, including public and private ownership and designated open space. Ownership shows where development pressures exist as well as the potential for open space protection.
- Mapped infrastructure, showing sewer lines, streets, and parcels and the areas most likely not serviced by them. Sewer line locations, along with streets, determine the infrastructure's ability to service development.
- Undermined locations. These locations provide a good picture of where historic mining activity occurred and the potential for future instability. Not mapped was the depth of the mines, which is a more significant factor in determining instability.
- Neighborhood identity, showing perceived boundaries, the major hillside paths that service them, and "hard" and "soft" development edges where the neighborhoods front onto hillside open space. These factors helped to understand how hillside neighborhood edges are formed and which edges are more effectively defined.
- Zoning designations currently applied to the study site. This information provided good information on those areas designated as parks and open space and the areas designated hillsides.

The mapping of this information for each of the study sites is located in the Appendix.

Each site was then analyzed for its access characteristics, views, neighborhood boundaries and edges, and the strength of its development pattern. The four prototypes were tested on each site to understand which would be the best approach for future development.

A development strategy map was produced for each study site that identified how the site might be developed per the recommendations. Developed edge and ribbon development are strengthened where edge infill or pattern extension would make a stronger neighborhood definition with the open space. Development and open space continuity is encouraged. Two types of development actions are recommended:

1. Develop vacant infill sites to strengthen the prototype pattern
2. Discourage development where sites should be incorporated into open space.

In certain locations selected open space should be improved for public use. Potential walking paths are shown within the open space to link neighborhoods and suggestive of passive recreation.

DUQUESNE HEIGHTS

The Duquesne Heights site contains a significant quantity of 25% and greater slopes that are highly visible from major highways, including the Fort Pitt Tunnel portal landscape. 15% to 25% slopes occur mostly at the tops of the slopes where they transition into the neighborhood plateaus and terraces. There is minor development at the base of the hillsides but it is not significant. Street patterns at the top of the slope run perpendicular to the hillsides, with corridor ravines between the promontories. Edge development is not strongly defined, particularly at the top of the slopes.

Site Analysis

Most of the hillsides in this study area are steep and remain in their natural landscape state. They are highly visible, obliquely along Sawmill Run and frontally by proceeding down Green Tree Hill and into the Fort Pitt Tunnel. Views of the hillsides at the tunnel portal are significant. This site is in a High Visibility zone. The slopes are finger-like, forming steep drainage ravines to the stream valley. Because of the geography, access is limited and development along the access routes is mainly non-existent, thus preserving the landscape. Edge development is ragged because of the orientation of the plateau neighborhood streets and a clear development edge has not formed. The woodland landscape provides the strongest definition

DUQUESNE HEIGHTS SITE ANALYSIS

of neighborhood boundaries. The site contains a number of paper streets and parcels that remain undeveloped, much of which is in public ownership.

Duquesne Heights from Route 51 South

Prototype Development

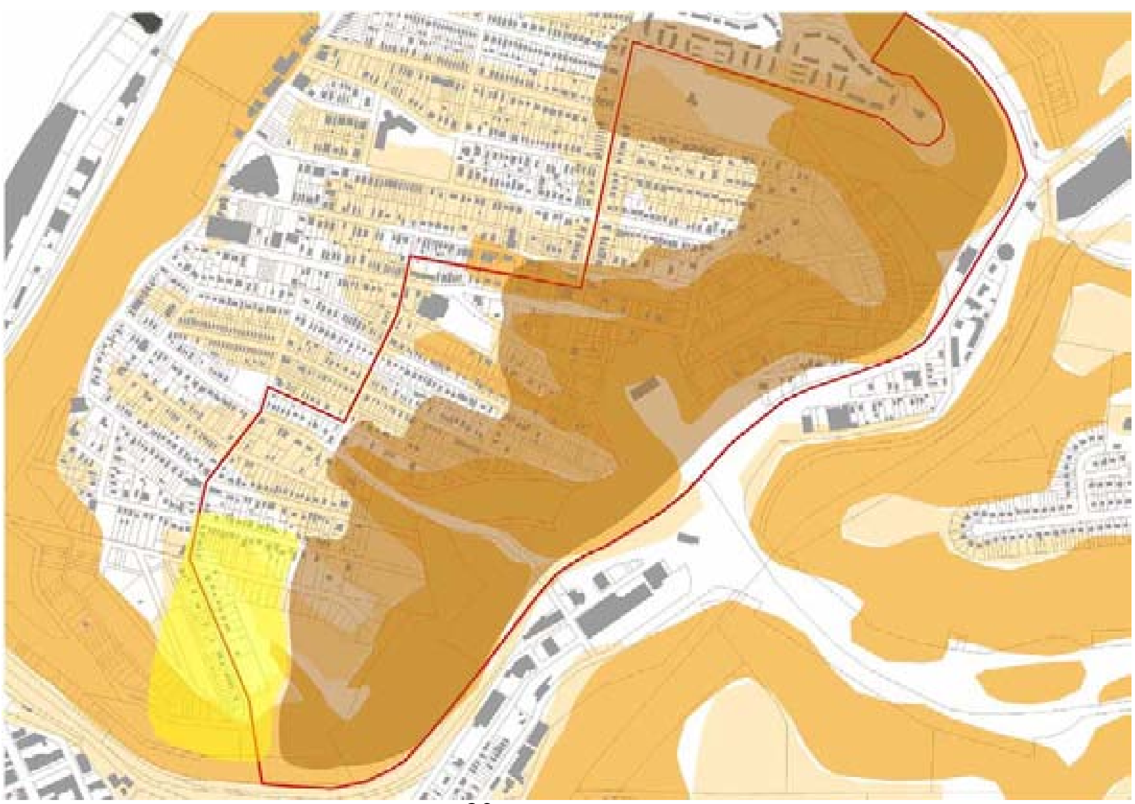
Almost the entire site is categorized as Developed Edges. The edges at the top of the hillsides are formed by individual residences oriented toward the streets, not the views down the hillsides toward Sawmill Run and the opposite slopes. Although the slopes are highly visible to the public, an almost private viewshed environment exists for the residential neighborhood at the top of the plateau. Edge development at the bottom of the hillsides is primarily on the southern side of the roadway, with only one pocket of buildings just to the east of the tunnel entrance on the north side. A small section of the hillside at the far western end of the study site exhibits the qualities of a Ribbon Development. Uncharacteristically, the ribbon extends almost straight up the slope and not at an angle to it. Consequently, its impact is minimal to the overall development pattern.

Development Strategy

This site has strong potential to remain natural. The continuity of the landscape is its most significant attribute and this should be preserved. The small pocket of buildings just east of the tunnel entrance should be considered as potential future open space to maintain the landscape continu

DUQUESNE HEIGHTS PROTOTYPE DEVELOPEMENT

Study Site
Prototype B
Prototype C



DUQUESNE HEIGHTS DEVELOPMENT STRATEGY

ity. There are a significant number of vacant and undeveloped parcels within the neighborhood boundary that can be potentially developed. In fact, filling them in would strengthen the presently ragged edge and provide an even stronger neighborhood open space boundary. There is the potential for walking paths near the top of the slopes along where the 15% to 25% slopes meet the steeper slopes and where natural promontories and terraces are formed.

Key Recommendations

- **Apply Developed Edges prototype aggressively.**
- **Maintain continuity of open space.**
- **Maintain and enlarge the open space surrounding the tunnel portal.**
- **Infill neighborhood edges to strengthen ragged crest with typical neighborhood residential buildings.**
- **Limit development at the foot of the slopes.**
- **De-map paper streets and parcels and convert to open space.**
- **Apply strict site and building development controls to maintain neighborhood pattern.**

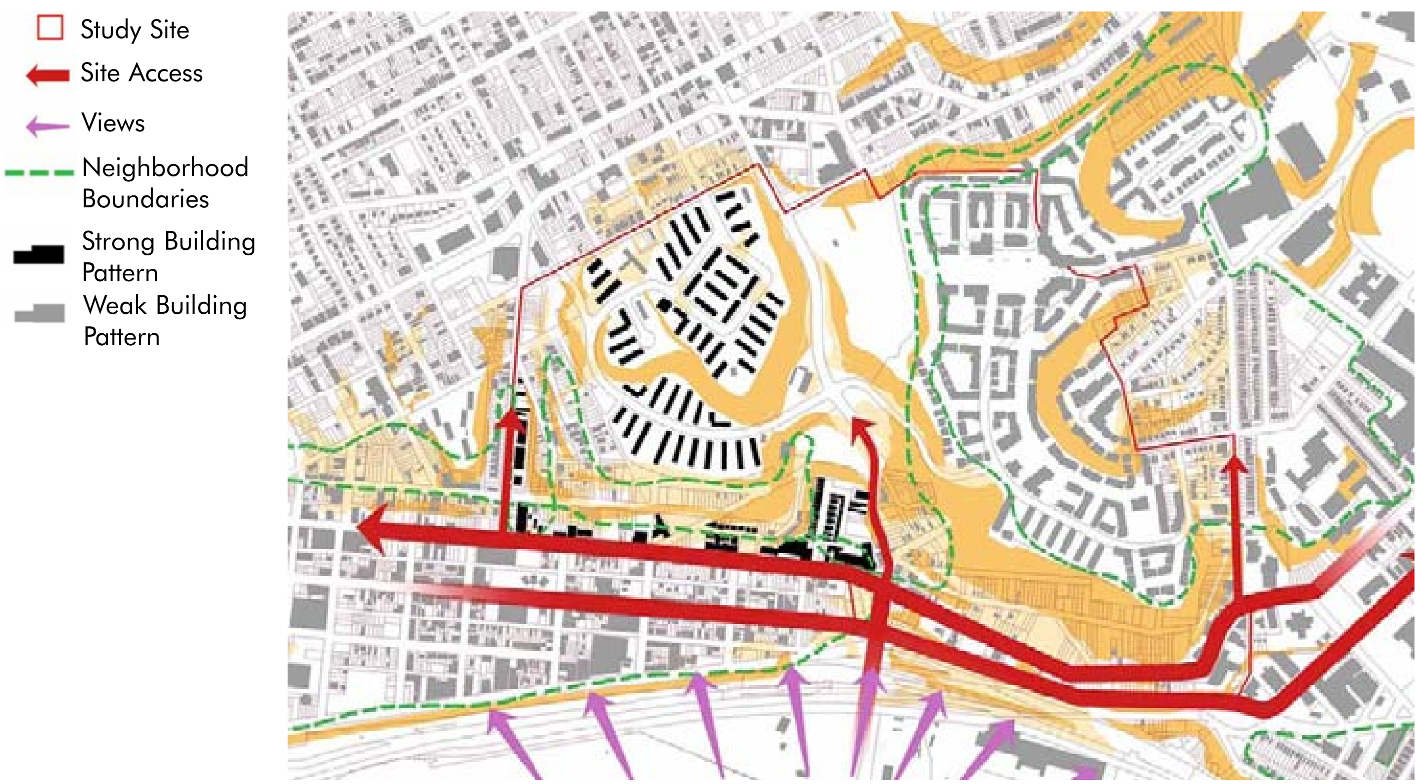
MIDDLE HILL DISTRICT

This study site has undergone two major transformations over time: terracing of the hillsides and disinvestment. Large terraces for public housing were created by leveling hilltops and expanding former terraces. As a result, what remains of steeply sloped areas are fairly narrow slivers of wooded landscape separating the public housing from the city grid fabric. Development patterning is unusual because of the impact of the larger-scaled public housing and the remnants of disinvestment which has left a residue of structures and a scattered-site appearance. Addison Terrace is likely to be redeveloped and Oak Hill is now in the process, thus providing the opportunity for shaping the edges of these developments.

Site Analysis

Areas of 15% to 25% slopes occur along the southern portion of the site where development exists and vacant parcels remain. A small valley bisects the site into two distinct areas: the eastern portion is the more distinctive and more clearly defined by hillside open space; the western portion contains a much smaller portion of hillside open space but almost equal amounts of neighborhood street grid and terraced public housing. Disinvestment is prominent on the southern portions of the site between the 25% and greater slopes and the Fifth and Forbes Avenue corridors. Most of these parcels are vacant and publicly owned.

HILL DISTRICT SITE ANALYSIS



Views of the site are from the South Side flats, the Birmingham Bridge, and from along the Boulevard of the Allies traveling east. However, only the eastern portion of the study site would be considered High Visibility; the western portion slopes occur behind larger footprint buildings that block public views, with only the upper portions of the hillside visible from a distance.

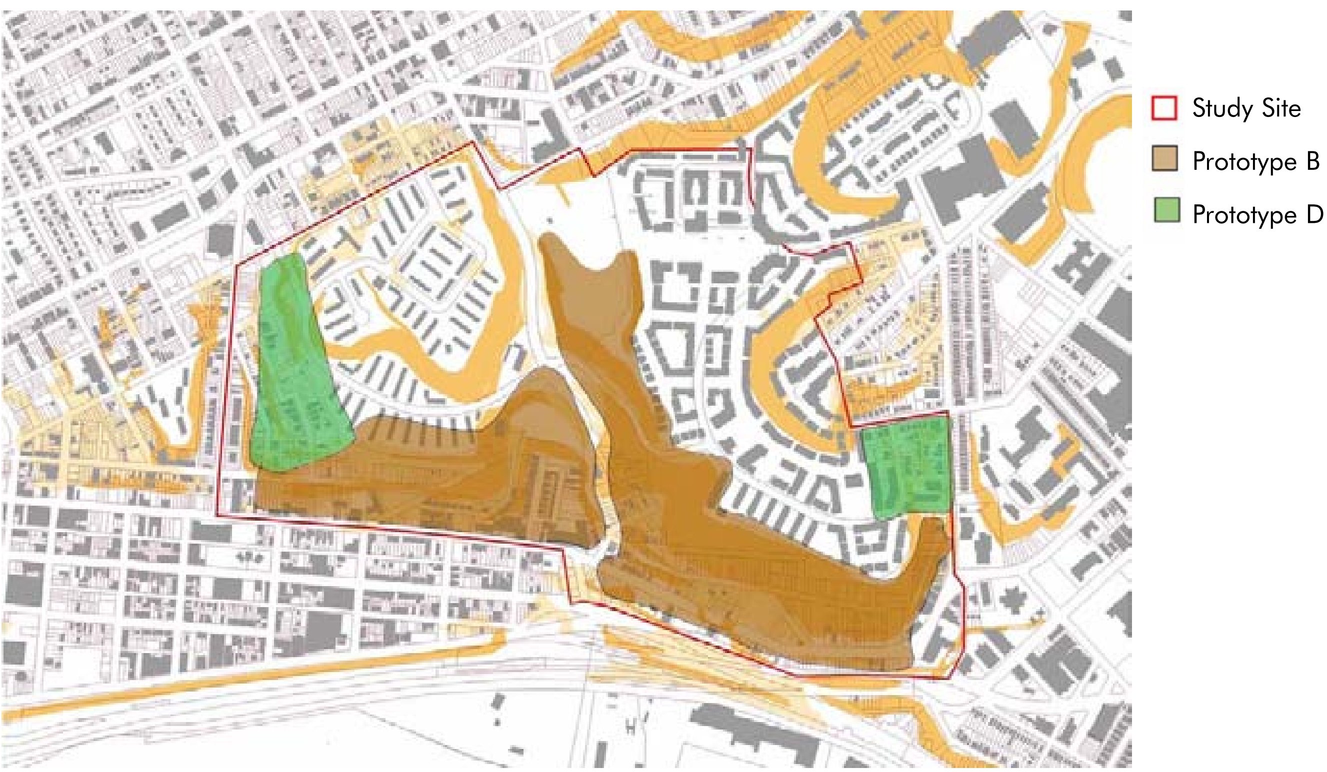
Hill District

Access is by a single path that winds up the hill in the valley that bisects the site. Other site access is from the adjacent street grids that surround the site. The neighborhood boundaries are obscure because of the terraced grading and the fragmentation of the former street grid. The slopes are helpful in making some boundary distinction by open space, however the strength of the public housing footprints are more significant in this aspect. The edges of the built fabric are quite strong because of the repetitive and bold nature of the public housing building footprints and the larger scaled development at the base of the slopes along Fifth Avenue.

Prototype Development

The bifurcated site contains two development prototypes: Developed Edges and Grid Development. Developed Edges predominates and provides the landscape setting between the bottoms of the slopes and the terraces at the tops. Grid Development occurs as small pockets of neighborhood street grid, however it is not a significant factor. The prototype conditions

HILL DISTRICT PROTOTYPE DEVELOPMENT



Hill District from Birmingham Bridge

are interesting for two reasons: this is an example of steep-slope slivers creating boundaries and development distinctions and the dominant effect that large-scaled and large footprint development has on the hillsides. The thin slivers of steep sloped landscape make it difficult to distinguish natural landscape continuity. The large-scaled development has the characteristics of wide-building anomalies, but in this case so dominating the tops of the hillside slopes with buildings that are almost ribbon-like in their disruption of the natural landscape. Only at the very top of the West Oakland hillside do the structures begin to blend in with the tree canopy.

Development Strategy

The main idea is to increase the amount of open space so that the natural landscape can increase in size and vertical height. This will make the development prototypes stronger in appearance and provide more edge definition. The open space can be increased by converting the vacant, disinvested parcels to permanent open space. There are a fair amount of vacant infill locations to absorb future development that would be offset by the additional open space conversion.

Key Recommendations

- **Increase the open space at the base of the eastern slope by claiming disinvested property utilizing the Developed Edges prototype.**
- **Utilize the Grid Development prototype to extend and integrate the neighborhood fabric with the public housing. This is an instance where built form is more advantageous than additional open space.**
- **Increase the amount of open space to strengthen the setting for the upper terrace public housing and to eliminate scattered development on the highly visible portion of the slope.**
- **Increase tree planting at the tops of the slopes to break down the scale and ribbon impact of the public housing and soften the visual ridge tops.**
- **New construction on the public housing sites should conform to the standards for crest development.**

HILL DISTRICT DEVELOPMENT STRATEGY

Houses on Mt. Washington "Saddle"

SOUTH SIDE SLOPES

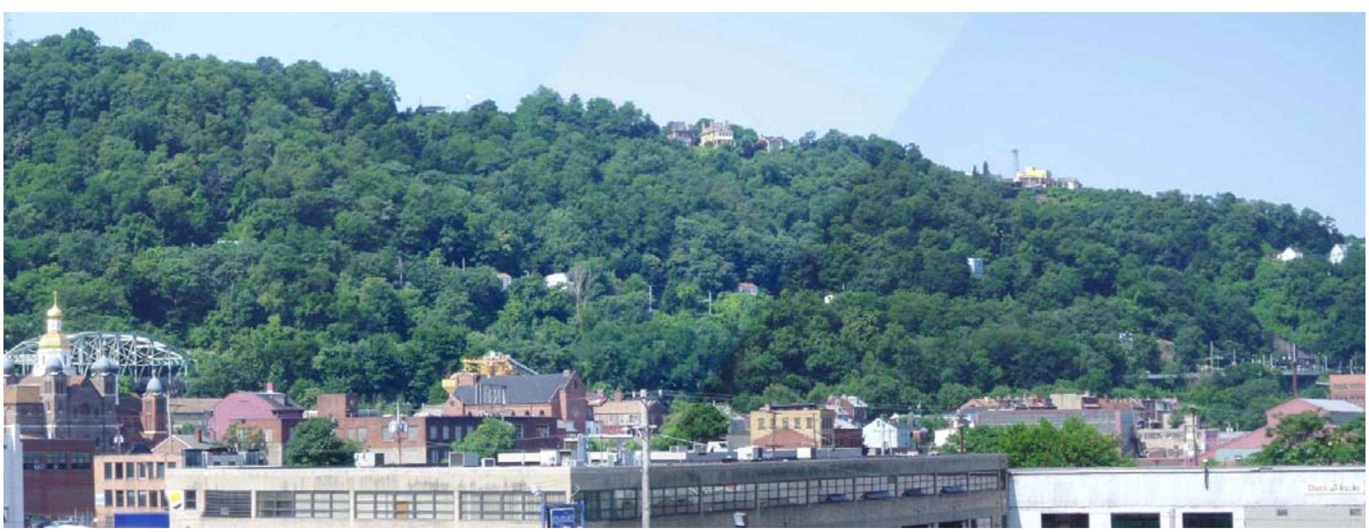
The South Side Slopes represent a quintessential hillside condition. Three of the prototype development patterns are evident. The site is highly visible and contains one of the most extensive examples of natural hillside landscape. Development pressure exists because of the spectacular views outward toward the Monongahela River, the opposite river bluffs, and downtown. There are also indications of disinvestment in the eastern portion where ribbon development occurs.

Site Analysis

This entire site is highly visible as it forms the southern edge of the Monongahela River valley. Views of the site are both panoramic and close-up and the views from the site are spectacular of downtown and the bluffs to the east. The Liberty Tunnel portal entrance is an important view shed. Most of the site is steeply sloped and undeveloped. Toward its eastern end the slopes flatten allowing for development along the access connections and where the slope is less than 25%. The eastern end is developed much like San Francisco, where the buildings become the visual asset of the hillsides. Access is by angled streets up the hillsides. The top edges of the hillsides are well-defined with strong block patterns and trees. Only at the westernmost end along Grandview Avenue do buildings assume the dominant ridgeline view. The amount of hillside open space is generous and continuous across the site's width.

Prototype Development

Three development prototypes characterize these hillsides: Developed Edges, Ribbon Development and Grid Development. The western portion is primarily Developed Edges, centering on the saddle area. Ribbon Development dominates the center section and Grid Development, where the slopes are less than 25%, is the major eastern prototype. There is little ambiguity of the hillside development patterns.



Arlington Avenue from South Side Flats

Development Strategy

The development strategy is fairly straightforward: concentrate on defining the prototypes by filling in the development edges at the crest line and along the 15% to 25% sloped ribbons leaving the center open space as large and untouched as possible. Unlike the Hill District site, the extent of open space is fortuitous and provides a strong, continuous landscape setting for downtown and the Monongahela River valley.

Key Recommendations

- **Apply the three prototypes, Developed Edges to the west, Ribbon Development to the center, and Grid Development to the east as shown.**
- **Develop infill sites for each prototype area.**
- **Discourage scattered site development on hillside above Ribbon Development.**
- **Maintain the continuity of the natural hillsides by not extending pattern development further onto the hillsides and discouraging scattered or any other development of hillside land.**
- **Do not allow attached townhouse development, other than duplex units, on any site.**
- **Impose strict building heights along the crest line so that the tree line dominates the ridge silhouette.**
- **Maintain small lot and small building footprints so that buildings will remain in scale with one another and in scale with the hillsides.**
- **Enforce the use of proper building colors and materials so as not to create visual anomalies.**
- **Plant only native species to maintain visual continuity and fall colors.**

Study Site
Site Access
Views
Neighborhood Boundaries
Strong Building Pattern
Weak Building Pattern

SOUTH SIDE SITE ANALYSIS

SOUTH SIDE PROTOTYPE DEVELOPMENT

Study Site
Prototype B
Prototype C
Prototype D

SOUTH SIDE DEVELOPMENT STRATEGY

Study Site
Open Space
Vacant Parcels
Pedestrian Circulation

PROTOTYPES AS A PLANNING TOOL

All of these sites exhibited evidence of multiple prototypes. They proved to be very helpful in understanding the underlying development pattern and suggestive of development strategies. They were also useful in making the case for protecting and, in some instances, increasing the open space.

The prototypes were most useful in guiding future development recommendations, which are more of a planning guidance nature than site-specific controls. What became apparent in each test site was the idea of completing the patterns, whether it be by filling in neighborhood edges to make them stronger and more recognizable, encouraging the infill of ribbon development so that these swaths of buildings do not appear as scatter-site development, or just filling in the vacant parcels within the existing street grid with the Grid Development prototype.

They were also useful in making decisions about open space. In the Middle Hill District site, the problem is the narrowness of the open space and natural hillside landscape. By applying the Edge Development prototype over disinvestment properties it became apparent that converting this formerly developed area into future open space provided the land area and vertical height to make a significant open space and setting for the public housing at the top. It places the housing into a better scaled relationship with the hillsides and provides much needed open space for the neighborhood residents. On the South Side Slopes site knowing where to encourage open space helps in deciding where development should stop.

What becomes important with the prototypes is the ability to maintain the continuity of the landscape and the continuity of development where either is appropriate and desired.

Mt. Washington and P.J. McArdle Roadway

9.0 OTHER POTENTIAL CONTROLS

This section contains other potential controls and ideas for regulating development that are not physical in nature, but nonetheless have the potential to place further controls and restrictions on development or are suggestive of methods of deferring development to other locations.

DEVELOPMENT ENVIRONMENTAL IMPACT ANALYSIS

A hillsides ordinance would be strengthened by placing an environmental impact analysis requirement on development. Other sections of the zoning ordinance require traffic and other impact studies depending on the potential adverse effect of a use or its intensity. In the case of hillsides, the potential for serious ecological impact and a development's threat to the health, safety and welfare of others off-site are cause for requiring an impact analysis.

Recommendation: **All development on slopes 15% and greater should be required to prepare a Development Environmental Impact Analysis. Its format could be similar to that of an Environmental Impact Statement required by state and federal agencies.**

Recommendation: **Suggested reports that comprise the Development Environmental Impact Analysis, covering impacts on the immediate site and the surrounding area, might include:**

- **Geologic and soils characteristics report.**
- **Grading or erosion control report that would also describe all site retaining and other proposed site improvements, including methods of preventing on-slope slippage and erosion.**
- **Vegetation and preservation report including tree caliper measurements, a proposed tree replacement plan, and a tree-screening plan of the proposed building.**
- **Hydrology and storm drainage report describing provisions for storm drainage and sewage disposal, how the drainage plan will meet PWSA daylighting requirements, and the downstream effects of development.**
- **Safety protection report describing site access by emergency vehicles as well as site improvements intended to lessen the impact of fire.**

DEVELOPMENT SITE AND BUILDING PLAN

To aid reviewing a hillsides project a Development Site and Building Plan that describes the proposed site and building plans should also be required of all hillside development. Its purpose is different than a Development Environmental Impact Analysis, but complimentary.

Recommendation: **All development on slopes 15% and greater should be required to prepare a Development Site and Building Plan that describes the development aspects of the proposed project. The Plan should include a detailed description of the proposed site and building plans, plus a visual analysis that describes how the building will be seen from off-site and in relationship to its hillside and landscape context.**

The Santa Rosa, California, R-H Hillside Residential District ordinance (19) contains a fairly comprehensive list of requirements that comprise a Development Plan submission. It could be used as a model for Pittsburgh's version. Some items regarding environmental impact have been removed from the following and included above.

- Legal description of the subject property.
- Proposed land uses showing the general locations of all buildings and proposed specific uses. (Note: a scaled site plan with building footprints, building elevations showing heights and materials and coloration, and building sections showing the relationship of the foundation and structure to the hillside should be provided.)
- Delineation of significant natural features such as trees, rock outcroppings, and bodies of water on a topographic map of the subject property and adjacent properties within a 300-foot radius of the subject property. Topographic maps shall not exceed the scale of 1"=100' and show contour elevations at an interval not to exceed five feet.
- A tabulation of the total land area and percentage thereof designated for various uses.
- General circulation pattern indicating both public and private vehicular and pedestrian ways.
- Relationship of present and future land uses to the surrounding area and the General Plan.
- Statement of conditions for ultimate ownership and maintenance of all parts of the development including streets, structures and open spaces.
- Delineation of development staging, if any.
- A visual analysis of the subject property as it relates to inhabited areas, specifically roadways, residential areas, activity centers, parks and other publicly used lands. The analysis shall include: a characterization of the significant visual elements of the land (and parts thereof) in terms of scale, form, color, visual amenity and relation to surrounding terrain, a characterization of the change in the above which the proposed land use shall effect.
- Statements on how the natural features, including vegetation will be preserved during construction and in perpetuity.
- Statements on the methods that will be utilized to minimize grading of building sites and streets and for utilities and indicating where natural materials will be deposited and removed.

- A conceptual landscaping plan indicating methods of maintnance.
- Any additional information which may be required to determine if the contemplated arrangement of uses is consistent with the hillside environment objectives and policies of the open space and conservation element of the general plan and the provisions of the R-H Hillside Residential District.

The Santa Clarita, California, Ridgeline Preservation and Hillside Development Ordinance (18) contains some useful criteria for development plan evaluation. Although written with ridgeline conservation in mind, they are also applicable for general hillside development.

- Proper relationship to adjacent uses, the development of the community and the various goals and policies of the General Plan.
- Use or development will not be detrimental to the visual character of the neighborhood or community, nor endanger health, safety or welfare.
- The appearance of the use or development will not be different from the appearance of adjoining ridgeline areas so as to cause depreciation of the ridgeline appearance in the vicinity.
- The use or development will not impede the normal and orderly development and improvement of surrounding property, nor encourage inappropriate encroachments to the ridgeline area.
- It has been demonstrated that it will not violate the visual integrity of the significant ridgeline areas through precise illustration and depiction.
- The use or development should minimize the effects of grading to insure that the natural character of ridgelines are preserved.
- Maintains the appearance of natural ridgelines consistent with density requirements.
- Utilizes or creates unique grading techniques, imaginative project site designs and spacing of development that significantly exceeds minimum standards.
- Designed to mimic the existing topography to the greatest extent possible. (This criterion may not be appropriate for Pittsburgh.)
- Demonstrates creative and imaginative site design resulting in a project that will compliment the community character and provide a direct benefit to current and future community residents of the city as a whole. (While not necessarily appropriate to encourage imaginative site design when extending an existing development pattern, this clause is useful when reviewing larger-scaled development proposals at the tops and bottoms of slopes.)
- Should not alter natural landmarks and prominent natural features which enhance the character of ridgelines in their natural environment.

MAINTENANCE OF HILLSIDE PROPERTY

Developing on hillside sites is a privilege and should come with responsibilities. Maintenance of hillside property and its appearance, since it is within the public realm, should be required of all property owners as a mandated obligation.

Recommendation: **The Ada County, Idaho, hillsides ordinance (1) has a very interesting maintenance clause that should be considered for Pittsburgh:**

> **"The owner of any private property on which grading or other work has been performed pursuant to a grading plan approved subject to the regulations of the Hillside Overlay Standards shall maintain in perpetuity and repair all grad ed surfaces and erosion-prevention devices, retaining walls, drainage structures, ..., and plantings and ground cover installed or completed. Such requirements shall be incorpo rated into the protective covenants for a subdivision and the conditions of approval for development applications."**

The clause could be strengthened by having it also apply to building and other construction not covered by a grading permit.

Recommendation: **Require a bond to guarantee the completion of revegetation plans, the stabilization of grading sites, cuts and fill, and construction/maintenance of storm water runoff facilities for several years after the completion date.**

DESIGN REVIEW

Just as important as a development impact analysis and in concert with it, a design review process should be required of all site and building plans for development on all slopes of 15% and greater. The design review would address the site and building design requirements.

Recommendation: **All development on slopes 15% and greater should be required to submit site and building plans for design review by the Zoning Administrator. All development which seeks to extend a development pattern on slopes 15% and greater should also be reviewed by the City Planning Department for compliance with the hillside's physical and development characteristics to assure that this new development maintains the desired development pattern. This two-step design review makes a distinction between infill and development extension sites. Infill sites would only require review by the Zoning Administrator. Development extension sites, because of their greater impact on the hillside development pattern, would receive more scrutiny.**

Recommendation: **Any hillside development design review should look beyond the typical use and massing review to also look at the aesthetic qualities of the landscape and building design. Tree placement and screening, the visual impact of site improvements, the visual impact of the building's design and profile, materials, colors, utilities, and other significant features of the building and site should be reviewed. The basic criteria should be compatibility with the development's hillside landscape context, both from on-site and off-site perspectives.**

Recommendation: **Appropriate visual material should be provided for the design review. In addition to the usual site and building plans and elevations, computer simulation, sight-line analysis, and models should be considered.**

The Santa Clarita, California, Ridgeline Preservation and Hillside Development Ordinance (18) requires of all submissions for the portion of its plan review based on visual analysis the following:

- Project simulation using computer-aided, three-dimensional modeling coordinated with photography showing before and after conditions.
- Scaled, three-dimensional model showing before and after conditions. (This might be optional, unless the development is large.)
- Scaled, sight-line analysis drawings with views from City-selected locations showing precise visual impacts of the development proposal.

This type of detailed visual analysis would be more appropriate when projects are additionally reviewed by the City Planning Department.

TAXATION OF HILLSIDE PARCELS BY "TRUE COST" METHOD

Pittsburgh's real estate taxes could begin to differentiate between hillside properties and those on flat land, not through the traditional method of land value, by recognizing that there are additional maintenance and safety costs to city government required of developed hillside parcels. Whether the taxation method be by redistributing taxes based on some multiple of the cost to the city or by placing additional tax burdens on hillside parcels only, there are certain objectives that could be achieved by this type of real estate taxation. An incentive to not develop hillside land could be implemented as well as a disincentive introduced to those who want to build on sensitive hillside sites.

This type of taxation could also contain incentives for development in more desired locations, with the distribution of development away from hillsides as the objective.

Recommendation: **Consider adjusting real estate taxation to account for higher on-going infrastructure and public safety costs that**

would reflect the "true" or "full" costs of hillside development. Higher taxation rates would apply to buildings on slopes of 15% and greater, with the rate increasing as the slope percentage increases.

Recommendation: **Consider incentives to redirect Pittsburgh development to infill sites and non-hillside sites. Provide tax incentives to live on neighborhood infill sites.**

- **Lower or eliminate property taxes on undeveloped/unimproved hillside parcels on slopes of 15% and greater.**
- **Create incentives for development on vacant infill sites within all neighborhoods.**
- **Do not incent development on vacant infill sites located at the edges of neighborhoods bordering on hillside open space.**
- **Create impact fees or other disincentives for development on new sites on slopes of 15% and greater that extend an existing neighborhood development pattern, with the penalties increasing as the slope percentage increases.**
- **Create an impact fee for developing on sensitive hillside and other sensitive sites where it would be in the public's interest to encourage preservation.**

Recommendation: **Consider other taxes and fees based on user impact.**

- **Storm water user fees based on the amount of impervious surface proposed on hillside sites.**
- **Automobile parking usage fee based on the narrowness of hillside streets and the inability to provide on-site parking.**
- **Adjust building and other permit costs to reflect the full cost of providing infrastructure for site improvements.**
- **Charge impact fees or other disincentives for developing adjacent to public hillside open space.**
- **Require that utilities charge true or full costs of utility infrastructure for any extensions on hillside properties of 15% slope and greater.**

TAXATION OF HILLSIDE PARCELS BY HILLSIDE AND OPEN SPACE MARKET VALUE

Although it can be argued that real estate taxes already account for a hillside site's increased marketability due to its view assets or its proximity to open space, the value of these sites do not reflect the value-based arguments put forward in this study. By re-valuing hillsides as city-wide ecological and aesthetic assets, their true value becomes more apparent. Pittsburgh might consider placing additional assessed values on parcels on hillsides and at the edges of hillsides where this potential is realized.

Recommendation: **Recognize the value of slope edge properties in the tax assessment rates.**

- **Increase the assessed values of slope ridge/edge parcels to more accurately reflect their true market value.**
- **Gradient assessed values from open space edges to infill locations, with the higher rates at the edges of open spaces.**

OTHER FUNDING FOR HILLSIDE PRESERVATION

Other than the outright purchase of hillside properties by foundations, public interest groups, or concerned citizens for preservation purposes, there have been other versions proposed which generate public funding to achieve similar purposes. Taxation options, described above, are one type of funded preservation. Others include general obligation bonds and creating a Recreation and Park District, both of which have been proposed for Claremont, CA. This type of funding, however, is recommended only when there is a shortfall in private monies to achieve desired results as there is the distinct possibility of the electorate defeating such measures.

The City Manager of the City of Claremont, California, proposed the following options, in addition to the more traditional methods of taxation, of generating funds for the purchase of hillside land for open space preservation (24):

> General Obligation Bond: This is a debt secured by the city and paid through increased property taxes. Approved by the public by ballot, the funds generated by selling the bonds on the open mar ket to investors would be used by the city to purchase hillside land for open space purposes. Each homeowner in the city would be assessed to pay for the debt.
>
> Creating a Recreation and Park District: A district would be formed that would organize, promote, conduct, and advertise programs of community recreation; establish systems of recreation and recreation centers, including parks and parkways; acquire, con struct, improve, maintain and operate recreation centers; and pro vide transportation services. Once formed, the district would be able to acquire land and easements inside and outside the district. A district would need the approval of the electorate and funds would be secured by levying a tax on the property taxable by the district, up to a maximum rate approved by the electorate. The dis trict could issue bonds or acquire other financing to fund the pur chase of land and pay for ongoing maintenance.

The district option appears to be similar to that of an authority in Pennsylvania. Establishing a hillsides authority might be an option if city residents and the state could be convinced that it was in their interest to protect hillsides as open space.

DENSITY TRANSFER OPTIONS

Scottsdale, Arizona's Hillside District (20) contained an interesting concept of transferring development rights from sensitive hillsides to another section of the city. It mapped a Conservation Area, where hillside land would be preserved in its natural state, and a Development Area, where development was encouraged and accepting of development rights transfers from the Conservation Area. Although found to be a "taking" of development rights from landowners in the Conservation Area by the Arizona Supreme Court (see the Land-Use Controls for Hillside Preservation in the City of Pittsburgh document within this report), because there was no offsetting monetary compensation, the idea of transferring development rights to preserve hillside open space is nonetheless valid.

Park City, Utah's Sensitive Area Overlay Zone Regulations (12) allows densities otherwise permitted in the underlying zone attributable to open space and no-build requirements of the overlay to be transferred to other portions of the site. No-build requirements pertain to steep slopes where development is prohibited. A hardship procedure accompanies the ordinance and the city, by City Council approval, is given the latitude to offset economic hardships by any reasonable incentive, such as waiving the overlay requirements or other compensation. It could be speculated that trading hillside land in private ownership for less-sensitive publicly-owned land may be possible.

Claremont, California's Hillside Ordinance (3) expresses the amount of development allowed on any hillside parcel in terms of "development credits." The ordinance encourages the transfer of some or all of the development credits from a "donor" hillside parcel to one of six flatter and more accessible residential sites in the city that are fairly large and widely dispersed. Once a hillside parcel has transferred all of its development credits, the owner is obligated to enter into a legal agreement that designates the land as open space in perpetuity.

Some form of density transfer option should be given serious consideration. If development rights, or higher densities, could be transferred from sensitive hillside areas, such as those proposed within the Highly Visible slope areas, to infill sites elsewhere in Pittsburgh where increased densities could be absorbed, hillside open space could be preserved or, at least, hillside densities lowered. Both properties would need to be the same ownership or there be consenting transactional parties. Another possibility would be to sell hillside property density development rights to fully-serviced, tax-delinquent and repossessed infill properties in existing neighborhoods. This transfer of development rights would not only support the infill strategy discussed in this report but would also generate income for the city. Transfers would need to be an option, not a requirement, for them to be legally acceptable.

Obviously, there would be political repercussions. Landowners in transfer-acceptable areas would be affected by an increased intensity in their neighborhood, although this study argues that an infill strategy would benefit existing neighborhoods. Unless it were simple to execute, developers and other landowners may be reluctant to undertake the endeavor.

On the other hand, developers may be interested because of the ability to increase densities in areas of high demand. It may be a less expensive means to provide required open space or a way to demonstrate civic-mindedness. Landowners of sensitive sites would receive compensation by the sale of their rights if they were not transferring the rights themselves.

The greatest obstacles will be demand and the economics of the transaction. Without demand for increased densities there is little incentive to exercise this option. While, perhaps, not a serious preservation tool at this point in time for Pittsburgh, looking at it from the longer perspective the City should have this tool available to those who may wish to take advantage of its benefits.

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Greeley, CO, Hillside Development Standards of the Greeley Zoning Ordinance

North Ogden, UT, Hillside Protection Zones

11.0 APPENDIX

ILLUSTRATIONS

STUDY SITES

Duquesne Heights
Slopes
Hydrology
Undermining
Infrastructure
Ownership
Zoning
Neighborhood Identity

Middle Hill District
Slopes
Hydrology
Undermining
Infrastructure
Ownership
Zoning
Neighborhood Identity

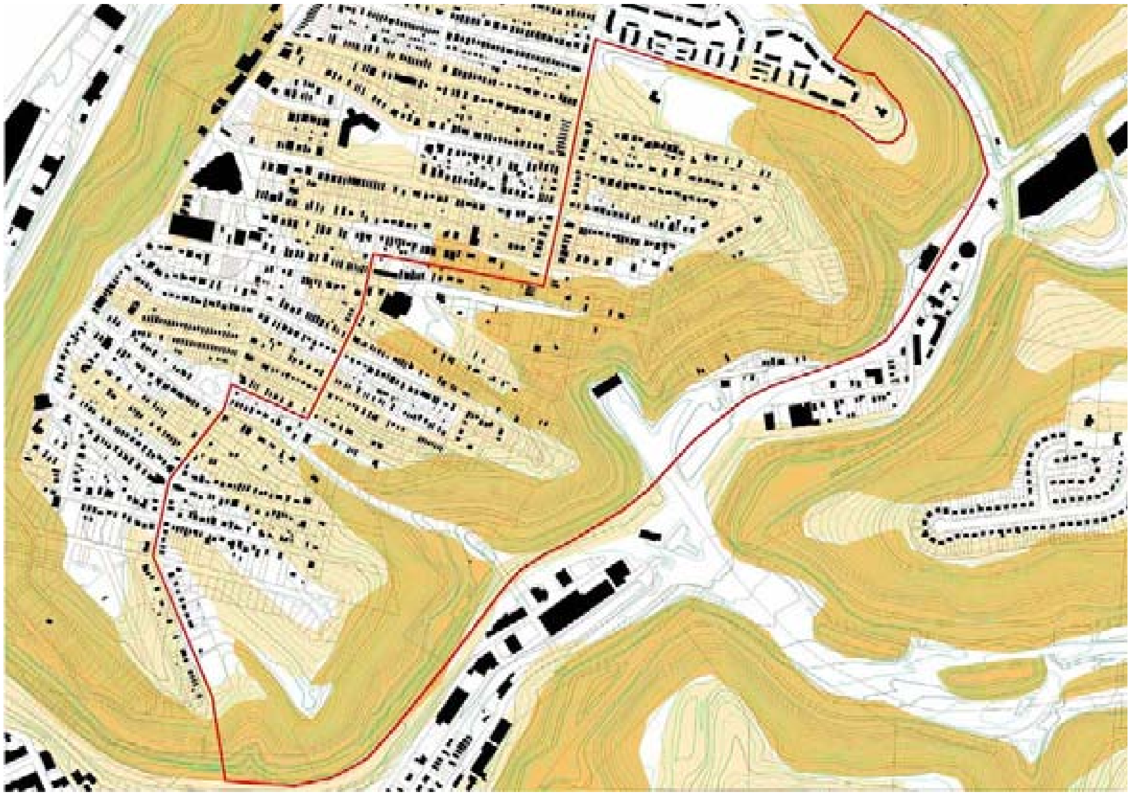
South Side Slopes
Slopes
Hydrology
Undermining
Infrastructure
Ownership
Zoning
Neighborhood Identity

DUQUESNE HEIGHTS - SLOPES

Study Site

15-25% Slopes

25%+ Slopes

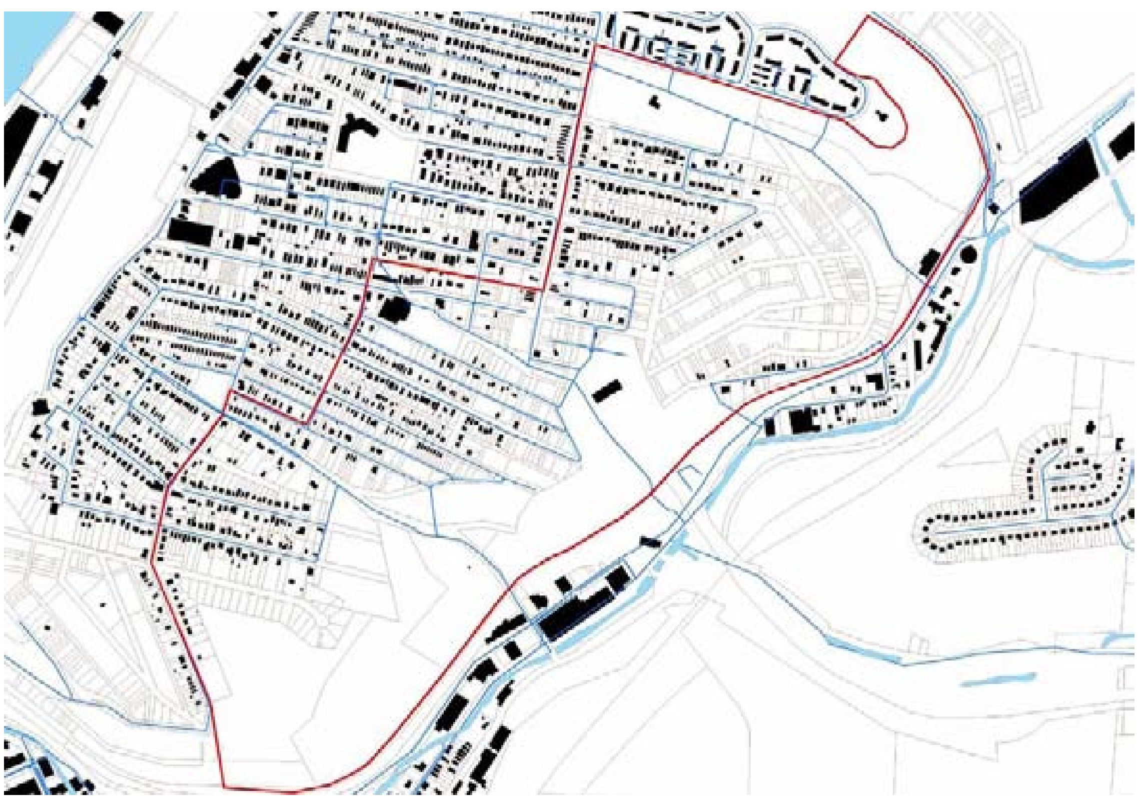


DUQUESNE HEIGHTS - HYDROLOGY

Study Site

Water Courses

Sewer Lines

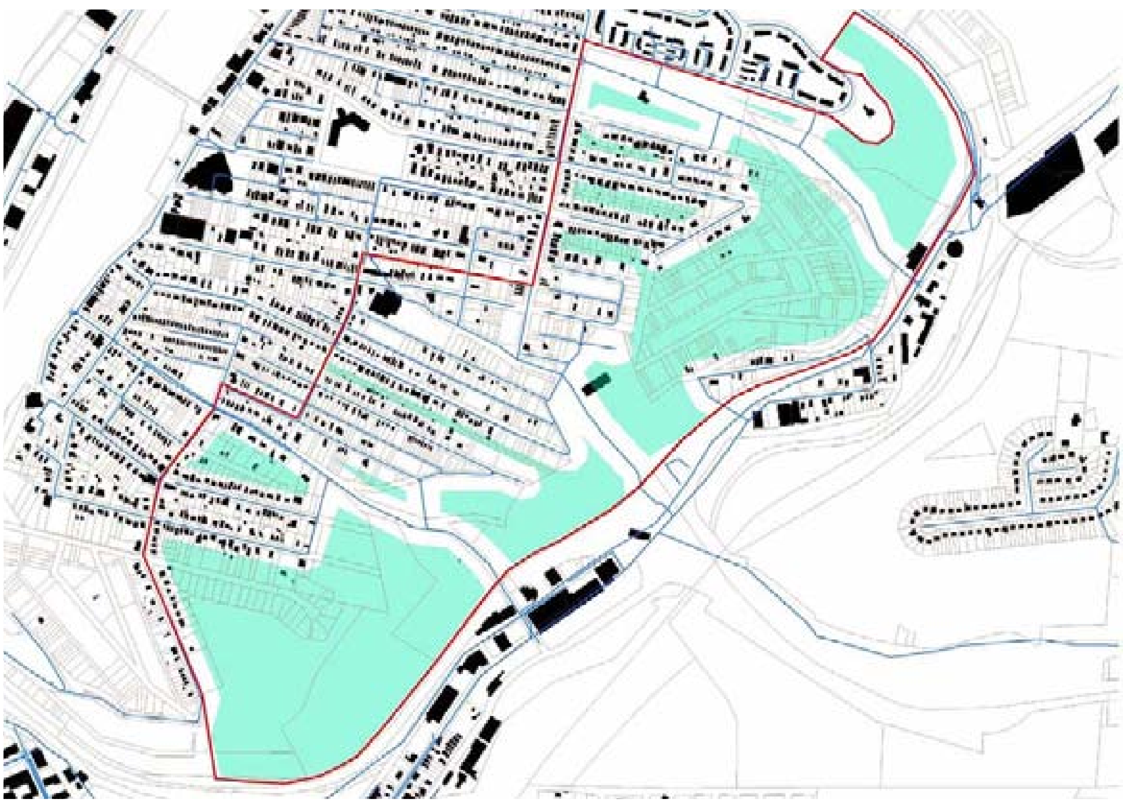


DUQUESNE HEIGHTS - UNDERMINING

Study Site

Undermining

DUQUESNE HEIGHTS - INFRASTRUCTURE



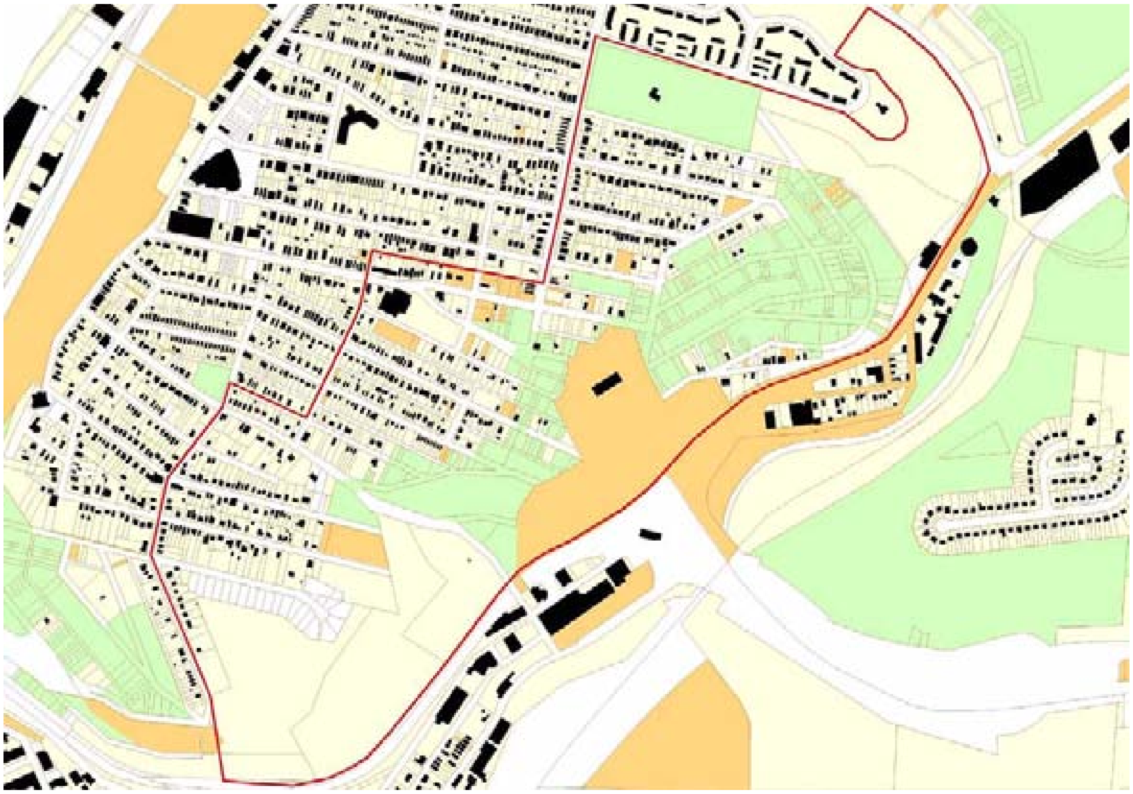
Study Site

Unserviced Areas

Sewer Lines

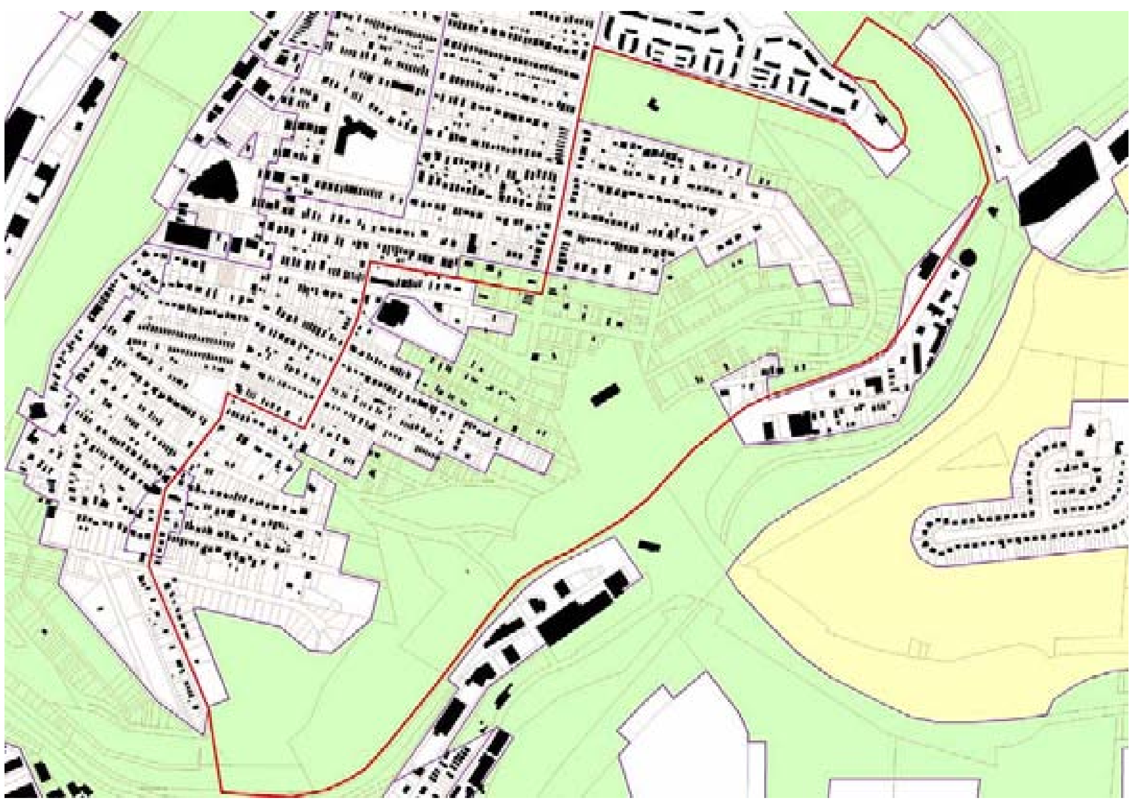
DUQUESNE HEIGHTS - OWNERSHIP

- Study Site
- Public Ownership (Non-designated)
- Private Ownership
- Public Designated Open Space

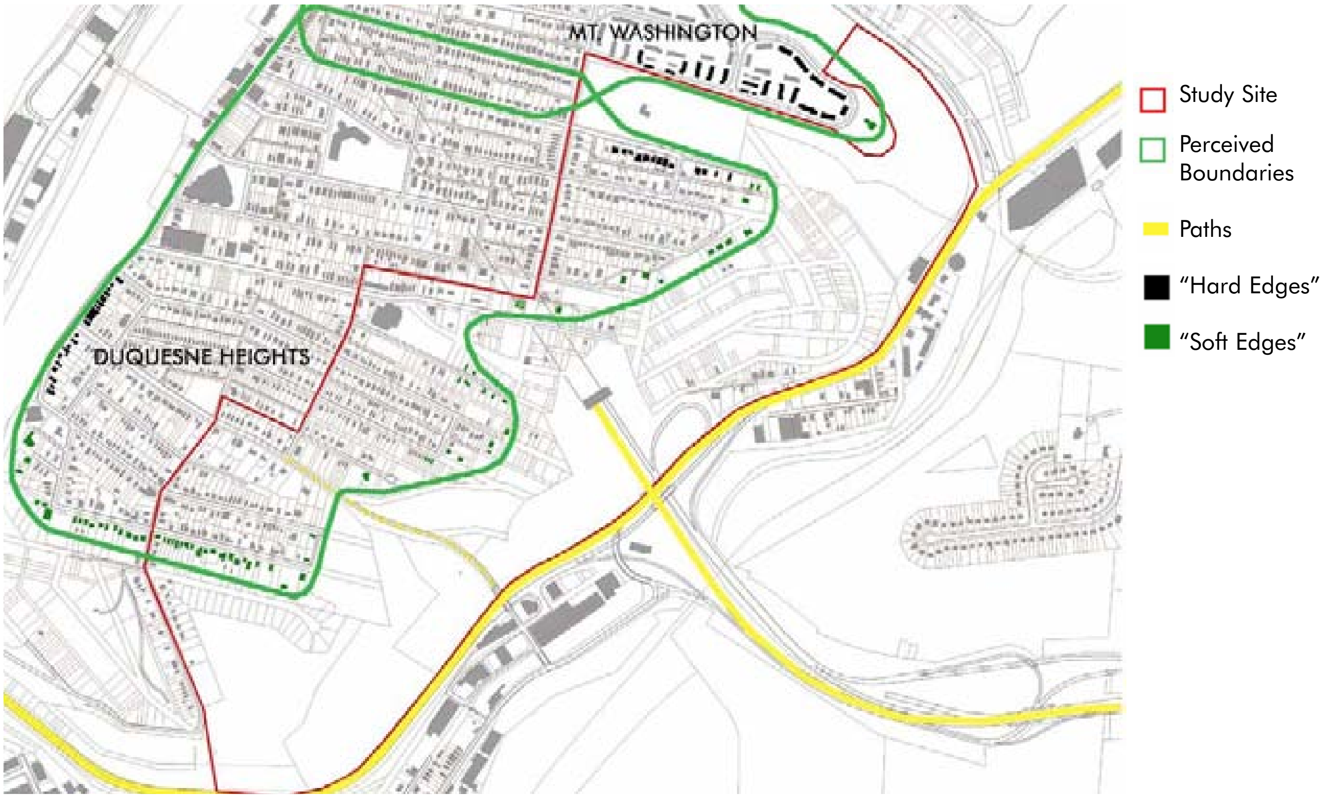


DUQUESNE HEIGHTS - ZONING

- Study Site
- Pgh Zoning
- Hillsides (H)
- Parks & Open Space (PO)



DUQUESNE HEIGHTS - NEIGHBORHOOD IDENTITY

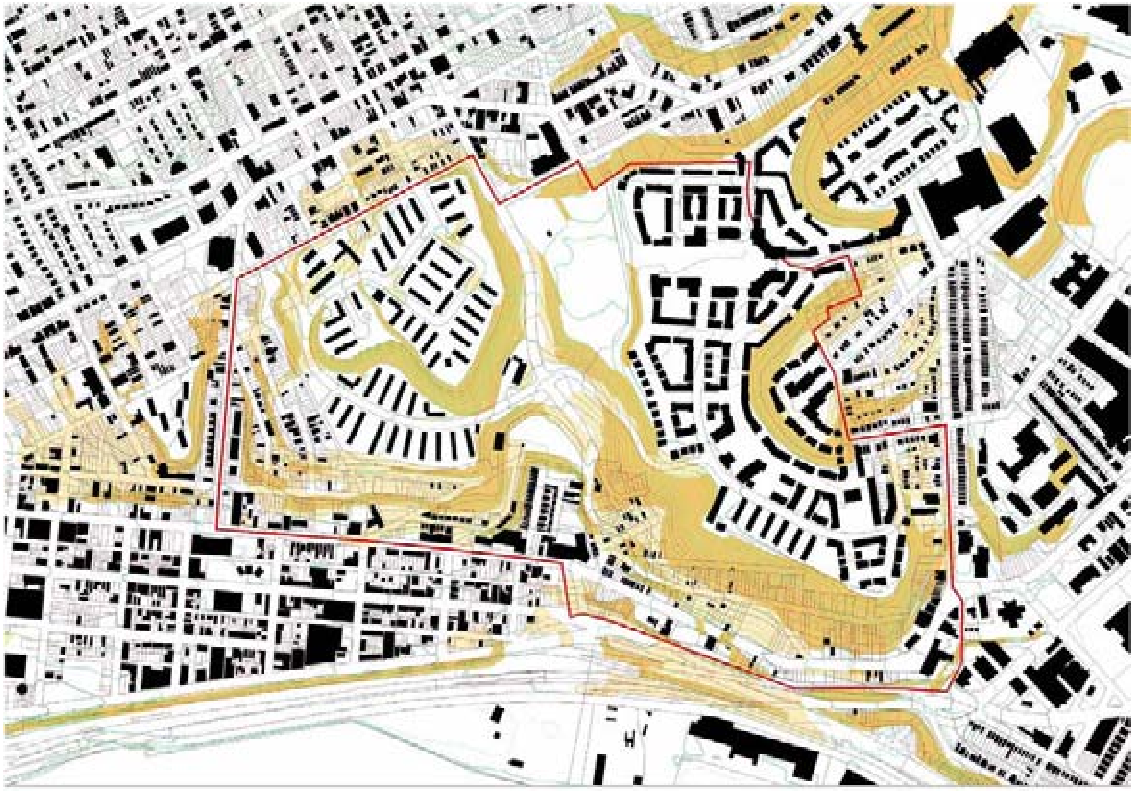


HILL DISTRICT - SLOPES

Study Site

15-25% Slopes

25%+ Slopes

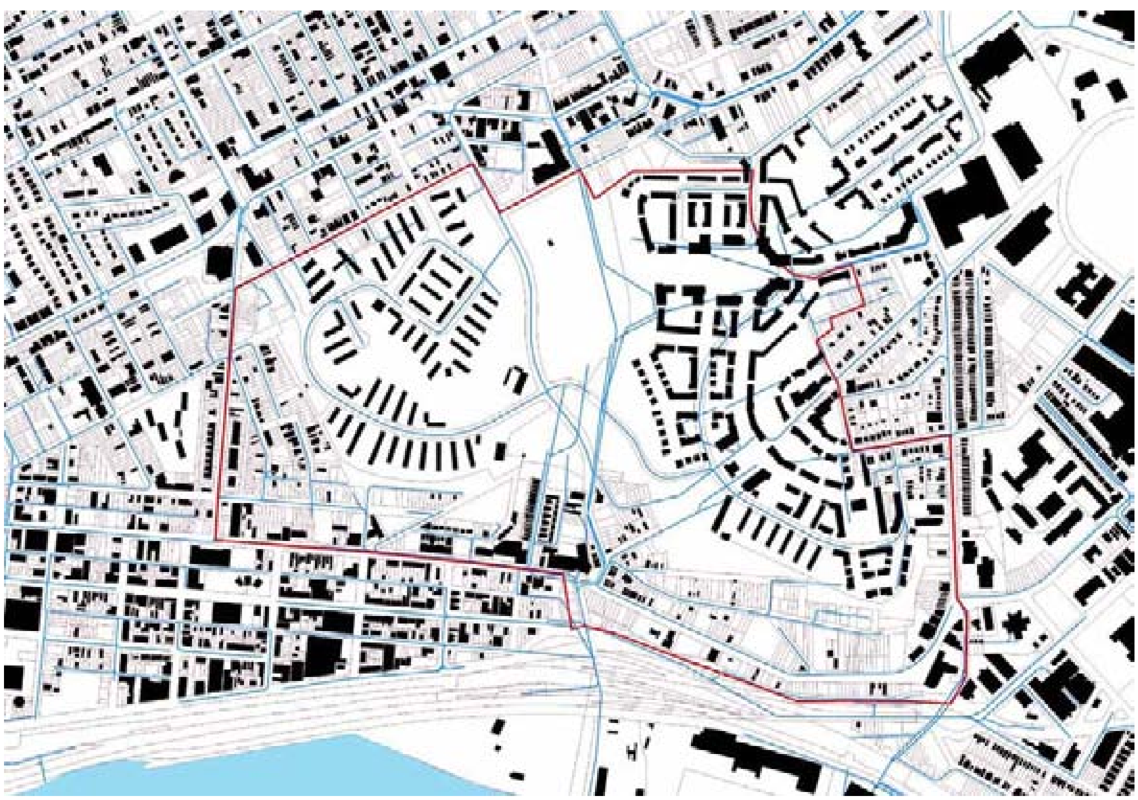


HILL DISTRICT - HYDROLOGY

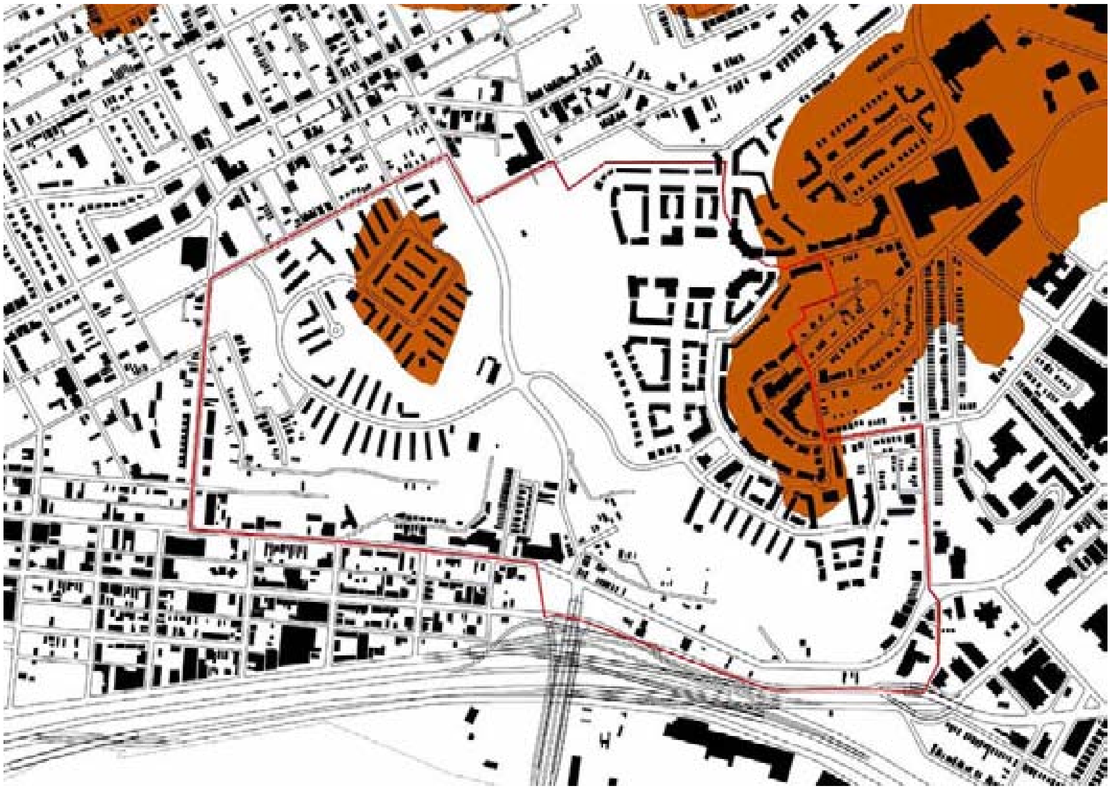
Study Site

Water Courses

Sewer Lines



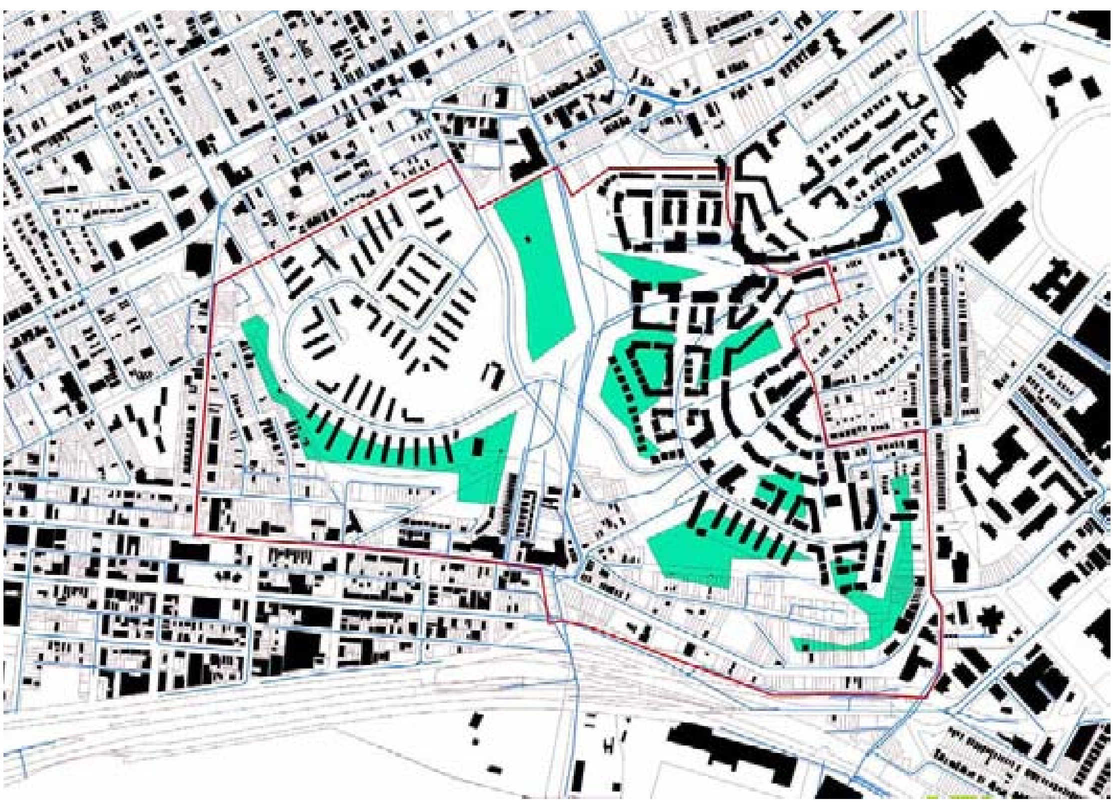
HILL DISTRICT - UNDERMINING



Study Site

Undermining

HILL DISTRICT - INFRASTRUCTURE



Study Site

Unserviced Areas

Sewer Lines

HILL DISTRICT - OWNERSHIP

Study Site

Public Ownership (Non-designated)

Private Ownership

Public Designated Open Space

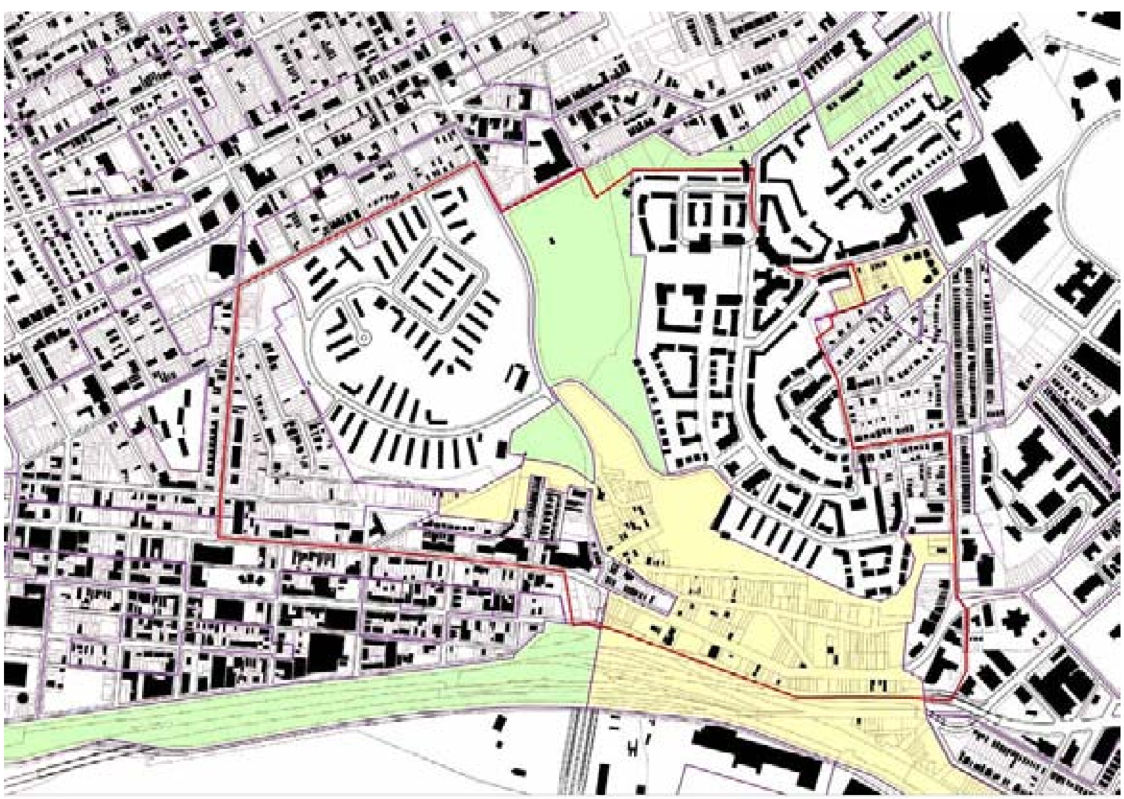
HILL DISTRICT - ZONING

Study Site

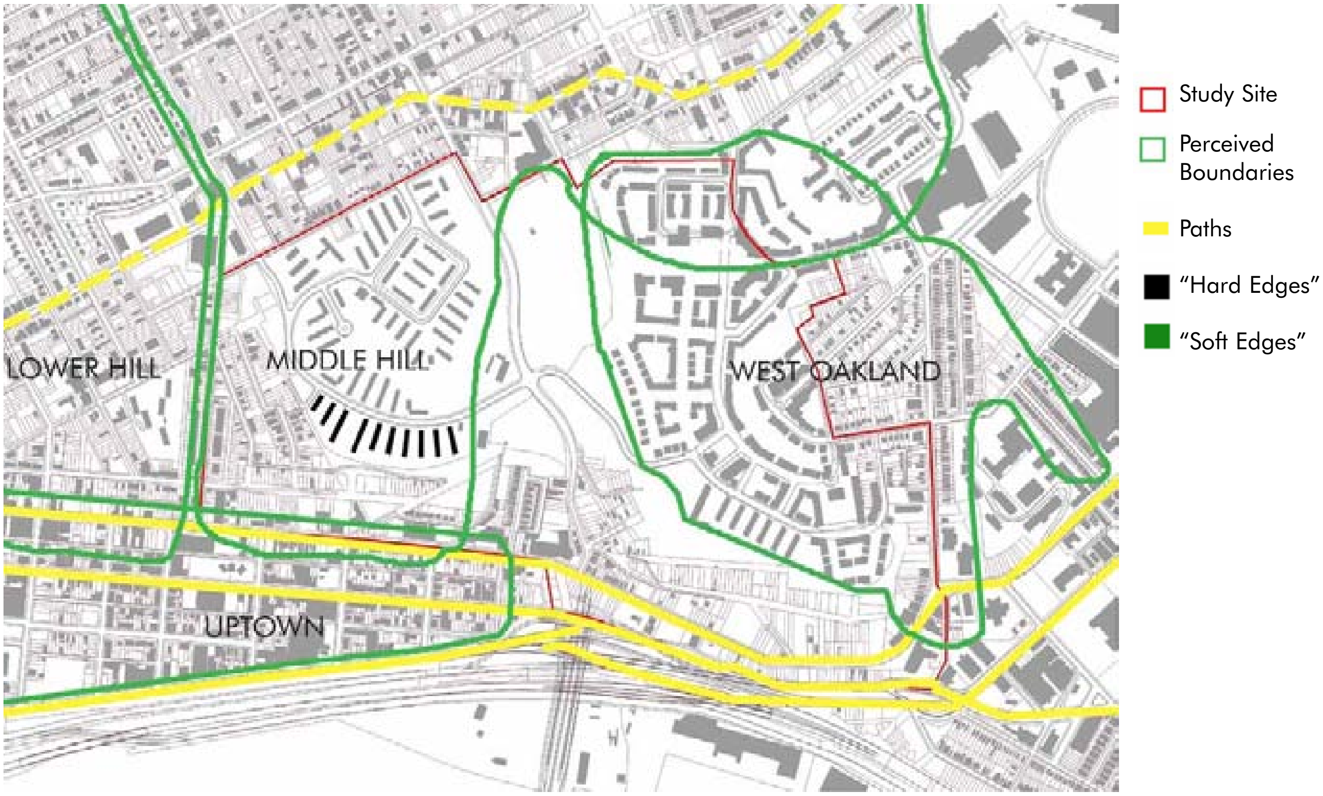
Pgh Zoning

Hillsides (H)

Parks & Open Space (PO)



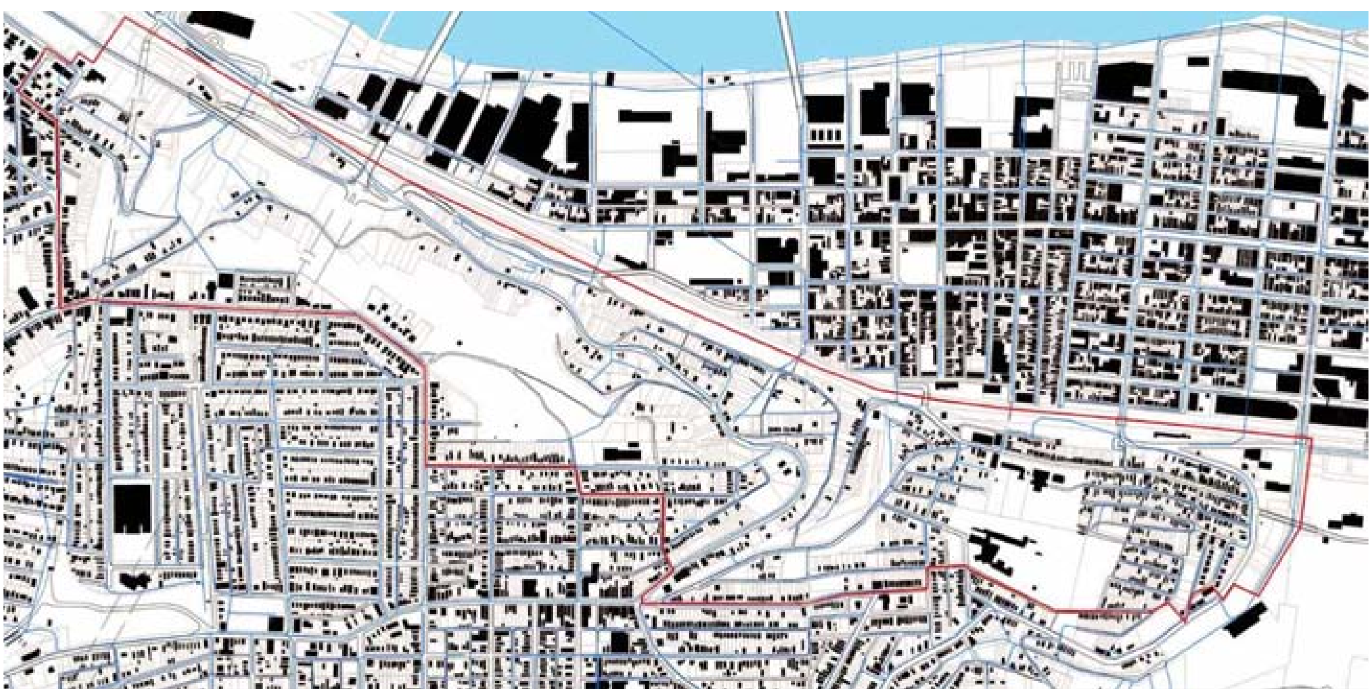
HILL DISTRICT - NEIGHBORHOOD IDENTITY



SOUTH SIDE - SLOPES

Study Site
25%+ Slopes
15-25% Slopes

SOUTH SIDE - HYDROLOGY



Study Site
Sewer Lines
Water Courses

SOUTH SIDE - UNDERMINING

Study Site

Undermining

SOUTH SIDE - INFRASTRUCTURE

Study Site

Unserviced Areas

Sewer Lines

SOUTH SIDE - OWNERSHIP

Study Site

Private Ownership

Public Ownership (Non-Designated)

Public Designated Open Space

SOUTH SIDE - ZONING

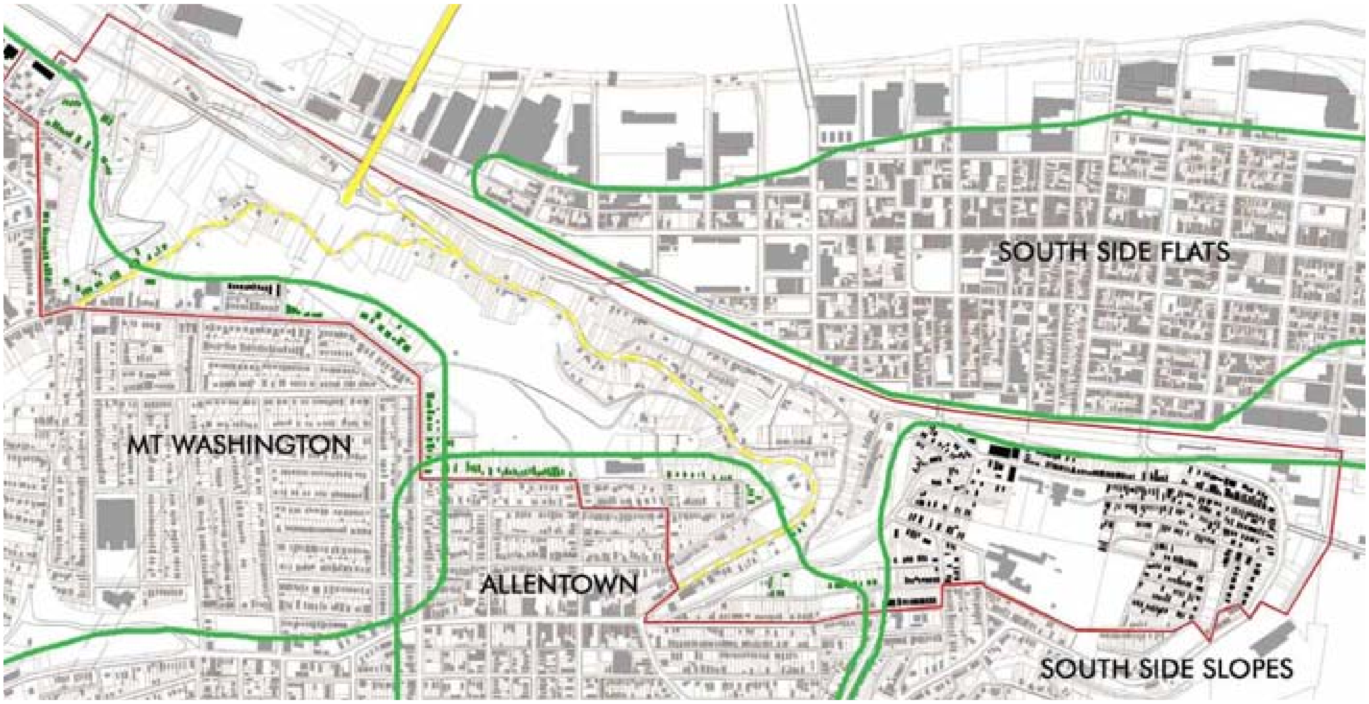
Study Site

Hillsides (H)

Pgh Zoning

Parks & Open Space (PO)

SOUTH SIDE - NEIGHBORHOOD IDENTITY



Study Site

Perceived Boundaries

Paths

"Hard Edges"

"Soft Edges"

An Ecological and Physical Investigation of Pittsburgh Hillsides
ECONOMICS REPORT to the City of Pittsburgh Hillsides Committee

Economics of Hillside Slope Development

Final Report
November 30, 2004

Prepared in cooperation with Allegheny Land Trust for the City of Pittsburgh Hillsides Committee
Funded by The Heinz Endowments

Prepared by:
Stephen Farber, PhD
University of Pittsburgh

Economics of Hillside Slope Development
Stephen Farber, PhD

I. Introduction

Hillside slopes are both natural and man-made, the latter resulting from cuts for highways, railroads, developments, and mining. The variety of slopes and associated landscape features, such as vegetative cover and streams, define the topographic relief of an area. Each element of relief - slopes, cover and streams - can have different roles in defining a landscape, although they are often tightly associated. The character of the slopes - steepness, elevation, geophysical composition - and local ecological conditions – rainfall, climate - will define the vegetation and hydrology of the landscape. Consequently, one must consider the complete ecological complex associated with hillsides, not just the steepness of its slopes. It is this complex that performs various ecological functions and produces valuable services.

II. The Value of Landscape Defining Topographic Features

Topographic relief is a large-scale landscape defining element that can be so unique and interesting that it provides identity to a place. Urban areas noted for their variegated relief include San Francisco, Seattle, San Diego, and Pittsburgh. Other urban areas are geophysically defined by the juxtaposition of flat and variegated landscape relief, such as Denver, Phoenix and Albuquerque. The topographic features of an urban landscape, and their associated ecological elements, thus play an important role at a large scale by defining a place as unique and memorable. These place defining landscape features generate values that flow from that definition, such as living and tourist interest. The Point in Pittsburgh would not be so unique and identifying if it were not for the contiguous topographic relief and even the elevated vantage points from which to view the joining of major rivers.

These unique, place defining topographic values are at such a large scale that it is difficult to place economic values on them. They would permeate all economic transactions of the region, from housing markets to commercial viability. Variegated topographic relief is attractive to people and defines the place as unique and interesting. Housing values are higher and wages lower as people desire to live in a variegated, unique and interesting landscape. While many studies have shown the property value and wage effects of environmental amenities, such as climate, clean air and water, greenspace, and forested landscapes, no one has done a similar study for the economic values of topographic relief, per se.

This variegated topographic relief is a very large scale defining landscape element crucial to the definition of a place. As this relief is diminished, either geophysically through landscape transformations, or visually through land use changes, so is the uniqueness and place defining character of this element. This relief can be lost piece-by-piece, as each transformation is thought to contribute only marginally to changing the landscape character of a region. But with each piece goes a little bit of the place defining element.

The elements of value that contribute to the uniqueness and memorability of a topographically variegated landscape are complex and often purely psychological. Viewsheds are often large and permit the observer to see large distances, view the variety of natural landscape features, such as valleys, hills and rivers, as well as view the variety of human activities in that landscape and in their economic world. These views are intriguing to the senses. As hillsides become developed, the natural landscape features disappear and something of value is lost from the viewshed. What this loss is worth, economically, is a challenge to estimate, although studies have shown what it may be worth to people to have broader vistas, or to have natural vistas altered by human activities and structures.

In addition to the visual values at the tops of variegated topographies, there may be some psychological values associated with safety and serenity on the tops of hillsides. While people are not likely to fear marauding invaders climbing the slopes behind their homes, there may still be some sense of safety when a large area of nearby landscape is inaccessible. Also, just the lack of development on hillsides would provide a region of tranquility in addition to possibly extensive views. These values may be reflected in the prices of properties near undeveloped hillsides. Empirical tests of these effects on property values can be made, although no one has done it. Studies of the property value impacts of forested landscapes are related, but have not been done in the context of hillside landscapes.

Valleys associated with variegated topographic relief would have diminished value as elements of that relief disappear. Living in valleys has always appealed to people. This is not only because it costs less to construct in valleys than on hillsides, but because there are psychological benefits associated with safety, serenity, and upward visualizations of natural hillsides that appeal to people. The belief that people will not build on hillsides provides some comfort that at least the perimeter of the valley will remain serene and natural. A psychological element of coziness and safety of a valley is lost when hillsides become developed. These values to valley properties in a topographically variegated area should be reflected in increased property values, although no one has attempted to make such estimates. A confounding issue is that it is necessary to compare valley properties with others not in a variegated landscape, but that have other similar property determining characteristics, such as proximity to jobs and ease of access. Such comparisons may be difficult, as valley communities are often isolated economically (e.g., West Virginia coal communities).

Variegated topographic features, such as hills, valleys and rivers, often play important roles in defining economic regions and social communities. Hills come to define communities, as geographic mobility is an important determinant of a community or neighborhood. And hills or rivers provide natural boundaries that define spaces, and provide convenient natural features that satisfy human needs for place definition. To the extent these boundaries are less identifiable, as they might be with development of hillsides, the sense of community and neighborhood is diminished. While historic definitions of neighborhoods may be maintained on maps and urban directories, the psychological value of these definitions are diminished as the places become blurred and communities integrated across their historic natural boundaries. One has only to look at San Francisco to see how development of almost every landscape feature has visually blurred any sense of neighborhood place. For this reason, the Association of Bay Area Governments, the regional planning organization, has as one of its six major environmental and land use objectives, to "Create and enhance community identity through protection of community separators, hillsides, ridge lines and viewsheds, riparian corridors and key landscape features." (http://www.abag.ca.gov/planning/rgp/menu/ menub.html)

The economic value of the identification and integrity of neighborhoods and communities through variegated landscape features is difficult to quantify even though this identification is a fundamental element in people's social, religious, and economic lives. But its loss can possibly be felt in varied ways, such as loss in social capital (networks of social relationships and sense of trust and caring), increases in crime rates, loss of interest in local political processes, and out-migration of young people. While a portion of the economic costs of crime can be measured, other elements of social capital and community cohesion are difficult, if not impossible, to value economically.

III. Ecological Values of Hillside Slopes

Hillside slopes, and their associated vegetation and streams, have functional ecological values. Slopes, per se, define a topography and related habitat that determine biological diversity at a small scale. Various plants may thrive in the steeply sloped, well-drained, and climate protected micro-regions of topographic relief. This resulting vegetation is critical to establishing the hydrologic and climate regimes of the sloped and surrounding areas, and may be difficult to replace if disturbed. Steeply sloped hillsides also provide unique or highly favored habitats for some animal species. So these sloped hillsides may play an important role in protecting biodiversity. The value of this biodiversity is difficult to estimate, but does have both local and regional value.

Hillsides are critical landscape features in determining hydrologic conditions. Vegetative cover of hillsides is essential to a variety of hydrologic processes, including management of sheet flow, uptake, and sediment loss through water flow and raindrop impacts on soils. The more steeply sloped the hillside the more severe the hydrologic effects of vegetative loss will be. The value of vegetative cover then increases with degree of slope. This value can be measured by the increased costs associated with more rapid and higher volume run-offs from sloped areas. These costs include stormwater management costs, flood protection or damage costs, as well as costs associated with increased stream sedimentation, such as water treatment costs and recreational fisheries losses. These costs are measurable, but depend upon the hydrologic and sediment fate modeling of watersheds.

The benefits of maintaining a forested landscape to control stormwater runoff are illustrated in a study done in Los Angeles, CA (Pincetl, et al, 2003). The study used a Geographic Information Systems (GIS) program, called CITYgreen (developed by American Forests), to analyze the impacts of tree cover on stormwater runoff, air pollution and urban temperatures. The study site was 146 acres, and included nearly 1900 trees. The GIS model was then used to predict runoff, pollution removal and temperatures under various "greening" scenarios, including the base case of current existing conditions. The study then created scenarios of increases in streetside trees, trees in parking lots, and introduction of permeable surfaces to parking lots. Using a value of $275 per cubic foot for managing stormwater runoff, the model estimated that current vegetative cover in the 146 acre study area saved $930,000 in stormwater infrastructure costs. However, the aggressive cover scenario with its additional planting, etc., would result in cost savings of over $7 million; or nearly $6 million more cost savings than under current conditions. This represents approximately $41,000 per acre of cost savings attributable to more intensive tree cover. While results are likely to differ substantially with topography, existing land cover and rainfall conditions, they are suggestive of the magnitudes of values of natural services provided by tree cover.

Another study in the Los Angeles, CA, area analyzed the effects of trees on rainfall interception and runoff reduction (Xiao and McPerson, 2002). A mass and energy balance rainfall interception model was used to simulate rainfall interception processes (e.g., gross precipitation, free throughfall, canopy drip, stemflow, and evaporation). Annual rainfall interception by the 29,299 street and park trees was 193,168 m^3 (6.6 m^3/tree), or 1.6% of total precipitation. The annual value of avoided stormwater treatment and flood control costs associated with reduced runoff was $110,890, or $3.60 per tree.

The stratified geomorphology of many steeply sloped hillsides provide for the gradual seep of groundwater down hillsides. Maintaining a low flow of groundwater is especially important in regions with coal and other mineral deposits that may cause acidification. Slow flow and hillside vegetation may provide for water treatment before reaching streams. Disturbing this geophysical and vegetative regime may have severe adverse consequences for stream quality as flows are increased and treatment is diminished. The economic value of hillside disturbances can be large, as the costs of acid mine drainage attest.

Hillsides and their vegetative cover will play some roles in local climate conditions depending on the topographic context. Changing the cover, as would occur with development, may increase wind flows and create greater extremes in temperature conditions at the micro-climate level. These climate effects would alter conditions in associated valleys and hilltops; increased heating and cooling costs may result. It is not clear whether these climate effects of loss of vegetative cover would be more or less severe in more steeply sloped hillsides.

A major study of the pollution removal and heating/cooling values of trees was done for the Chicago, IL, metropolitan area (McPherson, et al., 1997). The study found that increasing tree cover by 10% (corresponding to about three trees per building in the Chicago landscape context) could reduce total heating and cooling energy use by 5 to 10% ($50–$90 per year). On a per-tree basis, annual heating energy can be reduced by about 1.3% ($10 per tree per year), cooling energy by about 7% ($15 per tree per year), and peak cooling demand by about 6% (90.3 kW). This $25 annual savings per tree suggest a present value of cost savings of $500 per tree, using a 5% discount rate. For typical suburban wood-frame residences, shade from three trees can reduce annual heating and coolings costs 10 years after planting by $15 to $31 per year, and 20 years after planting by $29 to $50 per year.

The ecological function of trees in recycling gases and nutrients allows them to play a critical role in managing human created hazardous and toxic pollutants. Recent studies of fine particulate pollutants suggest the importance of managing fine particles. These fine particles adhere to tree leaves, so leaving hillsides with significant tree cover is important to fine particle pollution control (New York Times, May 18, 2004). Assuming the benefits of control exceed their costs, the value of this control can be measured by the costs of alternative methods for controlling the same volume of pollutants; e.g., industrial and auto emissions. An acre of trees would then have a pollution control economic value that depends on its leaf surface area.

Several studies have focused on the pollution control benefits of tree cover. The Los Angeles study (Pincetl, et al., 2003) estimated that the value of a typical acre of urban land, under current tree densities, for removal of ozone precursors (but trees produce ozone also), sulfur dioxides, nitrogen oxides, and small particulates ranged from $18 to $80 per acre with current tree planting densities. These benefits are based on avoiding more costly methods of point and non-point source pollution controls. Under a more aggressive urban planting program, the per acre value for pollution control rose to $142 to $185 per acre, illustrating the potential benefits of more dense urban tree cover; or the loss in benefits from deforestation and hillside development.

Using estimates from various studies of the pollution control values of urban trees, McPherson et al. (1997) concluded that the roughly 50.8 million trees in the Chicago urban region removed 5575 tons of air pollutants per year (0.22 pounds per tree per year) and sequestered 315,800 tons of carbon per year (12.4 pounds per tree per year). We can use their cost of alternative pollutant control of $1650 per ton and the cost of carbon removal by other means of $20 per ton, respectively to calculate the economic value of a tree for pollutant removal. This value is $0.30 per tree per year. The present value of a tree, using a 5% discount rate, is then $6 per tree. This may seem like a small value, but if tree densities are 50 trees per acre in an urban forested landscape, an acre of trees is worth $300 per acre. This would be the pollutant removal services component of the value of social loss from deforesting a one acre plot of urban trees.

The deforestation of urban tree cover, as is most likely to occur with hillside development, results in significant loss of “natural infrastructure.” The loss of tree covered landscapes results in substantial losses of natural systems services, such as aesthetics, water management, climate control, and pollution control. These are real social losses, and are not likely to be considered in the largely private decisions surrounding development. While urban communities may charge developers for physical infrastructure costs, such as streets, lighting, sewage, water supply, etc., there are few instances where developers are charged for damage to “natural infrastructure.” For example, Cincinnati charges for the value of trees in instances where someone wishes to remove a tree for a road widening, new driveway, utility upgrade or billboard visibility

(Architecture Division, Cincinnati, OH). The value of the tree is determined using an appraisal method created by the Council of Tree and Landscape Appraisers (http://www.sufa.com/appraisals.html). However, this value is a private property enhancement-based value, and not the type of socially-based, natural infrastructure value being considered here. The studies note above suggest the types of social development fee that could be charged for this loss in natural infrastructure through tree removal.

IV. Public and Private Values of Hillsides

Public values of hillsides and the associated vegetation are benefits that accrue to the public-at-large; they are available to all to enjoy. Such values include visual aesthetics and interest, biodiversity protection, climate control, nutrient and toxic pollutant management, flood and erosion control, community and neighborhood identification, unique place definition, tranquility, and natural awe. These are the broad, public values of a landscape. While they may accrue to everyone, and you have to only pass through to experience them, they can easily be destroyed by those whose private interests dominate their own share of the public values.

Private values of hillsides and the associated vegetation are much narrower than the public values. These would include the space on which to build a structure, and some of the public-type values that may be more accessible through land ownership. For example, the serenity and visual values of variegated, natural landscapes may be purchased along with the land that is on or proximate to these variegated landscapes. This "capture" of some of the public value may, ironically, diminish that public value for others. One developer opens up a hillside for development, claiming the natural, visual and serenity values of the development. Another does the same. Eventually, all hillsides are developed, and these amenities are lost to both private and public users. Any premiums paid for the original features of the landscape are eroded away.

Various studies have shown that property values are higher when nearby landscape amenities are present (see cites above). These elevated property values reflect only those amenities that can be experienced more extensively by proximate land ownership. These would include views, serenity, natural landscapes, recreational opportunities, biodiversity, etc. But these are also values that accrue to some degree to the public-at-large; I can see the tree covered hillside just by driving by, but I cannot see it all the time unless I purchase property.

However, there are some public values that may be incorporated partially in property values at a large scale. Air pollution and climate management afforded by vegetated hillsides are examples; an entire valley benefits, so one has to "buy into the valley" to enjoy those amenities. Flood and erosion protection of a vegetated hillside is another example; one would pay more for land downstream of a protected hillside.

To the extent that we observe property values increasing in proximity to natural and protected hillsides, we are likely observing the more immediate effects of views, aesthetics, uniqueness, and serenity on property values. The much larger region may also benefit from the other values mentioned above, but the identification of this enhanced value may be more difficult, as it affects the entire region. The local effect is just the marginal difference that proximity makes to property values.

V. Taxes and Hillside Slope Values

The fundamental, immediate values of hillsides and associated ecological conditions are a result of the aesthetic and functional services provided by these hillsides. These types of values have been discussed above. They accrue to the public-at-large, the regional as a whole, as well as to private landowners. When we consider the value to the society of these hillsides, we must think in terms of their ecological and social services.

Taxes are the collection of funds necessary to pay for public services provided by taxing authorities. Higher tax bases provide taxing authorities with greater opportunity to finance public services. When regional and local tax bases are improved as a result of amenities such as hillsides, or better flood and erosion management, public services can be enhanced and contribute to higher quality of life. So maintaining tax bases commensurate with the level of public services demanded is important to a community.

The tax benefits, and the ability to provide public services, associated with hillside landscapes depend upon the extent to which properties values are enhanced by these landscapes. Diminishing landscape features, through developments or other landscape alterations, can adversely impact values of properties locally and regionally. Recall that the premium people would be willing to pay for access to attractive hillside landscapes may not be just a local effect, but may positively impact property values of the region as a whole. There are public values that enhance life in a region with variegated landscapes, and these increase property values regionally. Considering increased property values, say within ¼ mile of the top of a hillside, is not adequate accounting for hillside values. Consequently, the property tax increases associated with a limited geographic area immediately proximate to the hillside does not fully measure the tax benefits of that hillside. It would show the minimum tax value of the hillside.

VI. Economic Valuations of Urban Environmental Amenities

Economists have employed several different methods to establish the economic values of urban amenities and disamenities. These methods include hedonic pricing and contingent valuation. Hedonic pricing takes market prices of residential housing and relates those prices to characteristics of the structures (age, number of bedrooms, etc.), neighborhoods (income, age distribution, etc.) and proximate landscape features or economic activities that are expected to add or detract from the desirabilities of locations (Farber, 1998; Boyle and Kiel, 2001; Jackson, 2001). Landscape amenities would include lakes, streams, open spaces, forests, parks, etc. Economic disamenities would include congestion, noise, industrial activities, power lines, etc. Well-accepted empirical techniques are used to establish the effects of these amenities and disamenties separate from the structural and neighborhood characteristics of sampled properties; i.e., we obtain these amenity and disamenity effects alone.

The standard measure used to reflect amenities and disamenities is "distance to the site" (Kohlhase, 1991; Kiel and McCain, 1995; Hite et al., 2001; Kiel and Zabel, 2001). Deaton and Hoehn (2004) summarize the disamenity literature and find that estimated hedonic models show that property values increase with distances from landscape or economic disamenities such as superfund and hazardous waste sites (Ketkar, 1992; Kiel, 1995; Kolhase, 1991; Thayer, et al., 1992), solid waste landfills (McClelland, et al., 1990; Reicher, et al., 1992; Smolen, et al., 1992), overhead power lines (Colwell, 1990), pipelines (Maani and Kask, 1991; Simons, 1999), incinerators (Kiel and McCain, 1995), storage tanks (Simons, et al., 1997), and railroad tracks (Strand, 2000).

VI.1 Urban Open and Green Spaces

There has been some research on the property value implications of urban amenities. Crompton (2000) reviewed 25 studies investigating the relationships between open and green spaces and neighboring property values. He concluded that 20 of these studies showed clearly that there were positive impacts. Several are these studies are relevant to the issue of preserving and restoring urban landscape amenities. One of the earliest hedonic studies of urban open spaces was by Correl, et al. (1978) of a Greenbelt in Boulder, CO. This study used walking distance from the nearest greenway access point to test whether houses similar in all other relevant characteristics (structure, distance to city center, age, etc.) would have higher sales prices if located closer to greenways. This relationship was clearly supported, as the following estimates suggest:

Walking Distance From Greenbelt	Typical House Sales Price ($1975)	Incremental Distance Effect on Price ($1975)
Less than 30 ft	$54,379	+$4,031
30 – 1000 ft	$50,348	+$1,176
1001 – 1283 ft	$49,172	+$2,980
1284 – 2000 ft	$46,192	+$4,986
2001 – 3200 ft	$41,206	blank
Source: Correl, et al. (1978)		

For example, column 3 shows that a house located less than 30 feet from the Greenbelt sold for $4,031 ($1975) more than a house located 30 to 1000 feet from the Greenbelt. A house within 30 feet would have sold for $13,173 ($4,986+$2,980+etc) more than a similar house 2001-3200 feet from the Greenbelt. This latter incremental value of proximity to the Greenbelt is roughly 27% of the value of a typical house in their sample.

Correl, et al. (1978) also estimate the increased property tax revenues to city and county governments, and school and special districts of the incremental property values created by the Greenbelt. They estimated that the aggregate property tax base increased by $5.4 ($1975) as a result of the Greenbelt, yielding additional tax revenues of $0.5 million annually. These additional tax revenues, when discounted at 5% over a 30 year period would increase the present value of tax revenues by $8.4 million.

A hedonic study of five urban parks in Columbus, OH, showed that direct proximity to a park increased the sales prices of houses (Weicher and Zerbst, 1973). If a house was adjacent to, and faced the park, it sold for $3,431 ($1967) more than a similar house not adjacent to a park. This represented roughly 23% of the typical house value in their sample. However, they also found that houses backing onto a park sold for prices similar to all houses in the sample, suggesting the park effect was very localized.

A hedonic study of two towns in England (Cheshire and Sheppard, 1995) found that publicly accessible open space within one kilometer of a property significantly increased the sales price. Each percentage point increase in open space increased the typical housing price by 1.5%. What is most interesting about their study is that the magnitude of this impact was greater in the town where such open space was relatively scarce (1.9%) than in the town where such space was abundant (1.1%). As economists would suggest, increased scarcity raises the price of access to open space.

A hedonic study of Portland, OR, open spaces (Bolitzer and Netusil, 2000), which include public parks, natural areas, and golf courses shows that these amenities have large and statistically significant effects of property sales prices. For example, a property (and associated structural improvements) sold for $2105 ($1990) more if located within 1500 feet of any type of open space than properties further from those amenities. This added value represented slightly more than 3% of the average sales prices in the sample. Also, each additional acre of open space increased the sales price of these nearby properties by $30 ($1990). So a property within 1500 feet of a 30 acre park would sell for $3005 more than a similar property located beyond 1500 feet of the park. The study also found that proximity to a golf course increased the sales price by more ($3400) than proximity to a public park ($2262), but that proximity to private parks did not positively impact prices. A further refinement of the distance measure divided distances from open spaces into distance intervals. The positive impacts of open spaces diminished with distance from the open space as follows:

Distance from Open Space	Positive Impact on Sale Price ($1990)
0-100 feet	$3523
101-400 feet	$2755
401-700	$1983
701-1000 feet	$1522
1001 – 1300 feet	$1455
1301 – 1500 feet	$1004
Source: Bolitzer and Netusil, 2000	

Another study of Portland, OR, housing markets tested a larger range of amenities and disamenities (Wu, et al., 2004). This study finds that sales prices are significantly higher for residences that have more parks or public open spaces within their zipcode areas, are closer to a park,, river or wetlands, and are situated at higher elevations with broader views. In addition, sale prices are higher when development densities are lower. The study finds that developers build at lower densities in locations where there is more park or open space and where elevations are higher, so an indirect effect of open space and elevated views is that housing densities are lower and lots command a higher price for that reason also; i.e., there are both direct and indirect effects of these landscape amenities on prices.

Wu et al. (2004) summarize these amenity effects on the price of a typical house in their sample as follows:

Amenity	Increase in House Price Per Square Foot ($1994)	Increase in Typical 1500 Sq Ft House Price ($1994)
Increase percent of zipcode land area in parks or open space by 5%	$0.73/ft^2$	$1095
Reduce distance to nearest park by 1000 ft	$0.24/ft^2$	$360
Increase elevation by 100 ft	$2.39/ft^2$	$3585
Reduce distance to nearest river by 1000 ft	$0.42/ft^2$	$630
Reduce distance to nearest lake by 1000 ft	$0.18/ft^2$	$270
Reduce distance to nearest wetlands by 1000 ft	$0.71/ft^2$	$1065
Source: Wu, et al., 2004		

For example, increasing the percentage of area in a zipcode that is in parks or open space by 5 percent increases the square foot price of a house by $0.73, and the full price of a typical 1500 sq ft house by $1095. The largest amenity effect is the increase in lot elevation, suggesting more extensive views; increasing lot elevation by 100 feet increase the typical house price by $3585.

A study of Baltimore-Washington, DC, residential sale prices by Irwin (2002) has sought to disentangle the various dimensions of open space that may contribute value to properties. This study distinguishes between whether lands surrounding a property are preserved or have development potential, whether they are publicly or privately owned, and between different types of land use. The study finds that forests on private land have a greater value to properties than either pastureland or cropland when using a broad 400 meter region. It finds that both private lands with conservation easements and public lands add to the value of properties. However, when a narrower region of 100 meters is used, the study finds that increases in forested lands actually reduce property values. So the scale at which private forested lands are considered has a substantial impact on whether they are viewed favorably; at a small local scale, private forests have a negative value, while at a larger scale they have positive value. It may be that at local scales the potential developability of private forest lands is viewed as a threat, but not at larger scales. The study finds that conversion of one acre of pastureland to private conservation land within the 100 meter region surrounding a residential property increases the typical property sales price by $3307 ($1997), or 1.9%. Conversion of an acre of pastureland to public land increases property values by $994 ($1997), or 0.6%. Conversion of an acre of pastureland to low density residential or to commercial/industrial reduces the value of a property by $1530 ($1997), or 0.9%, and $4450 ($1997), or 2.6%, respectively. While converting an acre of pastureland to private forest within the 100 meter region surrounding a property decreased sales prices by $1424 ($1997), or 0.8%, the same conversion within a 400 meter region increased sales prices by $280. This small forest value at even a larger regional scale may be due to the fact that these private forested lands are potentially developable, so people would be unlikely to pay much of a premium for likely fleeting forests.

Urban forested areas may include amenities such as aesthetic, ecological, human physical and psychological health (pollution and noise control), and recreational opportunities. Proximity to such a landscape amenity should command a higher property value. This has been shown to be the case in several studies. Tyrvainen (2000) has shown that a one kilometer increase in distance from the nearest forested urban area reduced property prices by 5.9%, other characteristics of the property being the same. In addition, the same study showed that the market commanded a 4.9% premium for properties with a view of the forest. This suggests that maintaining natural viewsheds has substantial economic value. While the tastes and preferences for these amenities among Finish people may differ from those of Pittsburghers, this study suggests the order of magnitude of this amenity effect.

Geoghegan (2002) has tested whether "developable" and "permanent" open spaces near residences in the Baltimore-Washington, DC, area have positive impacts on sales prices. She hypothesizes that permanent open spaces (including parks and lands with conservation easements) will have a more substantial effect of prices that developable open spaces (cropland, pasture, and forests). She finds that the percentage of lands within 1600 m that are open spaces has a positive and significant effect on residential sales prices. Furthermore, land in permanent open space has a considerably greater effect on prices than developable open space, as she expected. For example, a 10% increase in the percentage of land in permanent open space would increase sales prices of the average home in the sample from $241,000 to $247,285, or roughly $6300 ($1996). A similar increase in developable open space increases sales prices by only $1700 ($1996).

In a study that used both hedonic and contingent valuation methods, Earnhart (2001) found that the value of homeowners in Fairfield, CT, of having a forested area near their homes was $10,967 ($1996), or 4.5% of the value of a typical home in his sample. He also found that having an open field was valued at $2,208 ($1996), or 0.9% of a typical home value, by local residents.

Thorsnes (2002) has studied the effects of forest preserves on residential housing prices in Grand Rapids, MI. He found that lots backing onto a permanent forest preserve sold for $5800 to $8400 ($2000) more than other lots in the subdivisions considered. These premia represented 19 to 35 percent of the lot prices, respectively. Interestingly, lots immediately across the street from lots backing on the preserves did not command a market premium, suggesting that the forest proximity effect was very localized.

A study of the effects of green spaces on residential property values in Los Angeles shows that a roughly 10% increase in the amount of green spaces within 500 feet of a house results in a 1.5% increase in expected sales prices (Pincetl, et al., 2003). This is an additional $3,400 per property. The study also notes that creation or purchases of green spaces by urban governments are self-financing, as the increase in property values and resulting annual tax revenues would be sufficient to pay off purchases over fifteen years.

In a study of green spaces in Baltimore City and County, MD, Yu and Farber are assembling data reflecting the relationship between proximity to green spaces (parks, forested areas, golf courses, etc.) and residential property sales prices. This study is in its preliminary stages, but initial results, illustrated below, suggest the same types of relationships found in prior studies summarized above:

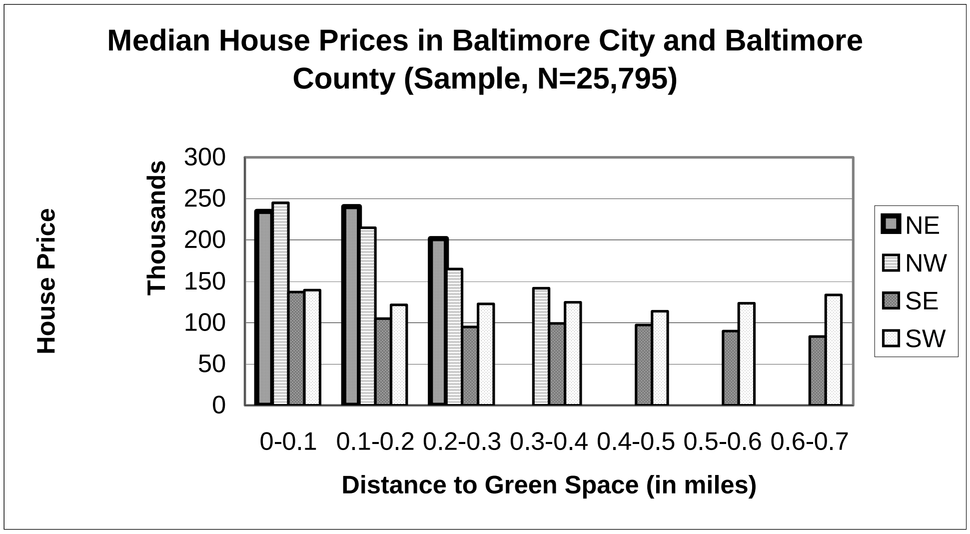


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Figure 1
Housing Prices and Proximity to Green Spaces, Baltimore, MD

This graph illustrates that sale prices generally decline with distances to the nearest green spaces (NE, NW, etc. represent regions of the city/county geographic area). For example, a property adjacent to a green space in the NW section of the region would sell for roughly $250,000 ($1998); but a property located in the same region but 0.2-0.3 miles from a green space would sell for $160,000 ($1998). At this preliminary stage of the research, this is not a hedonic study as housing structures and neighborhoods are not identical.

VI.2 Contingent Valuation Studies

A difficulty with hedonic studies is that they capture only what buyers are willing to pay for amenities that they would enjoy. The values to non-buyers of potential spillover effects of open space, such as views, flood and biodiversity protection, and other "public" types of amenities are not reflected in studies based on property values. One useful method to estimate these broader, more public values, is contingent valuation. In essence, it involves direct questioning of the public about what they might be willing to pay, or what they might require in compensation for saving or remediating open spaces.

A useful study by Breffle, et al. (1998) of the willingness to pay to preserve a 5.5 acre parcel of undeveloped land in Boulder, CO, used this contingent valuation technique. They surveyed households within one mile of the property, which was being considered for development. They estimated that the typical household would be willing to pay $294 ($1991) to preserve the property as open space. This estimate ranged from $1197 for households within 0.1 miles of the property to $47 for households living between 0.9 and 1.0 miles of the property. They propose that the $47 willingness to pay reflects the broad public values that are in addition to what people might pay to live close to the open space land. They also estimated that preserving this 5.5 acre parcel was worth $774,000 ($1991) to households within this one mile neighborhood of the site; i.e., roughly $141,000 per acre.

A survey conducted for the National Association of Realtors (2001) revealed that 50% of the respondents would be willing to pay 10% more for a house located near a park or protected open space. Nearly 60% stated that if they were in the market for a new home, they would be likely to select one neighborhood over another if it was close to parks and open space.

VI.3 Urban Wetlands

Wetlands in urban areas can play important economic and ecosystem roles. Their ecological functionality to moderate and treat water runoff, from rainfall or groundwater, is important to maintaining downstream water quality and regulate runoff volumes. Their functionality as habitat enhances biodiversity and resulting recreational and aesthetic activities. The health and integrity of wetlands depends upon the ecological condition of the watershed, including the extent, location and character of hillside vegetation.

Given the important ecological and economic roles of wetlands, it is not surprising that proximity to urban wetlands commands a property price premium. Mahan, et al. (2000) have investigated the magnitude of this wetlands premium in a study of Portland, OR. Their hedonic study concludes that increasing the size of the nearest wetland increases the residence sales price by $24 ($1995), or 0.02% of the average house sales price. Reducing the distance to the nearest wetland by 1000 feet increases the sales price by $436 ($1995), or 0.4% of the house price. The type of wetland (open water, emergent vegetation, scrub-shrub or forested) did not matter. The study also found that living 1000 feet closer to a stream increased sales prices by $259 ($1994) which suggests that wetlands are more desirable to live near than streams.

VI.4 Landscape Water Quality

The quality of water in one's landscape can be valued not only for health and safety associated with contact, but also for aesthetics, and for the psychological comfort that nature is working well and our lands and their waters are not polluted. The quality of local streams, rivers, and lakes depend upon the biogeophysical conditions of associated watersheds. Development of vegetated and forested hillsides contributes to degradation of water quality through sediment, nutrient and toxic runoff. For example, a recent study of land cover in the Pittsburgh region illustrates that increased tree cover in a township's landscape increases the percentage of streams in that township that meet PA Clean Streams standards (Farber and Argueta, 2000). This relationship is illustrated below:

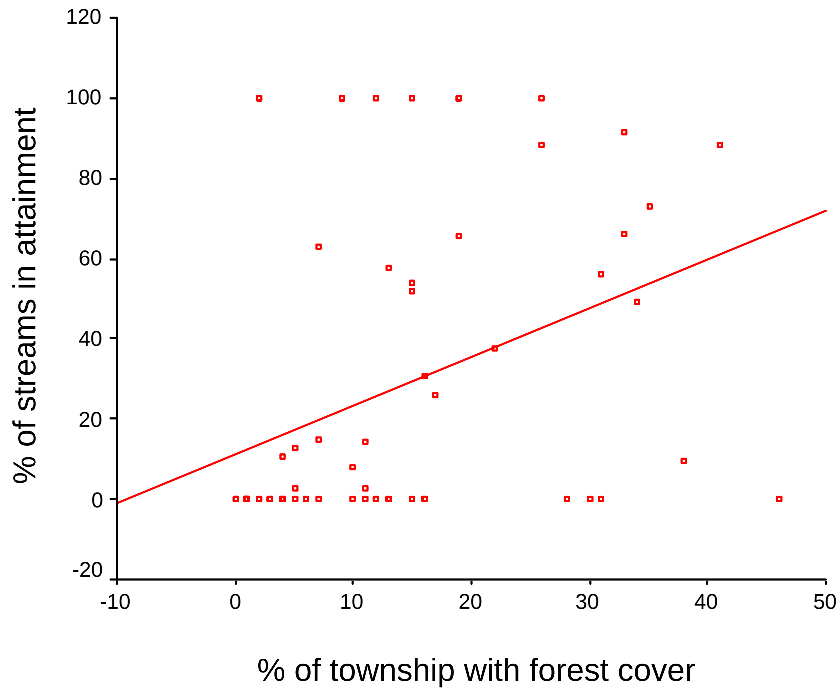
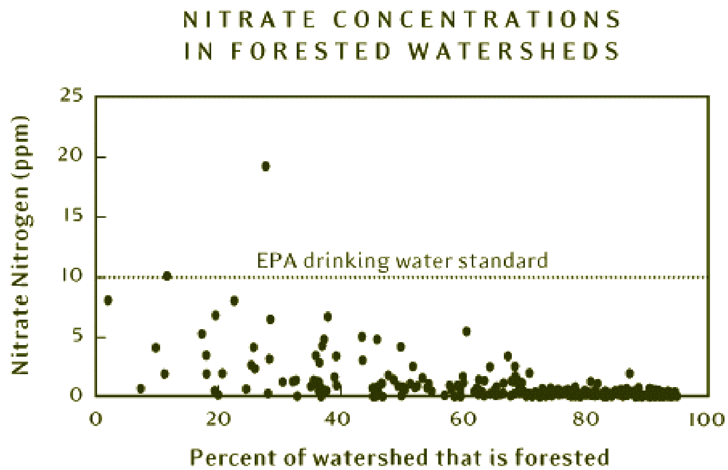


Figure 2
Relationship Between Forest Cover and Stream Water
Quality Attainment Across Allegheny County Townships

A further refinement of this study focused on land use in 600 ft buffers of streams. Streams were four times more likely to be out of attainment when buffers were dominated by residential uses than when they were dominated for forests. The study also found that when population densities were high, stream quality was low.

A study of nitrate concentrations and the percentage of a watershed that is forested showed a clear positive impact of forest land cover on nitrates in streams (USGS, . This relationship is shown below:



Source: USGS National Water Quality Assessment

Figure 3
Stream Nitrate Concentrations and Forestation of Watersheds

These studies clearly indicate the positive ecological impact that forest land cover has on water quality in watersheds.

Several studies have focused on the economic valuation of water quality as reflected in property values. Valuing water quality implicitly places value on maintaining an ecologically healthy watershed. A study by Poor, et al. (2001) has used hedonic pricing to determine the value of improvements in lake water quality in several towns in Maine. For Augusta and Lewiston, the study shows that housing prices are between $2,756 ($1993) and $8,985, or 3-9% of the typical house price, higher when the nearest lakes' water clarity is improved by one meter; i.e., one can see objects one meter deeper in the lake.

Leggett and Bockstael (2000) use the hedonic method to investigate the water quality impacts of Chesapeake Bay on surrounding property values. They find that a doubling of fecal coliform counts (from 103 per 100mL to 203 per 100mL) reduced property sales prices by $5,114 to $9,824 (1995), or 1.4%-2.6% of the typical property sales price. They also estimated that improving counts to the state standard for roughly 500 waterfront properties in Anne Arundel County would be worth roughly $12 million to these property owners. Of course, this does not include the benefits to non-waterfront property owners, such as recreationists and commercial fishermen. This study illustrates the substantial benefits from maintaining water quality.

VI.5 Ecological Economics: Landscape Preservation and Economic Development

A typical model of economic development in which landscape amenities are part of the development portfolio is that improving landscape amenities will increase the desirability of a region, resulting in increased housing prices, reduced wages as people are more willing to live there, increases in employment, and increases in both residential and commercial development as people move in and enhance the labor force and demands for commercial activities (Riddel, 2001). Riddle (2001) focuses on the effects of an open space purchase program in the Boulder, CO, area. She looks at the development dynamics over time of such a municipal bond funded program initiated in Boulder in the mid-1980's. Her empirical estimates suggest that over a six year period the 15,000 acre open space purchase program would increase employment by 1650 persons, average wages would fall slightly, 150 new residential units would be built, and average housing prices would increase by $10,125, or 3.75% of the average price. These are effects of the open space program that are intermingled with the broader effects of extensive economic development in the Boulder area.

Other ecological-economic relationships are suggested by the studies cited above. For example, attempts to limit population densities in some critical ecosystems can have positive ecological effects, such as reduced stormwater runoff from impervious, developed surfaces, and improved water quality from reductions in nutrient runoff. The positive ecological effects, in turn, have positive economic implications. In addition to reducing flooding costs and creating more valuable, higher quality waters, such improvements can positively effect economic development as the desirability of living in such an area is enhanced. In this sense, ecological development is also economic development.

VI.6 Summary of Economic Value of Urban Environmental Amenities

Research on the economic value of urban environmental amenities, such as open spaces, has primarily focused on the impacts of these landscape features on residential property values. Property value effects are one important consideration when valuing these amenities. However, property values capture only a portion of the broad ecological and economic values of landscape-based amenities. Property markets reflect only what people are willing to pay for private land and the associated amenities they can obtain privately or enjoy more extensively only through the purchase of that land; i.e., what we may consider as "private" benefits. There is a wide range of benefits associated with open space landscapes that may be enjoyed without having to purchase the property; i.e., what we would term "public" benefits. While the forested landscape view from a purchased property may be superior to viewing an extensively developed landscape, one does not need to purchase the property to obtain, at least, some portion of the visual benefits. While a property located near a park or accessible undeveloped landscape feature may command a higher price because of proximity, others may also enjoy that feature although their access may not be as easy.

There is an entire set of benefits from landscape features that may largely accrue to the public, and any premium paid for a property by an individual would reflect, at best, only a small portion of that public value; for example, protection of biodiversity, protection of downstream areas from flooding, protection of streams from nutrient runoff, local climate moderation are public benefits of forested landscapes. But when a person considers purchasing and developing a property in that landscape setting, they are unlikely to be willing to pay for those broad public values as they do not have to be proximate to the feature to enjoy them. The point is that property value studies of premiums people are willing to pay for the existence of, or proximity to, certain landscape features will capture only a portion of the broad public benefits of these features.

With the caveat of the prior paragraph in mind, there have been a considerable number of studies demonstrating that open space (parks, forests, greenways, golf courses, etc.) commands a residential property price premium. Residential properties that are closer to these features command higher sales prices. Properties for which there are more open space areas in their vicinity command higher sales prices. There is evidence that open spaces that are less likely to be developed in the future (publicly owned, private conservation easements) generate a higher price premium for nearby residential properties than open spaces whose future development is more probable (private forested lands, crop and pasture land).

While a variety of techniques could be used to assess the broad public values of land uses, contingent valuation, or simply asking the public what they might be willing to pay to preserve or restore some ecological feature, can be useful in determining landscape values beyond those for which a person would pay by purchasing property. One such study estimated that these public values can be very large. The study suggested that the policy implication of this public willingness to pay might be to publicly fund programs that preserve or restore desirable landscape features, such as potentially developable open spaces. Of course, this is what we do when we purchase conservation easements or properties for parks through public or non-profit organizations.

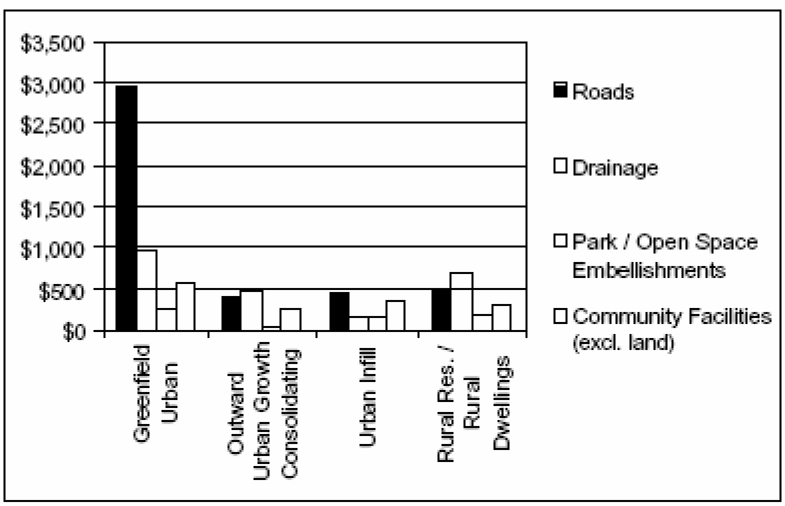
The ecology of a watershed is an interconnection between land cover and streams. Landscape features in one part of the watershed ecosystem can impact other parts. For example, studies noted above have shown relations between forest cover, streamside vegetation and stream quality. Consequently, some of the value of open spaces would be their functional contribution to downstream watershed quality, including wetlands and stream/lake quality. Studies summarized above have shown that both wetlands and water quality have values, some of which are translated into property price premiums for proximity to wetlands or higher water quality. This suggests that managing ecosystems to preserve and enhance their ecological functionalities can also have positive economic implications.

Economic measures of private and public values associated with open spaces have been tested and empirically determined. They have been shown to exist in a variety of geographic and cultural contexts. Insofar as these values are capitalized in to property values, open spaces can contribute substantially to tax bases for communities. An advantage of using open spaces to contribute tax value is that there may be a cost savings over other forms of tax base enhancement as open spaces may not require the extensive infrastructure typical of other forms of development. In fact, open space induced enhancements in local tax bases may be substantial enough to fully fund programs to preserve or restore these open spaces.

At least one study has focused on the relationships between ecological landscape conditions and economic activity. It suggested and tested whether enhanced open space conditions make an area more desirable, increasing property prices as people seek to live there, reducing wages as people want to live there, and increasing local commercial economic activity as people live and buy locally. The study found that these relationships did exist for the studied community. This is another example of how maintaining or enhancing ecological conditions can have positive economic impacts to a community; i.e., an ecological-economic win-win.

VII. Physical Infrastructure Costs

The costs of developing physical infrastructure (roads, drainage, sewers, lighting, water supply, etc.) in hillside environmental have to be substantially higher than in areas with low topographic relief. We were unable to find published studies that illustrated this. However, there have been studies showing that new development is more costly than infill development, as much of the infrastructure is already in place for the latter. An example of such a study is the Urbecon (2003) study of Victoria, AU. Figure 1 shows that road costs in urban greenfields (undeveloped urban sites) are at least six times as high as road costs in urban infill areas. Drainage costs are roughly five times higher for urban greenfields that infill areas. It is reasonable to expect that these physical infrastructure development cost differences would be even greater for urban "hillside greenfields" than urban infill areas.



Source: Urbecon (Dec 2003), published by SGS Economics and Planning, Sidney AU.

Figure 4
Average Physical Infrastructure Development Costs, per Dwelling, by Developing Area in Victoria, AU

VIII. Costs and Revenues of Residential Development

A frequently stated objective of local government officials for developing vacant and open spaces lands is to increase tax bases in order to fund public services. However, there is an extensive literature that compares the public service costs and revenues to local governments from various types of land use. This literature has originated largely from the debates about conversions of open space and agricultural lands to residential development. These cost of community services (COCS) studies have taken annual local public service costs (law enforcement, fire protection, ambulance services, inspections, street maintenance, street lighting, garbage collection, solid waste disposal, health and human services, culture and recreation, education, conservation and debt service) and allocated them to land uses. A similar allocation of local tax and fee revenues is made to land uses. The result is a ratio of expenses to revenues, or revenues to expenses, by land use. An example of this type of study is shown below for Amherst, MA.

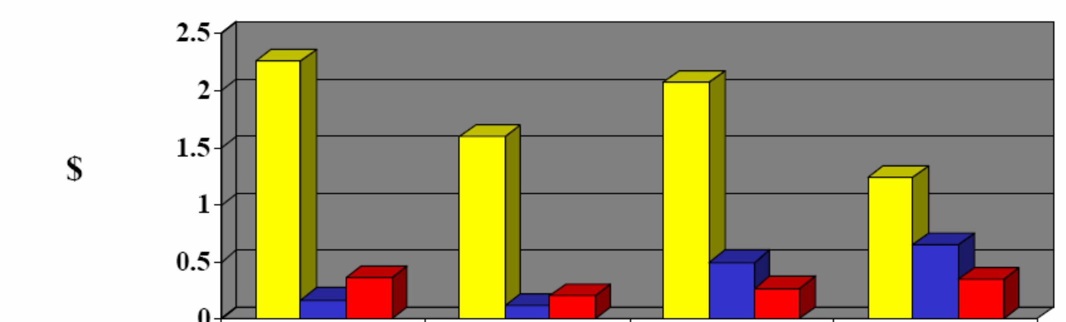
Cost of Community Services Study, Amherst, MA

Land Use Category	Revenues	Expenditures	Revenues Over (Under) Expenditures	Ratio of Revenues to Expenditures
Residential	$ 461,162,106	$ 518,623,795	$ (57,461,689)	**$ 1.00 / $ 1.12**
Commercial	$ 96,512,033	$ 42,624,121	$ 53,887,912	**$ 1.00 / $ 0.44**
Open Land	$ 7,419,403	$ 3,845,626	$ 3,573,777	**$ 1.00 / $ 0.52**
	565,093,542	**$565,093,542**	$ -	

Source: Town of Amherst, Industrial Development Agency, 2000.

The Amherst study shows that for every $1 in revenue collected from residential land use, there was a public service cost of $1.12. Commercial and open land uses raised considerably more revenues than public service costs.

A series of studies of counties in Georgia reveal similar relationships between revenues and costs of community services. These studies are summarized in the figure below:



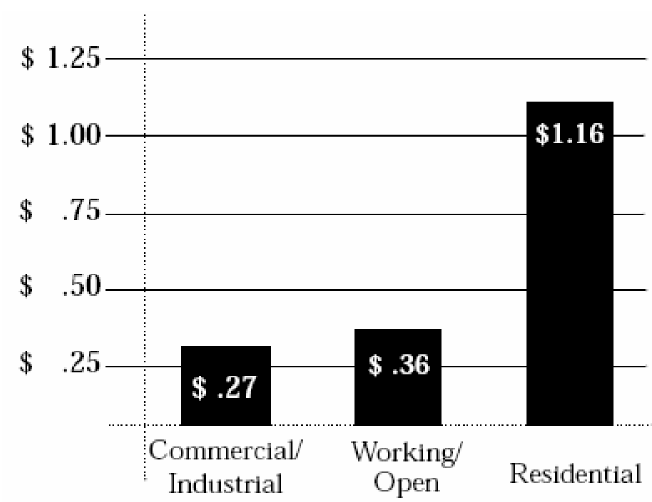
	Appling	Cherokee	Dooly	Jones
Residential	2.26	1.6	2.07	1.24
Comm/Ind	0.17	0.12	0.5	0.65
Farm/Forest	0.36	0.2	0.27	0.35

Source: Dorfman, et al., 2002

Figure 5
Expenditures per $1 in Revenue by Land Use,
Four Counties in Georgia

All counties show expenditures in excess of revenues for residential land use. The largest differential is in rural counties, Appling and Dooly, while the differentials are smaller for Cherokee and Jones, which are rural/suburban counties bordering on Atlanta and Macon.

A summary of 95 studies estimating the costs and revenues of land uses to local governments was compiled by the American Farmland Trust. These studies have been by a variety of researchers, agencies and non-profits in many states. The results of this summary are illustrated below:



Source: American Farmland Trust, 2002.

Figure 6
Summary of 95 Cost of Community Service Studies in the US
Median Ratio of Community Service Costs to Revenues by Land Use Category

The median across all these studies for residential land use shows that for every $1 collected in revenues from this land use, there were community service costs of $1.16 (the median is a statistic in which half the studies exceed $1.16 and half the studies show values less than $1.16). In fact, all 95 studies showed residential land uses having greater costs than revenues. As Dorfman, et al., (2000) note,

> "a growing body of empirical evidence shows that while commercial and industrial development can indeed improve the financial well being of a local government, residential development worsens it."

There were a number of studies done for Pennsylvania, all showing the same general relationships between local public service costs and revenues. These studies are shown below:

SUMMARY OF COST OF COMMUNITY SERVICES STUDIES, REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS

Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
Pennsylvania				
Allegheny Township	1 : 1.06	1 : 0.14	1 : 0.13	Kelsey, 1997
Bedminster Township	1 : 1.12	1 : 0.05	1 : 0.04	Kelsey, 1997
Bethel Township	1 : 1.08	1 : 0.17	1 : 0.06	Kelsey, 1992
Bingham Township	1 : 1.56	1 : 0.16	1 : 0.15	Kelsey, 1994
Buckingham Township	1 : 1.04	1 : 0.15	1 : 0.08	Kelsey, 1996
Carroll Township	1 : 1.03	1 : 0.06	1 : 0.02	Kelsey, 1992
Hopewell Township	1 : 1.27	1 : 0.32	1 : 0.59	The South Central Assembly for Effective Governance, 2002
Maiden Creek Township	1 : 1.28	1 : 0.11	1 : 0.06	Kelsey, 1998
Richmond Township	1 : 1.24	1 : 0.09	1 : 0.04	Kelsey, 1998
Shrewsbury Township	1 : 1.22	1 : 0.15	1 : 0.17	The South Central Assembly for Effective Governance, 2002
Stewardson Township	1 : 2.11	1 : 0.23	1 : 0.31	Kelsey, 1994
Straban Township	1 : 1.10	1 : 0.16	1 : 0.06	Kelsey, 1992
Sweden Township	1 : 1.38	1 : 0.07	1 : 0.08	Kelsey, 1994

Source, American Farmland Trust, 2002.

This table shows that expenditures exceeded revenues by anywhere from 6% (Allegheny Township) to 111% (Stewardson Township).

Some studies have estimated the average house value necessary for a local government to break even on costs and expenditures. For example, the studies of counties in Georgia, shown below, illustrate this break even analysis. For example, In Cherokee County, GA, in order to break even on just the county non-school costs, an average house must be worth $184,200. If we consider only school costs, the average break even value of a house with 2 children must be $644,900 in this county.

Break-even Home Value Estimates for County
and School Budgets: Four Georgia Counties

County	County Break-even	School Break-even With 1 Child	School Break-even With 2 Children	School Break-even With 3 Children
Appling	$192,900	$461,300	$892,600	$1,323,800
Cherokee	$184,200	$331,200	$644,900	$958,600
Dooly	$42,700	$245,400	$480,800	$716,200
Jones	$81,300	$151,000	$281,900	$412,900

Source: Dorfman, et al., 2002.

It should be noted that the typical COCS study considers only average costs and revenues across a jurisdiction. It may be that particular developments, on the margin, could create net revenues or net expenditures to local governments depending upon the values of the properties and additional public service costs. We would expect that hillside developments impose higher public services costs than the average, due to snow removal, and additional difficulties in maintaining streets and sewage facilities. Existing vacant lands where public services infrastructure is in place would likely impose less than average costs of public services.

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An Ecological and Physical Investigation of Pittsburgh Hillsides
LEGAL REPORT to the City of Pittsburgh Hillsides Committee

Land-Use Controls for Hillside Preservation in the City of Pittsburgh

Final Report
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LAND-USE CONTROLS FOR HILLSIDE PRESERVATION IN THE CITY OF PITTSBURGH

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Prepared for Perkins Eastman Architects
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NOTES 15

1. Introduction.

Although it is a Pennsylvania Home Rule Municipality, the City of Pittsburgh (the City) has no home rule power to engage in land-use regulation. The Home Rule Charter and Optional Plans Law specifically limits the power of home rule municipalities to engage in land-use regulation to those granted by the Municipality's Planning Code of 1968 or other enabling legislation.[1] Since the Municipalities Planning Code (MPC) specifically does not apply to cities of the second class[2] (Pittsburgh at the time of adoption of its home rule charter), Pennsylvania courts have recognized that the City's authority to engage in zoning and other land-use regulation must be found in its original enabling legislation and any subsequent statutes applying to second class cities in particular or to municipalities in general and not in the MPC.[3]

The City of Pittsburgh zoning enabling legislation is Act No. 69 of 1927, as amended.[4] Subdivision control enabling legislation is found in sections 9 through 12 of another 1927 Act;[5] authority for the adoption of an official map, in sections 5 through 8 and 14 through 20 to of that same Act.[6] The adoption of any of these land-use controls is discretionary with the City.

Certain state statutes impose mandatory land-use regulation on all municipalities in Pennsylvania. These include the Flood Plain Management Act of 1978 [7] and the Storm Water Management Act of 1978.[8]

2. Pittsburgh's Zoning Authority in General.

The authority to adopt and revise zoning regulations is lodged in the City Council, with advisory or recommendatory authority in the City Planning Commission. Land use control ordinances are an exercise of the police power entrusted to the City under the enabling legislation and the City's Home Rule Charter. These ordinances are presumed valid and any challenger must carry a heavy burden to establish that they are not.[9]

Essentially, there are two bases on which one may challenge the validity of a police power regulation:

1. The regulation fails to respect the due process rights of property owners in that it is not substantially related to the protection of any legitimate public purpose or is arbitrary, capricious, or an abuse of the City's legislative authority;
2. The regulation constitutes a "regulatory taking" of the owner's property without compensating the owner for that "taking."

A. Legitimate Police Power Purposes.

A land use regulation is valid when it promotes legitimate police power purposes — protection of the public health, safety, morals, or general welfare. Its provisions must be substantially related to the purpose it seeks to serve. The Pennsylvania Supreme Court has explained the proper approach to reviewing a land use regulation as follows:

> ". . . Pennsylvania courts use a substantive due process analysis which requires a reviewing court to balance the public interest served by the zoning ordinance against the confiscatory or exclusionary impact of regulation on individual rights. The party challenging the constitutionality of certain zoning provisions must establish that they are arbitrary, unreasonable and unrelated to the public health, safety, morals and general welfare. Where their validity is debatable, the legislature's judgment must control."[10]

The Pennsylvania courts have attempted to maintain a sensitive balance between the need of the public to adopt regulations for public benefit and the right of private property owners to make reasonable use of their property. The presumption in favor of the power to adopt particular regulations is not easily overcome. However, the municipality must act in a manner which does not sacrifice the constitutionally protected rights of its citizens:

> "Property owners have a constitutionally protected right to enjoy their property. That right, however, may be reasonably limited by zoning ordinances that are enacted by municipalities pursuant to their police power, i.e., governmental action taken to protect or preserve the public health, safety, morality, and welfare. Where there is a particular public health, safety, morality, or welfare interest in a community, the municipality may utilize zoning measures that are substantially related to the protection and preservation of such an interest."[11]

Whether a regulation serves a legitimate police power interest involves a balancing of the interest to be served and the rights of the landowner to make reasonable use of its property. "A conclusion that an ordinance is valid necessitates a determination that the public purpose served [by the ordinance] adequately outweighs the landowner's right to do as he sees fit with his property, so as to satisfy the requirements of due process."[12]

A regulation is arbitrary or capricious where it does not substantially advance a legitimate police power objective or treats similar landowners differently with no reasonable basis for that difference. An example of a regulation that is not substantially related to a legitimate police power objective is one whose purpose or result is to exclude lawful uses of land from the entire municipality.[13]

Therefore, zoning regulations must be designed to promote and protect the purposes of zoning as set forth in the City's enabling legislation. These are:

> "Such regulations shall be made in accordance with a comprehensive plan, and designed to lessen congestion in the streets; to secure safety from fire, panic and other dangers; to promote health and the general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks and other public requirements. Such regulations shall be made with reasonable consideration, among other things, to the topography and character of the district, with its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout such city."[14]

These several purposes readily encompass regulations to protect and preserve hillsides or steeply sloped land within the City and hillsides views from locations within the City. For example, hillside regulations can "secure safety from fire, panic and other dangers." Development on hillsides, especially steep slopes with unstable soils, can increase the danger of landslides. Unrestricted development is likely to increase the quantity of stormwater runoff from the developed site, threatening neighboring public and private properties by changing the natural slope of the land, removing existing vegetative cover, and adding impervious surfaces. Removing vegetative cover, particularly trees, can adversely affect air quality as trees serve as filters of fine particulates and reduce the amount of free carbon in the atmosphere.

By protecting those distinctive characteristics that define the Pittsburgh cityscape and city neighborhoods, hillside zoning regulations "promote health and the general welfare." What evidence there is suggests strongly that property values are enhanced by the availability of public and private open spaces.[15] One of the essential purposes of zoning from its earliest days has been the protection of private property values. These regulations can also serve to prevent or minimize erosion that often follows development on steeply sloped land and encourage soil stabilization. The Ecological Report on Pittsburgh's Hillsides developed by The STUDIO for Creative Inquiry has produced tools that permit identification of steeply sloped parcels with unstable soils and other physical conditions that argue for or against development of specific parcels based on the presence or absence of ecological hazards and other characteristics.[16]

Hillsides can be particularly appropriate places to "prevent the overcrowding of land" and "avoid undue concentration of population." Increased density of development requires more intensive use of the land. As density increases, so do the public safety risks created by landslides on unstable soils, unconfined stormwater runoff, with concomitant downhill flooding, earth movement, and erosion. Public health and safety concerns from increased development on steep slopes also include the ability to provide such public services as police, fire, and ambulance service, water and sewer service, snow removal on public streets and steps, street and utility maintenance, refuse collection, and public transportation. Providing adequate public services and infrastructure becomes more difficult as development density increases on steeper slopes. By limiting population on steeply sloped areas of the City to prevent overcrowding of the land, the City can reduce the public and private risks that attend development in those areas.

Existing vegetation, particularly trees, have been shown to contribute to improved air quality in a variety of ways.[17] Regulations addressing the need to maintain or restore trees and other vegetative ground cover on steeply sloped lands will serve the enabling legislation's zoning purpose of "provid[ing] adequate light and air."

Limiting the density of development on steeply sloped areas aids "the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements" in a variety of ways. Some of these have already been described in this Report; others are described in the Farber Report and the Perkins Eastman Report.[18] By limiting the removal of protective ground cover and the creation of impervious surfaces, requiring control of surface water runoff from new development, limiting the location of new streets and other public utilities, and similar requirements, the City's hillside zoning regulations directly address the enabling legislation's goal of "the adequate provision of transportation, water, sewerage, schools, parks and other public requirements." As mentioned, the cost of installing and maintaining public infrastructure – streets, water and sewer lines – on steeply sloped land is believed to be more expensive than similar infrastructure on flatter land, as is the provision of public services – police, fire, ambulance, snow removal, refuse collection, public transportation. These are among the "other public requirements" whose "adequate provision" are proper bases for zoning regulations.

The same section of the enabling legislation specifically requires that zoning regulations "be made with reasonable consideration, among other things, to the topography and character of the district, with its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout such city."[19] The Perkins Eastman PHYSICAL REPORT demonstrates that there is a small number of development patterns or prototypes on steeply sloped land that describe the texture and character of Pittsburgh's hillsides. Along with its river (and the few remaining major stream) valleys, the hillsides themselves are the essential determinant of Pittsburgh's physical and social character. Pittsburgh's hills define many aspects of its essential spatial and cultural character. They serve as the edges or boundaries of neighborhoods and as defining visual elements from many vantage points within the City. Protection and maintenance of those elements furthers legitimate public interests explicitly recognized in the enabling legislation. In other words, "topography and character" of zoning districts in the City are inextricably linked together. The enabling legislation invites regulations that respect these distinct prototype characteristics and are designed to preserve them.

A regulation may be found to be arbitrary where it results in different treatment of similarly situated properties without providing a reasonable basis for that difference in treatment.[20] The very nature of a significant hillside slope suggests the reasons for treating the sloping land here differently from flat land. While it may be difficult to see a difference in the carrying capacity of two neighboring parcels at the extreme edges of sloped and flat land, the City's determination of specific boundaries where made in good faith and not obviously discriminatory or otherwise unreasonable will be upheld.[21] Our courts do not require mathematical precision in the location of zoning district boundaries; what is required is a reasonable, good faith effort to determine where one district should end and another begin.

B. Regulatory Takings.

Even where a zoning or other police power regulation satisfies the basic requirements of substantive due process (considerations of essential fairness), it may be held unenforceable as a "regulatory taking" in certain rare instances. Although developers and landowners often challenge regulations on their face as "regulatory takings," these facial challenges are almost always unsuccessful. They are unsuccessful because the facts before the court do not demonstrate the impact of the regulation on a specific parcel of land. Without this information, the presumption of validity that attaches to police power regulations swings the scales of judgment in favor of the government.

Successful "regulatory takings" challenges, relatively rare as they are, are those that demonstrate how the regulations, when applied to a specific parcel of land, are so restrictive as to leave the owner with no reasonable economic use of its land. Here the court is able to weigh the impact of the regulation on a specific parcel of land. Sometimes, this impact will be so severe as to overcome the presumption of validity and swing the balance in favor of the property owner.

The Pennsylvania "regulatory taking" analysis parallels that of the United States Supreme Court, so that the Pennsylvania and federal tests are essentially the same.[22] The regulation is judged by standards of substantive due process or essential fairness. A regulation works a "taking" only if it does not bear a substantial relationship to the legitimate police power purposes or it deprives the property owner of all reasonable economic uses of its property. The regulation is presumed valid. The property owner bears the heavy burden of proving that it is not. As the Commonwealth Court has observed: "An ordinance which promotes the public health, safety, morals, or general welfare of the community and is substantially related to the purpose which it purports to serve substantially advances a legitimate state interest"[23]

Even though the regulation meets the first prong of this test, it still may be a "taking" as applied to the owner's property if the owner is not left with some reasonable economic use of its property.

There can be several steps to a "regulatory takings" analysis in Pennsylvania, once the regulation has been found to bear a substantial relationship to a legitimate police power objective. First, the court must examine the regulation's effect on the value of the property as regulated. If that effect prevents the owner from making any economic use of the land, the regulation works a "taking" as a matter of law, provided the owner could have made the prohibited use of its property without the regulation. This type of challenge often is called a "*Lucas* challenge" after the United States Supreme Court decision in which it was applied.[24] Successful *Lucas* challenges are extremely rare, since most land use regulations limit what an owner may do with its property, but leave the owner with some available economic use. Where a hillside protection zone limits the density of development or the removal of vegetation in order to protect against landsides or uncontrolled surface water runoff or to preserve the character of the hillside, a *Lucas* challenge should not pose a significant threat to the regulation as long as the owner is still able to make some use of the property.

At the extreme, even if the owner is left with no developmental use, the regulation may survive a *Lucas* challenge if the owner's development plans would have created a public nuisance, as by exacerbating the risk of landslides or uncontrolled surface water runoff damaging neighboring land or public facilities. The *Lucas* decision, itself, recognized that a landowner does not have a constitutional right to use its land in a way that creates a public nuisance.[25]

Once it has been determined that the regulation does not deny the owner all economic use of its property, the court will look to see if the regulation unfairly deprives the owner of economic value by applying what the Pennsylvania courts term "traditional takings analysis."[26] Here, three factors, also often called the "*Penn Central* factors,"[27] are evaluated to determine whether the regulation amounts to a "regulatory taking."

First, the court examines the character of the regulation to determine if it is "invasive" or "regulatory" in nature. An "invasive" regulation is one that requires the owner to admit others to its land without that owner's voluntary consent. A property owner's right to exclude is one of the most fundamental rights of ownership. A regulation that prevents the owner from excluding others is unconstitutional as a matter of law.[28] The economic impact of this regulation on the owner is irrelevant, it is the denial of the right to exclude that works a taking.

If the regulation is not "invasive," the court next turns to the economic impact of the regulation on the owner's property rights. Most land use regulations affect the value of land and many reduce the value from what it might be without the regulation. This reduction in value, by itself, is not a "taking." A property owner is not entitled to make the highest and best use of its land; it is entitled to make an economically reasonable use of its land.[29] If the regulation does not allow the owner some reasonable economic use, measured by the owner's "reasonable investment backed expectations," it will be regarded as a "taking."

It is important to note that, where the regulation amounts to a "regulatory taking" of an owner's property in Pennsylvania, that owner is give a choice of remedies. The owner may seek compensation for the value of the property that has been "taken" under the Pennsylvania Eminent Domain Code. Alternatively, it may ask the court to hold that the regulation, as applied to the owner's property, is invalid. If the regulation is found to be invalid as applied, the owner may proceed to develop its property without regard to the restrictions of that regulation. A judicial determination that the regulation is invalid as applied to one owner's property is not conclusive of its validity as applied to another owner's property or other property of the same owner. Each decision must stand on its own unique facts.

C. Conclusions.

A zoning regulation that is intended to preserve the character of the City by protecting its steep hillsides from the dangers of over-development or to preserve the City's character should be found to serve a legitimate police power purpose, particularly when reference is had to the purposes of zoning as set forth in the City's enabling legislation. As long as the owner of the zoned parcel is allowed some reasonable use of its property, the regulation should also satisfy the "regulatory takings" test.

3. Jurisprudence — The Courts and Hillside Protection.

A. In Pennsylvania.

Although the Pennsylvania courts have not been asked to review many zoning ordinances or other police power regulations intended to protect the integrity of hillsides or steep slopes, the Commonwealth Court has upheld two approaches to hillside protection, one in the form of a zoning ordinance and the other as a separate ordinance regulating the commercial removal of trees from steep hillsides. Both techniques survived "regulatory takings" challenges.

In *Jones v. Zoning Hearing Board of the Town of McCandless*,[30] the Town amended its zoning ordinance to create a new D-Development District that, among other things, established standards for the preservation of steep slopes, forests and woodlands, and streams in the District. Under the ordinance, increasingly smaller lot areas could be developed or stripped of vegetation as the lot 's slope increased from 12 to 15%, from 15 to 25%, and above 25%.[31] The ordinance also limited the area of woodlands that could be cleared and developed, requiring the remaining area to maintained as permanent open space. The required amount of open space varied depending on whether the lot contained "young woodlands," "woodlands," and "mature woodlands."[32]

Jones, a landowner in the D District, challenged the validity of the ordinance under the MPC. The trial court upheld the ordinance. On further appeal to the Commonwealth Court, Jones also challenged the ordinance as a "regulatory taking."

Following the Pennsylvania analysis already described, the court first looked to see if the ordinance substantially advanced legitimate state interests or was unreasonable, arbitrary, or capricious. The landowner bore the burden of rebutting the presumption of constitutional validity that attaches to zoning ordinance. He asserted that the definitions and related restrictions governing steep slopes and woodlands were arbitrary and unreasonable because they lacked any scientific or engineering basis. The rezoning resulted from an architectural firm's study of the area. The firm's recommendations formed the basis of the new zoning district regulations. Although the court's opinion does not indicate the scientific or engineering basis for the particular restrictions adopted, it concludes this part of its analysis by saying: "Upon review of the record and the regulations attacked, we conclude that the challenged portions of the Ordinance are not arbitrary or unreasonable, but rather substantially related to the purpose which they purport to serve."[33]

The court then proceeded to the second step of the "regulatory takings" analysis, the economic impact of the regulation on Jones' land. Jones asserted that the ordinance worked a "taking" of his property because it did not permit him to build on 70% of his land. However, he conceded that he could still develop the remaining 30% for 89 residential units or 150,000 square feet of commercial space. The Town's expert witness testified that even more intensive development for either of these uses was possible. Without further discussion, the court upheld the ordinance, saying only: "It is clear from the evidence presented that Landowner has not been deprived of the viable use of his property." Like so many unsuccessful "regulatory takings" challenges, Mr. Jones was unsuccessful because he could not show that the regulations at issue deprived him of the reasonable economic use of his land.

The second case, *Taylor v. Harmony Township Board of Commissioners*,[34] involved an ordinance (not a zoning ordinance) prohibiting timber harvesting "in areas determined by the [Township] Engineer, with reference to published or commonly accepted guidelines, to be landslide-prone or flood-prone."[35] Taylor was refused a permit to log his land after the Township Engineer had determined that the area in question was "landslide-prone." Taylor then requested a variance, as provided for in the ordinance, and was again denied, following a hearing before the Township Board of Commissioners. The Commissioners found, based on geologic reports and other evidence submitted at the hearing, that the area was prone to slide and that timber harvesting would increase the risk of landslides.

Taylor's first challenged the power of the Township to regulate timbering, asserting (1) that the Township's enabling legislation did not provide this power and (2) the MPC prohibited unreasonable restrictions on timber harvesting. The court found numerous provisions in the enabling legislation authorizing the adoption of ordinances to protect public safety and welfare. The court rejected this attack, explaining:

> "Although police powers are not without limitation, Pennsylvania courts have recognized that municipalities have the power to enact legislation aimed at protecting the health, safety, and welfare of citizens under the general welfare clauses contained in municipal codes."
>
> "Turning now to [the ordinance], it is clear that the Township enacted that ordinance to prevent harm to the public welfare caused by landslides and stormwater runoff. Keeping in mind that [the ordinance] enjoys presumptive validity, and judging by the plain language and necessary effect of [the ordinance], [the ordinance] is a valid exercise of the Township's power because it seeks to minimize floods, landslides, and dangerous stormwater runoff; it seeks to prevent damage to roads, damage to drains, damage to public utilities, damage to watercourses, fire hazards, and reduction in property value; and it seeks to enhance the natural beauty and environment within the Harmony Township. All these aims fall squarely within the general police power provisions of the Code cited above."[36]

Because the ordinance lacked any of the "exclusive hallmarks of zoning," it was not limited by the provisions of the MPC. "[W]e we conclude that [the ordinance] is not a zoning ordinance, does not deal with subdivision of Taylor's land, and does not deal with residential development; instead, the scope of Ordinance 335 is to regulate logging and timber harvesting that may jeopardize the integrity of the land in flood-prone or landslide-prone areas."

Finally, Taylor asserted that the ordinance was invalid as a "regulatory taking" because it denied him the economically viable use of his land. The court noted that it had already decided the first step of this challenge when it found the ordinance substantially advanced legitimate state interests. Since Taylor provided no evidence as to the economic impact of the ordinance on his land if timber harvesting is not allowed, there was insufficient evidence to overcome the presumption of validity.

A similar ordinance withstood validity or "regulatory takings" challenge in the Allegheny County Court of Common Pleas.[37] Like the Harmony Township ordinance, Shaler Township's Logging Ordinance prohibits logging on slopes of 25% or greater; it further regulates logging where permitted by requiring mulching and reforesting. The plaintiff charged that the ordinance was so unreasonable as applied to the land in question as to be invalid. The court, affirming the Zoning Hearing Board's denial of a variance, found that the plaintiff had not proven that the regulations rendered the land valueless. In other words, the plaintiff, like the *Jones* and *Harmony* plaintiffs, failed to meet the burden of proof necessary to establish a "regulatory taking."

In the *Jones* case, the Commonwealth Court demonstrated its unwillingness to engage in any lengthy review of the adequacy of scientific and engineering standards for steep slope and woodland preservation where the ordinance was based on studies and expert advice and the landowner did not demonstrate the unreasonableness of the regulations. It was sufficient that the municipality had carefully considered the regulations and the public purposes they served. In *Taylor*, the court recognized the validity of limiting timber harvesting, and presumably the removal of other vegetation that contributes to slope stabilization, where removal would increase public hazards. The existence of evidence of the hazardous nature of the specific land played a more important role in upholding the denial of the permit because the ordinance was designed to protect against a specific peril ─ landslides. It became important to know if the land in question was susceptible to that peril.

B. Elsewhere.

Hillside or slope protection zoning is a relatively new zoning objective. There is almost no significant discussion in the legal literature. Hillside protection zoning ordinances have generally been upheld in the relatively few jurisdictions where they have been challenged on substantive due process grounds. A California intermediate appellate court upheld a zoning provision prohibiting development on slopes greater than 20% and within 500 feet of a major ridge.[38] Colorado has upheld an ordinance limiting development on certain slope areas where there were significant erosion and drainage problems.[39] Idaho has approved the application of zoning code and building code requirements to development on slopes of 15%.[40] Ohio has upheld the application of Cincinnati's Environmental Quality-Hillside District overlay zoning technique against charges of vagueness and a challenge to the City's authority to adopt overlay zones.[41] Finally, Oregon has upheld implementation of a hillside development zoning ordinance against facial, procedural, and vagueness challenges.[42]

At least one hillside preservation zoning regulation has been invalidated as a "regulatory taking." In *Corrigan v. City of Scottsdale*,[43] the City attempted to protect hillside or mountain land by creating a Hillside District, consisting of two parts, the Conservation Area and the Development Area. No buildings, structures, or impermeable surfaces were permitted in the Conservation Area, but "density credits," or transferable development rights, were allocated to lands in that Area which could be transferred to permit development in Development Area. Corrigan brought a "regulatory takings" challenge to the ordinance as it applied to lands she owned in the Conservation Area. Each court that reviewed the ordinance found that it substantially advanced a legitimate police power interest in protecting open space and, to that extent, was a valid regulation. The Arizona Supreme Court, however, also found that ordinance worked a "taking" of Corrigan's land because it denied her any economic use of that land. The availability of the development credits did not constitute just compensation for that taking under the Arizona Constitution, which requires compensation be made by the payment of money. As a result, the landowner was entitled to monetary compensation for this "taking."

One lesson of *Corrigan* is that the municipality must not get too greedy in its efforts to restrict private property for public benefit. The property owner must be left with some reasonable economic use of its land if the regulation is to survive a "regulatory takings" challenge.[44] The existence of administrative relief from the strictures of the regulation by way of a variance, as in the case of zoning ordinances, can greatly reduce the risk of a successful "regulatory takings" challenge. The agency empowered to grant the variance can conduct the intensely factual inquiry required in "regulatory takings" cases and tailor relief that both protects the essential objectives of the regulation and the landowner's right to make reasonable use of its property.

4. Aesthetics and Zoning in Pennsylvania.

It is exceedingly tempting to bottom many hillside preservation measures solely on aesthetic values. Heavily forested hillsides do appeal to most observers. Courts in many jurisdictions regard aesthetic considerations alone as a legitimate basis for police power measures.[45] Even in those jurisdictions, of course, a restriction which totally destroys all value of land to secure an aesthetic benefit to the community will be invalid.

Pennsylvania planners and lawyers, however, must be more cautious. The Pennsylvania courts have not looked with favor on regulations designed primarily to serve aesthetic values. Police power regulations must be "reasonable." What is "reasonable" requires some degree of non-subjective verification in Pennsylvania jurisprudence. Our courts tend to view purely aesthetic judgments as subjective, personal judgments of the decision-maker, judgments whose reasonableness can not be tested by objective standards. Although language in some earlier zoning cases may suggest that aesthetic values alone can support zoning regulations,[46] more recent cases strongly state otherwise. As the Commonwealth Court recently observed, "We have stated many times that a 'municipality may include aesthetic factors in the exercise of its zoning powers, but aesthetics alone cannot justify zoning decisions.'"[47]

This is not to say that aesthetic considerations may not play an important role in zoning and other land-use regulations. The Commonwealth Court has also stated: "Our cases also make clear that a municipality may include consideration of aesthetic factors in the exercise of its zoning powers. We note, however, that our Supreme Court has held that aesthetics alone cannot justify zoning decisions. Our decisional line, consequently, links aesthetic factors with considerations of property value."[48] Pennsylvania courts do recognize that property values are affected by the aesthetic qualities of the neighborhood.[49] Regulations that link aesthetic values to private property value are sustainable.

Thus, where aesthetic considerations support other legitimate police power objectives — "provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks and other public requirements" — or show "reasonable consideration, among other things, to the topography and character of the district, with its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout such city" — they should be upheld. These aesthetic requirements are now not simply subjective judgments of one person or a small group of people, they are an important part of preserving those aspects of the City's character that its enabling legislation directs it to protect.

5. Intergovernmental Zoning Conflicts.

Pennsylvania's courts have long held that land-use activities by some other governmental agencies are subject to land-use control authority of a municipality, while others are not. Examples of the latter include direct activities of the federal government[50] and of the Commonwealth itself. Problems can arise, however, where agencies of the Commonwealth seek to use land within the City for purposes not permitted in the particular zoning district.

A closely divided Pennsylvania Supreme Court initially set forth a general test to be applied in resolving inter-governmental disputes of this nature.[51] Where the dispute is between two agencies of the Commonwealth, e.g., the City and another government agency, the conflict is to be resolved by determining the legislature's intent as to which agency should prevail. Generally, the City's land-use regulations control unless the General Assembly has exempted the other agency from local control by granting it the power of eminent domain in locating its facilities or by clear statutory language showing the legislative intent to exempt it.

Subsequently, the court modified this principal significantly.[52] The grant of eminent domain to another agency is no longer evidence of a legislative intent to allow that other agency to acquire and develop land for its governmental purposes without regard to local land-use regulation. Traditional principles of statutory interpretation apply to determine the legislature's intent where that intent is not expressed in either body's governing statutes.[53] As a result, state and local agencies are subject to a municipality's land-use controls unless (1) the legislature specifically provided otherwise or (2) subjecting the other agency to local control would frustrate the state's mandate to that agency. In the court's view, this two step examination permits two co-equal instrumentalities of the Commonwealth to fulfill their missions with the least disruption of legislative intent.

Where the legislature has expressly stated that a state agency is subject to local zoning control, that intent will be given effect. For example, the enabling legislation of the Housing Authority of the City of Pittsburgh specifically requires that projects developed by the Authority comply with local zoning and other land-use controls.[54]

The City's zoning enabling act provides further evidence of legislative intent that the City's requirements pre-empt the less restrictive provisions of conflicting state statutes. Where certain provisions of the City's zoning regulations – yard requirements, building height, open space requirements, or "other higher standards than are required in any other statute" – conflict with other statutes, the stricter provision – of the zoning ordinance or the statute – will control.[55] Other principles of statutory interpretation that may apply include (1) more recent statutes control over earlier statutes and (2) more specific statutes control over more general statutes.

In a 1998 decision, the Commonwealth Court addressed the need of the Pennsylvania Turnpike Commission to obtain local zoning approval for the expansion of a rest area on the main line of the Pennsylvania Turnpike.[56] The Township sought to enjoin the Commission from completing the expansion until it had complied with the Township's zoning regulations. The Commission argued that it was exempt from local land-use controls by virtue of that part of its enabling legislation which reads: "The exercise by the commission of the powers conferred by this act in the construction, operation and maintenance of the turnpikes and in effecting toll road conversions shall be deemed and held to be an essential governmental function of the Commonwealth."[57] To subject this "essential governmental function of the Commonwealth" to local regulation would frustrate the legislature's purpose in creating the Turnpike Commission.

The court rejected the Commission's argument, saying:

> "In the present case the Commission's proceeding on the assumption, never tested in court, that it could ignore such local police power enactments has led to the frustration of the Township's zoning scheme and to injury sufficient to merit the imposition of a preliminary injunction. Questions of the precise scope and design and impact of the project, which could have been addressed in proceedings pursuant to the land-use ordinances, were not addressed. The Commission's enabling legislation does not expressly confer upon it the power to disregard local land-use regulation, regardless of the consequences, and the Court is convinced that the legislature did not intend for the Commission's authority to be pre-eminent over that of the Township here."[58]

In a later decision in this case, the court entered partial summary judgment against the Turnpike Commission, holding that it was subject to the Township's local land-use controls even though the expansion project may have been motivated by health and safety concerns.[59]

This case involved the expansion of an existing rest area along the Turnpike and not the location of the route of the Turnpike. While the logic of the case may suggest that local land-use regulations apply equally to the location of state highways and Turnpike Commission routes, it seems unlikely that our courts will allow local municipalities to frustrate state agencies' route choices all together. It is more likely that the Commission and PennDOT will be required to comply with local land-use regulations for facilities ancillary to the highway, and to highway design requirements imposed by local ordinances when the municipality imposes those same requirements on other road development decisions, including those made by the municipality.

This judicial reluctance to interfere with route selection is made an even more likely by the extensive process in which both the Turnpike Commission and PennDOT must follow in selecting highway routes where federal highway funding is involved. For example, PennDOT is required to conduct a public hearing on the acquisition of land for new or additional right-of-way that will be financed in any part by the federal Department of Transportation and to follow the hearing procedures of the Federal Government for federal-aid transportation programs.[60] The state statute sets forth 23 specific factors which the Department must consider before making a final determination as to the location of the highway. These factors include the effect of the location on "residential and neighborhood character and location;" "conservation including air, erosion, sedimentation, wildlife and general ecology of the area," "recreation and parks;" "aesthetics," "property values;" engineering, right-of-way and construction costs of the project and related facilities;" "maintenance and operating costs of the project and related facilities." Courts will be reluctant to overturn decisions made after good faith consideration of all of these factors.

6. Other Hillside Protection Mechanisms ─ Streets and the City's Official Street Map.

The City of Pittsburgh's land-use control enabling legislation makes reference to a "major street plans," "official street map," and "street plats." The "major street plan" is an element of the City's master plan. The "official street map" serves an additional function. The Planning Commission is required to maintain copies of all approved subdivision plans and each street plat made by it, as adopted or modified by Council, as well as a plat showing the location of all public streets accepted by Council. In addition, the Commission is to maintain a map or maps of all streets established by law or officially approved by the City. All of these plans and maps together constitute the "official street map" of the City.[61]

The City may not accept, open, improve, or use any street which either (1) does not otherwise have the legal status of a public street or (2) is not shown on the official master plan or on a street plat or the official map. No building may be erected on a lot unless "the street giving access to the [lot] … shall have received the legal status of … a public street …" or is shown on the "official street map" or "or unless such tract, lot or parcel has been created or transferred in compliance with this act [subdivision regulations]"[62] No cases were found to indicate whether the lot to be improved must, itself, front on a street, or whether the lot will qualify under this provision if it has legal access to a mapped street but no frontage on that street. It is likely that a court would conclude that the lot must have access to a public street, but need not front on that street. Under this view, a back lot that enjoys an access easement over an adjoining lot fronting on a public street would qualify as having the required "access" under this provision.

By statute, a municipality's power to accept an offer of dedication, in an approved subdivision plan or otherwise, expires 21 years after the offer was made.[63] The Pennsylvania Supreme Court has held that formal acceptance by ordinance or resolution is not sufficient to preserve the public's rights to use a dedicated street beyond this 21 year period.[64] The street must be "actually opened and used" as a public street within that time or the power of acceptance is lost. This interpretation requires the municipality to take some physical action indicating its intent to accept the offer of dedication within those 21 years. This may be by grading and paving the street; municipal maintaining the street, as by paving, cleaning, snow removal, or similar activities; or by installing or allowing the installation of utility lines within the right-of-way. Acts that amount "opening" or "using" part of a street (e.g., 2 of the 5 blocks in the original dedication) will not preserve the public character of the unused part (the other 3 blocks).[65] Once a street dedication has been actually accepted and opened, the roadway will not revert to the abutting owners merely because the street has not been used for 21 years; proper and formal vacation is required.[66]

Because the enabling legislation prohibits the improvement of property which does not have access from a public street, The Planning Commission may want to review the "Official Street Map to determine if offers of dedication in sensitive hillside areas have expired and the paper street is no longer properly included on the Map. The vacation of existing paper streets in development sensitive areas that have been accepted would serve to reduce pressure for undesirable development. After vacation, new development would, most likely, be subject to subdivision controls that could assure adequate street access compatible with the nature of the area.

Expiration of the City's power to accept an offer of dedication is not a perfect remedy. Those property owners who purchased lots in the subdivision after the offer was made and their successors have an implied private easement in these streets.[67] They may continue to use the easements without legal objection from their neighbors.

NOTES

[1] 53 P.S. § 2961(a)(10) ("(a) POWERS GRANTED BY STATUTE. – With respect to the following subjects, the home rule charter shall not give any power or authority to the municipality contrary to, or in limitation or enlargement of, powers granted by statutes which are applicable to a class or classes of municipalities: . . . (10) Municipal planning under the act of July 31, 1968 (P.L. 805, No. 247), known as the Pennsylvania Municipalities Planning Code.").

[2] See, e.g., 53 P.S. §§10105 and 10107(5).

[3] *Klein v. Council of Pittsburgh*, 643 A.2d 1107, 1109-110 (Pa. Cmwlth. Ct. 1994) (conditional use). *See also Vitti v. Zoning Board of Adjustment*, 710 A.2d 654, 657 n. 4 (Pa. Cmwlth. Ct. 1998) (variance criteria); *Pessolano v. Zoning Board of Adjustment*, 632 A.2d 1090, 1093 n. 3 (Pa. Cmwlth. 1993); *Nernberg v. City of Pittsburgh*, 620 A. 2d 692, 694 n.5 (Pa. Cmwlth. Ct. 1993) (standing to appeal grant of conditional use); *North Point Breeze Coalition v. City of Pittsburgh*, 60 Pa. Cmwlth. Ct. 298, 431 A.2d 398 (1981) (conditional use).

The Pennsylvania Supreme Court has occasionally evaluated zoning variances in Pittsburgh by MPC standards, but the result would not have changed had that court used the City's zoning enabling act standards. *See Hertzberg v. Zoning Bd. of Adjustment*, 554 Pa. 249, 721 A.2d 43 (1998); *Allegheny West Civic Council v. Zoning Bd. of Adjustment*, 547 Pa. 163, 689 A.2d 225 (1997).

[4] Act of March 31, 1927, as amended, 53 P.S. §§ 25501 to 25508.

[5] Act of March 31, 1927, as amended, 53 P.S. §§ 22769 to 22773.

[6] Act of May 13, 1927, as amended, 53 P.S. §§ 22769 to 22773 (Supp.).

[7] 32 P.S. § 681 *et seq.*

[8] 32 P.S. § 680.1 *et seq.*

[9] *See, e.g, C&M Developers v. Bedminster Twp. Zoning Hearing Bd.*, 573 Pa. 2, 820 A.2d 143 (2001); J*ones v. Zoning Hearing Board of the Town of McCandless*, 134 Pa. Cmwlth. Ct. 435, 578 A.2d 1369 (1990) (upholding zoning ordinance provision preserving "sensitive natural resources such as woodlands, streams, and steep slopes" against regulatory takings challenge), *citing Boundary Drive Associates v. Shewsbury Twp. Board of Supervisors*, 507 Pa. 481, 491 A.2d 86 (1985) (upholding constitutional validity of agricultural preservation district as applied to owner's property).

[10] *Boundary Drive Associates v. Shewsbury Twp. Board of Supervisors*, 507 Pa. 481, 489, 491 A.2d 86, 90 (1985). *See also C&M Developers v. Bedminster Twp. Zoning Hearing Bd.*, 573 Pa. 2, 820 A.2d 143 (2001).

[11] *C&M Developers v. Bedminster Twp. Zoning Hearing Bd.*, 573 Pa. 2, 820 A.2d 143 (2001) (citations omitted).

[12] *Hopewell Twp. Bd. of Supervisors v. Golla*, 499 Pa. 246, 452 A.2d 1337 (Pa. 1982).

[13] *National Land & Inv. Co. v. Easttown Twp. Bd. of Adjustment*, 419 Pa. 504, 215 A.2d 597 (1966).

[14] 53 P.S. § 25053.

[15] See Stephen Farber, Hillside Slopes and Valuation (2004).

[16] Timothy Collins, et al, An Ecological and Physical Investigation of Pittsburgh Hillsides ECOLOGICAL REPORT to the Hillsides Steering Committee (2004).

[17] See Stephen Farber, Hillside Slopes and Valuation (2004).

[18] Perkins Eastman, An Ecological and Physical Investigation of Pittsburgh Hillsides PHYSICAL REPORT to the Hillsides Steering Committee (2004).

[19] 53 P.S. § 25053.

[20] *See, e.g., C&M Developers v. Bedminster Twp. Zoning Hearing Bd.*, 573 Pa. 2, 820 A.2d 143 (2001) *Hopewell Twp. Bd. of Supervisors v. Golla*, 499 Pa. 246, 452 A.2d 1337 (1982); *Surrick v. Zoning Hearing Bd. of Twp. of Upper Providence*, 476 Pa. 182, 382 A.2d 105 (1978).

[21] *See DiSanto v. Lower Marion Twp.*, 410 PA. 331, 189 A.2d 135 (1963); *Best v. Zoning Bd. of Adj.*, 393 Pa. 106, 141 A.2d 606 (1958).

[22] *See, e.g., Machipongo Land & Coal Co. v. Department of Envt'l Protection*, 569 Pa. 3, 799 A.2d 751 (2002); *United Artists' Theater Circuit v. City of Philadelphia*, 535 A.2d 370, 635 A.2d 612 (1993) ([T]his Court has continually turned to federal precedent for guidance in its 'takings' jurisprudence, and indeed has adopted the analysis used by the federal courts.")

[23] *Jones v. Zoning Hearing Board of the Town of McCandless*, 134 Pa. Cmwlth. Ct. 435, 578 A.2d 1369 (1990).

[24] *Lucas v. South Carolina Coastal Council*, 505 U.S. 1001 (1992).

[25] Lucas, 505 U.S. at 1027-1029). For the comparable Pennsylvania constitutional view, see *Machipongo Land & Coal Co. v. DEP*, 569 Pa. 3, 34, 799 A.2d 751, 769 (2002) ("*Lucas* stands for the proposition that regulations that deprive an owner of 'all economically beneficial or productive use of land' are takings unless the use constitutes a public nuisance or are caused by the nature of the use and the owner could have expected that the government might prohibit it.").

[26] *See Machipongo, supra*, n.18.

[27] This name comes from the case in which the factors were first enunciated, *Penn Central Transportation Co. v. City of New York*, 438 U.S. 104 (1978).

[28] *Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419, 422, 73 L. Ed. 2d 868, 102 S. Ct. 3164 (1982) (state statute granting cable company access to apartment building owner's land to install cable service without owner's consent held an unconstitutional "taking").

[29] *Miller & Sons Paving, Inc. v. Plumstead twp.*, 552 Pa. 652, 717 A.2d 483 (1998).

[30] 134 Pa. Cmwlth. Ct. 435, 578 A.2d 1369 (1990).

[31] *Jones*, 134 Pa. Cmwlth. Ct. at 438 n.4, 578 A.2d at 1370 n.4.

[32] *Jones*, 134 Pa. Cmwlth. Ct. at 438 n.5, 578 A.2d at 1370 n.5.

[33] *Jones*, 134 Pa. Cmwlth. Ct. at 440, 578 A.2d at 1371.

[34] 851 A.2d 1020 (Pa. Cmwlth. Ct. 2004).

[35] *Taylor*, 851 A.2d at 1020.

[36] *Taylor*, 851 A.2d at 1025.

[37] *Trumco, Inc. v. Zoning Hearing Board for Shaler Twp.*, 132 Pgh. Leg. J. 259 (All'y Co. 2004).

[38] *Northwood Homes, Inc. v. Town of Moraga*, 216 Cal. App. 3d 1197, 265 Cal. Rptr. 363 (Cal. Ct. of App. 1989).

[39] *Sellon v. Manitou Springs*, 745 P.2d 229 (Colo. 1987).

[40] *Ada County v. Fuhrman*, 91 P.3d 1134 (Id. 2004).

[41] *Franchise Developers, Inc. v. Cincinnati*, 30 Ohio St. 3d 28, 505 N.E.2d 966 (Ohio 1987) ("Based on the foregoing analysis, we find that the overlay zoning scheme presented here constitutes a proper exercise of the city's zoning authority in its attempt to preserve and protect the character of certain neighborhoods that the city deems important, in order to promote the overall quality of life within the city's boundaries."). *See also Approval of a Residence at 10 Guido St. v. Zoning Bd. of Appeals of Cincinnati,* 117 Ohio App. 3d 319, 690 N.E.2d 593 (Ohio Ct. App., 1996) (Issuance of zoning permit under Environmental Quality-Hillside District affirmed as development application met ordinance requirements; "The evidence showed that the building would be designed, colored and landscaped to blend in with the hillside and that it will actually help to support it. The proposed building would not detrimentally impair the public view or the majority of the private views." 690 N.E.2d 596.)

[42] *Rogue Valley Ass'n of Realtors v. City of Ashland*, 158 Ore. App. 1, 970 P.2d 685 (Or. Ct. App. 1999).

[43] 149 Ariz. 538, 720 P.2d 513 (1986).

[44] *See, e.g.*, *Corrigan v. City of Scottsdale*, *supra,* n. 37 and accompanying text; *Burrows v. City of Keene*, 121 N.H. 590, 432 A.2d 15 (1981).

[45] See 2 Rathkopf's The Law of Zoning and Planning § 16:5 (2004 Electronic Edition; WestLaw).

[46]

> "If the legislature has the power to compel a property owner to submit to a forced sale for the purpose of creating an attractive community, it has the power to regulate his property for such objectives.
>
> "Not only is the preservation of the attractive characteristics of a community a proper element of the general welfare, but also the preservation of property values is a legitimate consideration since '[Anything] that tends to destroy property values of the inhabitants of the ... [community] necessarily adversely affects the prosperity, and therefore the general welfare, of the entire ... [community].' State ex rel. Saveland Park Holding Corp. v. Wieland, 269 Wis. 262, 69 N.W.2d 217, 222 (1955).
>
> > "'We are satisfied that at long last conscientious municipal officials have been sufficiently empowered to adopt reasonable zoning measures designed towards preserving the wholesome and attractive characteristics of their communities and the values of taxpayers' properties.'"

Best v. Zoning Board of Adj., 393 Pa. 106, 117, 141 A.2d 606, 612-13 (1958) (citations omitted).

[47] *Lombardozzi v. Millcreek Twp. Zoning Hearing Bd.*, 829 A.2d 779, 782 (Pa. Cmwlth. Ct., 2003) (citations omitted). *See also Norate Corporation, Inc. v. Zoning Board of Adjustment,* 417

Pa. 397, 207 A.2d 890 (1965); *Rogalski v. Upper Chichester Twp.,* 406 Pa. 550, 178 A.2d 712 (1962) (similar language).

[48] *White Advertising Metro, Inc. v. Zoning Hearing Board of Susquehanna Twp*., 70 Pa. Cmwlth. Ct. 308, 320, 453 A.2d 29, 31 (1982).

[49] *See Berk v. Wilkinsburg Zoning Board*, 48 Pa. Cmwlth. Ct. 469, 410 A.2d 904 (1980) (landscaping requirements; "Aesthetics and property values are legitimate considerations in a township's exercise of its zoning power to promote the general welfare.").

[50] *E.g*., *United States v. City of Chester*, 144 F.2d 415 (3d Cir. 1944).

[51] *City of Pittsburgh v. Commonwealth*, 468 Pa. 174, 360 A.2d 607 (1976).

[52] *Commonwealth v. Ogontz Area Neighbors Ass'n*, 505 Pa. 614, 483 A.2d 448 (1984); *see also Olon v. Commonwealth*, 534 Pa. 90, 626 A.2d 533 (1993) (legislative intent to pre-empt local zoning shown where legislature authorized acquisition of specific property for specific use that conflicted with existing zoning); *County of Venango v. Borough of Sugarcreek*, 534 Pa. 1, 626 A.2d 489 (1993) (county jail location subject to borough zoning ordinance); *Hazelton Area School Dist. v. Zoning Hearing Bd. of Hazle Twp.* , 566 Pa. 180, 778 A.2d 1205 (2001) (use of school baseball field by private business for summer baseball league unrelated to School District's constitutional and statutory duties and subject to local zoning control); *Northampton Area Sch. Dist. v. E. Allen Twp. Bd. of Supervisors*, 824 A.2d 372 (Pa. Cmwlth. 2003) (school district subject to Twp. land use regulations).

[53] *Commonwealth v. Ogontz Area Neighbors Ass'n*, 505 Pa. 614, 633, 483 A.2d 448, 452 (1984). *See also Kee v. Pennsylvania Turnpike Commission*, 722 A.2d 1123, 1125-1126 (Pa. Cmwlth. Ct. 1998).

[54] 35 P.S. 1556.

[55] 53 P.S. § 25058.

[56] *Kee v. Pennsylvania Turnpike Commission*, 722 A.2d 1123 (Pa. Cmwlth. Ct. 1998).

[57] 36 P.S. § 651.6.

[58] *Kee*, 722 A.2d at 1127.

[59] *Kee v. Pennsylvania Turnpike Commission*, 743 A.2d 546 (Pa. Cmwlth. Ct. 1999). For another case in which the Pennsylvania Turnpike Commission applied for a variance from the Twp. zoning ordinance, see *Kennedy v. Upper Milford Zoning Hearing Bd.*, 779 A.2d 1257 (Pa. Cmwlth. Ct. 2001) (local zoning power not an issue).

[60] 71 P.S. § 512(b).

[61] 53 P.S. § 22780.

[62] 53 P.S. § 22775.

[63] 36 P.S. § 1961.

[64] *Appeal of Gaus*, 531 Pa. 133, 137, 611 A.2d 696, 698 (1992).

[65] *Appeal of Gaus*, 531 Pa. 133, 611 A.2d 696 (1992).

[66] *See Appeal of Gaus*, 572 A.2d 246 (Pa. Cmwlth. 1990)., *rev'd on other grounds*, 531 Pa. 133, 137, 611 A.2d 696, 698 (1992). As to vacation of streets, see 53 P.S. §§ 6501 to 6705.

[67] *See e.g., Estojak v. Mazsa*, 522 Pa. 353, 562 A.2d 271 (1989).

Final Report

Opportunities for Hillside Protection

Prepared by:

The Hillside Steering Committee

Prepared for:

City of Pittsburgh – Department of City Planning

16 March 2005

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I. PREFACE

1. Background

From 1958 until February of 1999 the City of Pittsburgh's hillsides, parks and cemeteries were all included in the "S" Special Zoning District. This "S" zoning district limited development and required minimum lots of 8000 square feet for single family dwelling development. In 1999 Pittsburgh's comprehensive zoning code revision became effective. The lands which had been included in the "S" District were divided among two new zoning districts, the "H" Hillside Zoning District and the "PO" Parks and Open Space Zoning District.

The "PO" District was always somewhat of a misnomer since it was intended to address parks and cemeteries. This is, in fact, the only zoning district to permit cemeteries. The "H" District was intended to:

- Promote environmental preservation and fiscal responsibility;
- Allow reasonable use and development of property zoned "H", Hillside; and
- Apply in areas that are not suitable for intensive development because of the presence of environmental or scenic resources and because of the difficulty of providing essential public facilities and services in an efficient and cost-effective manner.

Both the "PO" and the "H" Districts allowed single family detached dwellings with minimum lot sizes of 3,200 and 30,000 square feet, respectively.

At the time that the new zoning code became effective, all former "S" Districts were temporarily denoted as "PO" Districts with the intention of separating true "PO" Districts from "H" Districts during a process called *Map Pittsburgh*. This process was designed to review the zoning of every City neighborhood under the new zoning code and either affirm the zoning map or make the necessary amendments to district boundary lines. Parks and cemeteries were to be placed in the "PO" District under this process and hillside areas, including designated "greenways", were to be placed in the "H" District. Chapter 915 of the new code, *Environmental Performance Standards,* provided some minimum criteria for development and was applicable to both the "PO" and "H" Districts. Additionally, "overlay zones" addressed new submittal requirements in landslide-prone and undermined areas, as well as stormwater management requirements throughout the City.

Map Pittsburgh soon identified some problems in designating lots to the "H" and "PO" Districts. A review of the existing lots in the "H" and "PO" zoning districts which were not part of parks or cemeteries indicated that more than 90% of those existing lots did not meet the desired minimum lot requirement. Additionally, the Zoning Administrator felt there were very few criteria to assure the quality and site responsiveness of development in the hillside areas. In order to assure legally defensible regulations related to lot size, density, and more responsible design, the Planning Department proposed revisions in the Hillside District text. Among other things, the proposed revisions reduced the required lot size to 3,200 square feet in the "H" District. This, along with zoning map changes under the Map Pittsburgh process which reclassified areas from "PO" to "H", resulted in concerns that the City was abandoning hillside conservation efforts, was diminishing protected open space, and was actively promoting hillside development at a cost to the aesthetic, habitat, and natural environment of the City's hillsides.

In November 2002, City Council approved the Planning Department's proposed revisions to the "H" District text. Due to the concerns raised during the adoption process, Council also passed an accompanying resolution, directing the Department of City Planning to "conduct a feasibility study to determine the appropriateness of an action by City Council to preserve land on the City's hillsides". The study was directed to include, at a minimum, the following issues:

- The appropriateness of a new Conservation Zoning District in the Pittsburgh Zoning Code.

- The appropriateness of amending specific zoning districts in the existing Zoning Code to address preservation of hillsides and open spaces.
- The appropriateness of an Overlay Zoning District to address issues pertaining to conservation on the City's hillsides.
- The impact of current permitting and development practices on preservation and conservation in the City of Pittsburgh.
- The appropriateness of adopting a City policy that requires the dedication of all publicly held hillside areas as open space.

2. Contributors

In response to this resolution, the Department of City Planning established a Hillside Steering Committee (HSC) consisting of parties interested in promoting conservation as well as those who had been involved in planning and development. The committee consisted of:

Jacqui Bonomo	Western Pennsylvania Conservancy
Tom Cummings	Urban Redevelopment, Director of Housing
Caren Glotfelty	Heinz Endowments
Joe Hackett	LaQuatra-Bonci Associates
Roy Kraynyk	Allegheny Land Trust
Bob McDunn	Sierra Club
Sarah Miller	Riverlife Task Force
Bill Peduto	Pittsburgh City Council, Councilman
Yoko Tai	TAI + LEE Architects, P.C., Principal

The Committee also included:

Susan Golomb	Department of City Planning, Director
Dan Sentz	Department of City Planning, Environmental Planner

3. Scope of Work

Over a two-year period, Committee members met periodically, inviting consultants to share their expertise. Among them were:

Karen Brean	Karen Brean Associates
Leslie Kaplan	
George Specter	City of Pittsburgh Law Department,

When the Committee realized it needed professional assistance and advice, the Heinz Endowments funded a study by Perkins Eastman Associates and Carnegie Mellon University, entitled *An Ecological and Physical Investigation of Pittsburgh Hillsides – REPORT to the City of Pittsburgh Hillsides Committee,* herein referred to as the PE/CMU Report. This report, managed by the Allegheny Land Trust and funded by the Heinz Endowments, included:

"Economics of Hillside Slope Development", by Stephen Farber, PhD;
"Ecological Report" under the direction of Timothy Collins of CMU Studio for Creative Inquiry;
"Physical Report", by Perkins Eastman Associates; and
"Land Use Controls for Hillside Preservation in the City of Pittsburgh", by Cyril A. Fox.

As a result of such input and study, the Committee discussed current processes, new initiatives and innovative ideas such as:

- Various conservation and preservation efforts from around the country, both public and private;
- Public and private ownership of lands to be conserved or preserved, along with conservation easements;
- Regulations promoting conservation in the context of private property rights;
- Responsibility related to the taking of tax delinquent lands and 3TB property (Three Taxing Body property, where City, County and School District taxes are all delinquent)
- City of Pittsburgh's directed sale process (through the URA with the goal of getting property back into private hands) and Greenways Program;
- The provision and maintenance of public infrastructure and services;
- Public safety in the context of development on steep landslide prone slopes, along with issues related to stormwater management and erosion;
- The desire to promote infill housing and avoid greenfield development;
- The role of the hillsides in defining the City's character and image;
- The opportunity to provide natural habitat and ecological experiences in an urban context, as presented by undeveloped natural hillsides;
- The quality of vegetation on the hillsides; and
- The application of site specific analysis under the guidance of a philosophy of conservation.

The following report represents the Committee's research, findings and recommendations to the Department of City Planning. It should be noted that the terms "hillsides" and "slopes" are used interchangeably. This document is intended to guide the Department of City Planning in the revision of existing regulations affecting the City's hillsides and the adoption of new regulations to promote the wise use of our hillsides. It also proposes to inform the Planning Commission, City Council, and all entities of City government in decisions involving hillside stewardship, public investments, and enforcement. The following attempts to define the community's role and calls for community involvement through stewardship, vigilance and pride. It also suggests the opportunity for private involvement in the conservation effort through ownership and conservation easements.

4. Divergent Opinions

The members of the Committee offered a wide range of views yet all value the important resource that our wooded hillsides represent. There was often agreement and at times disagreement within the Committee as to the best course of action. The following report summarizes the important topics and offer generally agreed upon recommendations.

II. REPORT TO THE DEPARTMENT OF CITY PLANNING

1. Introduction

The desire to protect hillsides and sensitive natural resources is not unique to Pittsburgh. Many other cities have struggled with this issue and developed innovative techniques. Cities such as Boulder, Colorado and Albuquerque, New Mexico have taken a comprehensive approach to natural resource protection combining smart-growth principles and public funding to create a preservation/protection mechanism that fits the unique qualities of those cities. Other cities, such as Pacifica, California; Asheville, North Carolina and Saratoga, California use environmental overlay districts within their zoning ordinance to regulate and protect sensitive areas.

Development, in many forms, has always taken place on Pittsburgh's hillsides. There are many inherent qualities to hillside sites that make them attractive for such development including proximity to downtown, scenic views and the perceived privacy these sites offer. As a result, much of the hillside property in the City has been divided into parcels, individual properties and street rights-of-way.

Hillsides have potential private development value, however the Hillside Steering Committee recognizes their more important role as an environmentally sensitive public resource. The PE/CMU report outlines many of the benefits green hillsides provide (ecologic, economic, scenic…) to Pittsburgh. The "highest-and-best use" of a property is typically determined by its development potential. However, if left in their natural state , many hillsides have greater public value if not developed.

The purpose of this hillside study and the PE/CMU Report was not to prohibit private development, but rather to determine how the hillsides could best serve the public. In some instances where the environmental sensitivity of the hillside is so great (undermining, landslide prone soils, erosion, severe topography, unique vegetation…) or development would cause an undue financial burden on the City (lack of available utilities, long-term cost of maintaining public infrastructure), development should be prohibited or encouraged elsewhere. The PE/CMU reports identify a number of characteristics that can be used to predict whether a particular hillside site is environmentally sensitive or whether public infrastructure is available. Although there were limitations of time and resources for the PE/CMU report, it provides a foundation for the understanding of the complex nature of Pittsburgh's hillsides.

2. Hillside Issues

A. Aesthetics

Steeply sloped land (25% slope and greater) occupies approximately 11% of the area of the City. Pittsburgh's hillsides shape its public realm, contribute to the green and healthful character of the city and the identity of its neighborhoods, maintain air and water quality, the integrity of the natural ecology, and provide aesthetic, historical and cultural continuity. The often densely wooded hillsides of Pittsburgh are a remarkable natural resource, interlacing and complementing the densely constructed built fabric of Pittsburgh neighborhoods.

Several hillside development prototypes exist in Pittsburgh providing an identity that is quite unique among other hilly cities throughout the world. The arrangement of the topography carved by the rivers has created a series of portals, corridors and rooms, often with steep "walls". Pittsburgh's growth has responded to these features over a century to create a unique and distinctive urban pattern.

At one time, the steep slopes were impediments to access, as a result, the high terraces remained largely undeveloped until mid-20th Century. These slopes and terraces have dictated our transportation systems and provided most of the open space within the city. Neighborhoods are often physically defined by steep slopes or separated by long ribbons of wooded hillsides that provide dynamic backdrops when viewed from public vantage points. This urban landscape and built form is unique and should be protected, celebrated and promoted as distinctly Pittsburgh.

Today, at the beginning of a new millennium and in spite of an industrial past, Pittsburgh finds itself interlaced with a natural system of hillside greenways - not through some master plan or design, but as a result of the constraints they presented as Pittsburgh expanded organically over the past 250 years. Although hillsides provide aesthetic, environmental, recreational and other public benefits, they are often vulnerable to activities that can impact the contribution they make to the City. Community members and government officials need to rethink how to value and protect such unique urban natural assets before this critical mass of green space is lost.

B. Hillside Ecology

An investigation of the plant and animal species within the City limits found surprisingly wide diversity. The City's largest masses of forest are large enough to have an "interior forest patch", a forested area surrounded by at least 100 meters of buffering green space. Interior forests provide a special habitat for animal species that require solitude and large areas to roam. Trees in excess of 3 meters in circumference and evidence of black bears were found within the City limits. The majority of tree species found on several steep hillsides of Pittsburgh are native species.

The large masses of Pittsburgh's densely wooded hillsides not only provide habitat for many native species of the region, but also mitigate air and noise pollution, reduce stormwater runoff and flooding, and reduce the heat island effect that cities have on local climate.

C. Hillside Geology

Pittsburgh is sited on the Allegheny Plateau, once part of the bed of a huge inland lake. Its slopes and valleys were formed by an erosive process rather than by folding and uplifting. Erosive soils, and unstable geology have resulted in slopes in excess of 40%, making development extremely difficult, impractical, expensive and arguably prohibitive. Slide prone slopes become more unstable when their vegetative cover is disturbed, mass grading occurs or when the surface or subsurface hydrology is altered.

Steep slopes will attract development because they offer the opportunity for distant views and provide natural surroundings in an otherwise urban environment. However, they do not lend themselves to development easily. Steep slopes impose serious development constraints, and exact added costs both public and private. Engineering solutions can be found to mitigate these destabilizing influences. However, manmade solutions are rarely permanent, nor are they without the need for repair, replacement or added public cost at some future point.

D. Economic Issues

The hillsides offer broader economic, benefits beyond those that produce revenue for the city. First, Pittsburgh's distinctive topographic relief is a major landscape defining feature that provides a unique identity to the region. The image of Pittsburgh projected nationally and internationally with scenes of the Golden Triangle and associated riverine/hillside landscapes is inestimable as a distinctive feature. Keeping the image of Pittsburgh as a pleasant place to live and visit has an economic development value that would be difficult to quantify but is likely substantial. A second value is the role of topographic relief in defining neighborhoods and communities. The hills and valleys afford a sense of place and community identity that is difficult to measure yet clearly apparent from the settlement patterns and strong identities with local communities. A third and more estimable economic value is that of the natural system services offered by undeveloped hillsides such as storm-water management, pollution control and soil stabilization.

Costs of public services for residential developments often compare unfavorably with the tax revenues from those developments. A summary of more than 90 cost-of-services studies in the US shows that, on average, residential developments cost roughly 15% more than the revenues that could be expected from those developments on a per dwelling unit basis (property taxes, local sales and income taxes, etc.) To the extent that the full value of the extraordinary costs of hillside development are not paid for, other taxpayers end up subsidizing these developments, and the less-than-full-costs simply encourage such developments.

In addition to extraordinary infrastructure and public service costs, hillside developments result in the loss of natural system services, as described below. Natural systems may have considerable economic value especially in landslide, flood-prone, and high topographic relief regions such as Pittsburgh. The public bears the costs of these lost services in the form of increased pollution of streams, increased water treatment costs, increased flood conveyance and control costs, etc.

Several studies conducted in other parts of the country indicate that natural areas provide a variety of public benefits. For example, a study in Columbus, Ohio showed that proximity to a park increased property values up to 23%.

Woodlands reduce storm water runoff and flooding. A study in California estimates that an acre of trees provides as much as $41,000 worth of stormwater management cost savings. Dense vegetation also helps to stabilize the slide prone soils and geology of the Pittsburgh region and reduce costs associated with Public Works maintenance.

Urban woodlands are especially valuable in the role they play in maintaining air quality. They can act as a *carbon sink*, absorbing carbon dioxide and releasing oxygen. A Chicago study found that a single tree can remove 0.22 pounds of air pollutants and 12.4 pounds of carbon per year.

Through providing shade, wind breaks and evapo-transpiration, trees and other types of vegetation can also help reduce energy demands and abate the heat generating effect that cities have on the climate. A Chicago study found that annual heating and cooling costs can be reduced by 1.3% and 7% respectively per tree per year.

E. Legal Considerations for Regulating Hillside Development

Although it is a Pennsylvania Home Rule Municipality, the City of Pittsburgh obtains its authority to adopt land use regulations, including zoning, from legislation adopted in 1927, not from the Pennsylvania Municipalities Planning Code. Land use control ordinances, such as zoning and subdivision ordinances, are an exercise of the police power entrusted to the City under the enabling legislation and the City's Home Rule Charter. These ordinances are presumed valid and any challenger must carry a heavy burden to establish that they are not.

The City's enabling legislation sets forth several public "police power" purposes to be served by zoning regulations that readily encompass regulations to protect and preserve hillsides or steeply sloped land within the City. The same section of the enabling legislation specifically requires that zoning regulations "be made with reasonable consideration, among other things, to the topography and character of the district, with its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout such city." This language invites regulations that respect and preserve the City's distinct hillside development patterns where that "character" is appropriately defined or described in the regulations. Pittsburgh's unique development patterns, as described in the PE/CMU Report, provide a sound basis for these regulations.

A zoning regulation that is intended to preserve the character of the City by protecting its steep hillsides from over-development or to preserve the City's character should be found to serve a legitimate "police power" purpose, particularly when reference is made to the purposes of zoning as set forth in the City's enabling legislation. As long as the owner of the zoned parcel is allowed some reasonable use of their property, the regulation should also satisfy the "regulatory takings" (i. e. regulations that are so strict and inflexible that they have removed all economic value for the owner and the regulator has effectively seized the property through the regulations) test.

There are few Pennsylvania Appellate Court decisions evaluating hillside protection regulations. One case upheld a zoning ordinance preserving steep slopes, forests and woodlands, and streams in a particular development district, while another upheld an ordinance prohibiting timbering on landslide prone land anywhere within the municipality. Both ordinances survived reasonableness and "regulatory takings" challenges.

Legal research suggests that steeply sloped hillsides can be protected through zoning. Because hillsides provide a variety of public benefits when left intact and because the risk to the public health, safety, and welfare can increase when they are disturbed, protecting hillsides from disturbance through legislation is possible. Municipalities in Pennsylvania are adopting and enforcing codes to limit disturbance of sensitive environmental areas, such as steep slopes, and the courts have upheld their authority to do so. The distinctive hillside development pattern unique to Pittsburgh can provide foundation for a zoning initiative to sustain the pattern.

F. Stewardship

Stewardship, or caring for land that has been acquired for the purpose of being permanently protected in a natural condition, is an important component of any public or private land conservation initiative - especially if the land is intended to be made available to the public.

Protected lands need to be monitored for boundary encroachments, vandalism, dumping, timber theft, vehicle trespass, physical hazards that may develop over time, and other activities that are deemed deleterious to sustaining the tract's resident natural amenities and beneficial qualities.

A management plan describes the actions necessary to maintain, enhance and restore the ecology of a tract or greenway, as well as the specific undesirable activities. Trained volunteers from the local neighborhoods can provide this critical stewardship service, act as the eyes and ears of the title holder, and be a liaison between the title holder and surrounding land owners.

G. Opportunities for Hillside Protection

At this point in Pittsburgh's history there is an opportunity to redefine our collective attitude toward hillsides and slopes. The green hillsides are often discussed and are considered as one of the defining characteristics of this city, not unlike the three rivers. Furthermore, there is currently a ground-swell of local support for environmental concerns (Western Pennsylvania Conservancy, Allegheny Land Trust, Sierra Club, Pennsylvania Environmental Council…) as well as a number of groups concerned with Pittsburgh's urban quality (Department of City Planning, Riverlife Task Force, Cultural Trust…).

III. Recommendations

Introduction

The Hillside Steering Committee feels strongly that adequate protection of the slopes cannot occur with a single strategy. The most effective way to deal with the variety of parcel sizes, soil types, ownership options and ecologic conditions found on the slopes is a combination of techniques. This will ensure there is a control mechanism available for any condition and for unforeseen circumstances. The initial charge of the Committee came from City Council, as Resolution #86. That Resolution asked the Department of City Planning to evaluate:

1. The appropriateness of a new Conservation Zoning District;
2. The appropriateness of amending specific zoning districts in the existing Zoning Code to address preservation of hillsides and open space;
3. The appropriateness of an Overlay Zoning District to address issues pertaining to conservation of the City's hillsides;
4. The impact of current permitting and development practices on preservation and conservation in the City of Pittsburgh;
5. The appropriateness of adopting a City policy that requires the dedication of all publicly held hillside areas as open space.

The Hillside Steering Committee offers the following recommendations to the Department of City Planning for consideration as they craft legislation for City Council regarding hillside protection strategies.

Recommendations

The following are the general recommendations of the Committee related to zoning:

- Expedite the Map Pittsburgh process;
- Clarify the intent of the "H" and "PO" zoning districts and make appropriate zoning map changes;
- Consider utilizing sub-districts within the "H" district to address the issue of appropriate lot size so that context is addressed (promoting infill rather than isolation or sprawl); or consider a flexible lot size approach that respects the slope of the land rather than the arbitrary size of a given parcel ;
- Have standards (rather than guidelines) associated with development in the "H" district;
- Provide regulations that will encourage cluster development where it will minimize site impact, preserve open space and prevent sprawl;
- Establish a Steep Slope Overlay District based upon a slope of 25% with specific standards to determine if development is appropriate and specific standards for how that development is to be implemented;
- Prohibit development on slopes greater than 40%;
- In determining if a site is appropriate for development, give priority to the natural and built context through specific standards that address proximity to infrastructure, proximity to other development, as well as geologic and soils limitations;
- Address the concept of buffer areas adjacent to the Steep Slope Overlay District including the brow (top of slope and immediately adjacent flat lands) and the toe (bottom of the slope and immediately adjacent flat lands) of such slopes;
- Establish special protection for highly visible steep slope areas;
- Assure that the vast majority of the hillsides will always provide the distinctive green backdrop so important to the City's image;
- Utilize site plan review requirements in the "H", "PO", steep slope, and buffer areas;

- Review and revise as appropriate pertinent associated overlay zones such as the Landslide Prone and Stormwater Management Overlay Zones.

In implementing any and all of the above zoning recommendations the Department of City Planning should utilize the information developed during the course of this two year effort, particularly the PE/CMU Report.

Action Items

- Establish a Steep Slope Overlay Zoning District (based upon all slopes that are 25% or greater) that encourages conservation through strict, legally-defensible controls.
- Update the Land Development Application to require that developments proposed for steep slope areas provide detailed information for such things as slope conditions, vegetation and soils.
- Revise and re-map the "H" and "PO" Zoning Districts to support the Steep Slope Overlay District.
- Revise the Landslide Prone and Stormwater Management Overlay Zoning Districts to be consistent with and provide additional support for the Steep Slope Overlay District.
- Assure appropriate use of publicly controlled lands through revisions to the City's directed sale procedure and appropriate acquisition of tax delinquent hillside properties for conservation.
- Consider using conservation easements to provide open space protection for public property.
- Conduct a systematic evaluation of all publicly held or tax delinquent hillside properties.
- Evaluate, update and promote the City's Greenways for Pittsburgh Program.
- Evaluate the addition of lands to City parks and greenways through various mechanisms.
- Promote a stewardship ethic through improved administration, enforcement of hillside regulations, a public education campaign, and public-private partnerships.
- Establish appropriate incentives and penalties related to hillside stewardship with regards to such items as dumping, illegal tree cutting, and encroachment on public property.
- Assure that the actions of all City departments and related public entities reflect a new hillside stewardship ethic, by encouraging departments (City Planning, URA, Council, Zoning, etc.) to utilize the PE/CMU Report as the foundation for the appropriate and wise use of our hillside resources.
- Require stewardship training of key City personnel who will be involved with or responsible for the care of steep slope areas.

Additional Recommendations

There is not a need to dedicate all publicly held hillside lands as open space; however, there is a need to evaluate publicly held hillside lands to assure appropriate action results in hillside protection. This must be a site-by-site specific evaluation (as every parcel of land is different) and would ideally be done City wide. Therefore, the Committee recommends the City undertake a land analysis. Factors identified during the course of the work of the Committee such as soils, geology, visibility, proximity to infrastructure, ability to provide and costs associated with public services, hydrology, vegetation, habitat, neighborhood need and continuity of open space must be considered in this land analysis. Such an effort would involve a significant commitment of staff time. In the interim, any transfer of public land for any purpose in a steep slope, "H" zoning district, "PO" zoning district, Landslide Prone Overlay Zoning district or any land within 50 feet of such areas should require public action by the City Planning Commission in the form of a recommendation to City Council. Subsequent action involving the disposition of such lands by City Council should follow the precedent of zoning regulations in that it would take a super majority of City Council (seven of nine Council Members) to take action contrary to the recommendation of the City Planning Commission.

As part of the Land Analysis, the Committee recommends that "paper streets" (street rights-of-way that were platted but never built) be vacated (the right to establish a public street is relinquished) when they exist on steep hillsides. This would discourage development of properties that exist adjacent to these right-of-ways and the owners of those parcels should be encouraged to participate in the new conservation easement program mentioned above, where they can donate or obtain a conservation easement. This will also require that the current City maps be corrected so rights-of-way that were never adopted or those recently vacated are not shown.

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The best means to assure that hillsides are protected and achieve their highest and best use, remaining in an undeveloped or undisturbed state, is ownership.
Ownership as a control is not limited to City or public ownership but can also include private ownership. Private ownership can take the form of title ownership by a non-profit entity with the purpose of conserving or preserving land. Protection of private hillside lands can also be accomplished through conservation easements held by such a non-profit entity. The conservation easements can be held on lands held by private individuals or entities and they can be held on public lands.

The Committee recommends that the City immediately begins to craft a program with an appropriate private non profit entity (The Allegheny Land Trust and the Western Pennsylvania Conservancy are two such entities) to facilitate hillside conservation and preservation through title ownership or conservation easements. This program would include among other items the promotion of private land acquisitions (title or conservation easements) by that entity via sale and donation, the opportunity for the entity to acquire public lands, the transfer of conservation easements on dedicated public greenway lands and parks to that entity, and the identification of funding sources to address costs associated with this program.

The Committee further recommends that the City begins to acquire tax delinquent properties in the hillside areas to achieve the degree of control that ownership offers in the pursuit of the highest and best use of the hillside sites. The current process assumes that the most appropriate use of 3TB properties is to quickly get those parcels back on the market and in private hands to again generate tax revenue. However, the Committee believes that there is a greater public value if some 3TB properties (those with very steep slopes) were preserved in their natural state. To achieve this, will require a re-evaluation of the entire process by which tax delinquent properties (and the associated liens) are handled.

There is a significant need for better enforcement related to development actions that are not consistent with approved plans.
There is a need for better administration of the regulations that protect our hillsides. Building inspectors are very effective when addressing the traditional life safety issues of the Building Code. However, issues related to an approved Site Plan are not addressed with the same effectiveness. The issue of enforcement has implications on follow-up by the City's Law Department as well as the Bureau of Building Inspection. In the end, regulations are only as effective as associated compliance. Toward that end, a new ethic of hillside stewardship must begin with those directly associated with the administration of regulations as well as management of public hillside resources. However the issue of hillside stewardship will ultimately involve the entire community

An intrinsic need associated with hillside conservation is stewardship. Currently there is not a city-wide ethic regarding the value of hillside sites and the need to protect these sensitive resources.
Any private entity holding hillside sites as open space or conservation easements associated with them will need to address this issue in terms of monitoring, debris removal, vegetation programs (invasive species

control, supplemental plantings, etc.). While there will be certain costs associated with acquisition for private entities holding hillside lands, stewardship costs will represent continuing operating costs.

Other private property owners holding hillside sites must also address the stewardship issues such as debris removal, appropriate actions related to vegetation (pruning and defoliation to provide views, control of invasive species, planting of conspicuous non natives, etc.), runoff control, and screening of certain use aspects such as parking, storage and mechanicals. These actions can be assured through appropriate zoning regulations discussed further below.

The City, in addition to adopting appropriate zoning regulations addressing hillside stewardship on private lands, must address the issues of regulation enforcement, public education, dumping and other stewardship issues on public lands that will require collaboration with neighborhood groups. The City will need cooperation from neighborhood or special adopting groups to help prevent and prosecute dumping as well as assist in the removal of debris from public hillsides. The City's Greenways Program may provide the starting point for some of these stewardship efforts. Other efforts related to increasing fines for dumping and vigorous prosecution may require ordinance amendments and new priorities for legal actions. In addition to educating the public on issues such as dumping and encroachment on public hillside lands there may be a need to educate the judicial community so that the cost to the public will be accurately considered in decisions regarding dumping, encroachment and zoning violations on hillside sites.

Hillside property controlled by private concerns interested in development must be addressed primarily through zoning regulations to assure there is cognizance of and adherence to a hillside stewardship effort. The committee believes the Department of City Planning can best address the specific language of such regulations.