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# 移动的地表:

## 哥伦比亚麦德林市的危险栖居点与地质灾害

### Shifting Ground:

#### Precarious Settlements and Geological Hazard in Medellin, Colombia

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摘要 .....

21世纪初期,城市化日渐复杂多样、范围不断扩大、速度逐渐加快,设计师、城市规划师和决策者等相关人士必须建立新的理论和方法论途径。本文对景观作为现代城市化理论阐释的基础框架进行了论证,并通过对一篇关于麦德林阿布拉山谷泥石流造成的死亡风险的设计报告进行讨论,提出了防御性的设计策略。在过去80年中,这些存在地质危害的山坡已造成784名低收入居民死亡,2030年预计约有350 000名居民面临危险。

“移动的地表”是位于麦德林市的行政、金融和技术大学的Urbam城市与环境研究中心,与哈佛大学设计学院社会机构实验室共同开展的一个合作项目,该项目建议采用基于景观的策略对城市化进程进行引导,从而避免山谷地区更为严重的灾害出现,与此同时亦可带来新的经济体。在该项目中,景观成为了研究和设计的框架,同时也将坡地的地质构成、区域水文、当地经济和迁入坡地的居民均纳入考虑范围当中。

关键词 .....

城市化; 景观基础设施; 设计研究; 泥石流; 侵蚀

Abstract ...

As the force field of urbanization grows in complexity, variety, scale, and range in the early decades of the 21st century, designers, urbanists, and policy-makers alike must develop new theoretical and methodological approaches. This article demonstrates the use of landscape as a primary framework for theorizing contemporary urbanization and developing pre-emptive design strategies through a discussion of a design research report on the risk of death by landslide in Medellin's Aburra Valley. Landslides in these geologically hazardous slopes have killed 784 low-income residents in the past 80 years, and by 2030 nearly 350,000 residents will be at risk.

Shifting Ground, a collaboration between the think-tank URBAM of Eafit University in Medellin and the Social Agency Lab of the Harvard Graduate School of Design, proposes landscape-based strategies for redirecting urbanization processes in order to avoid further disasters in the valley and simultaneously produce new economies. Landscape is used as a research and design framework and takes into account the geologic makeup of the slopes, regional hydrology, local economies, and the flow of settlers relocating to the slopes.

Key words ...

Urbanization; Landscape Infrastructure; Design Research; Landslide; Erosion

要调和21世纪中城市化前所未有的复杂性、多样性、尺度和速度,就需要设计师、城市规划师和决策者等提出新的理论框架、新的方法策略和新的分析类别。<sup>[1]</sup> 这些新工具的开发瓦解了设计和城市化中那些沿袭于20世纪的陈旧的分析类别,为城市未来的其他可能性铺展了舞台。预测性研究和前瞻性设计方法与当下的绘图理论和技术浪潮相结合,有助于消除建筑、景观设计与规划之间长久以来的学科分裂。正如无法用20世纪的词汇来归结新兴城市的情况一样,过去的方法和分析类别也无法创造出一个对环境更为敏锐、社会



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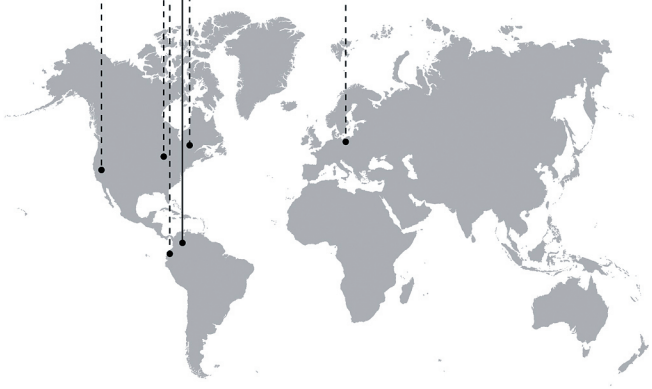
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**EPM 项目管理**



1. 发生于2007年5月的麦德林阿布拉山谷山体滑坡。  
© Departamento Administrativo de Planeación, Medellín
2. 团队组成(图片来源:参考文献[2])

减轻污染等级的手段; 20世纪中后期, 伊恩·麦克哈格的方法过度强调环境保护主义, 使得许多自然与城市的过程被分而治之; 而在当今城市化已席卷全球的时代<sup>[1]</sup>, 景观的作用已经转变: 当前的景观将城市过程看作存在于空间和时间中的持续波动, 它跨越了全球、大洲, 以及本地尺度, 并超越了学科间的界限。

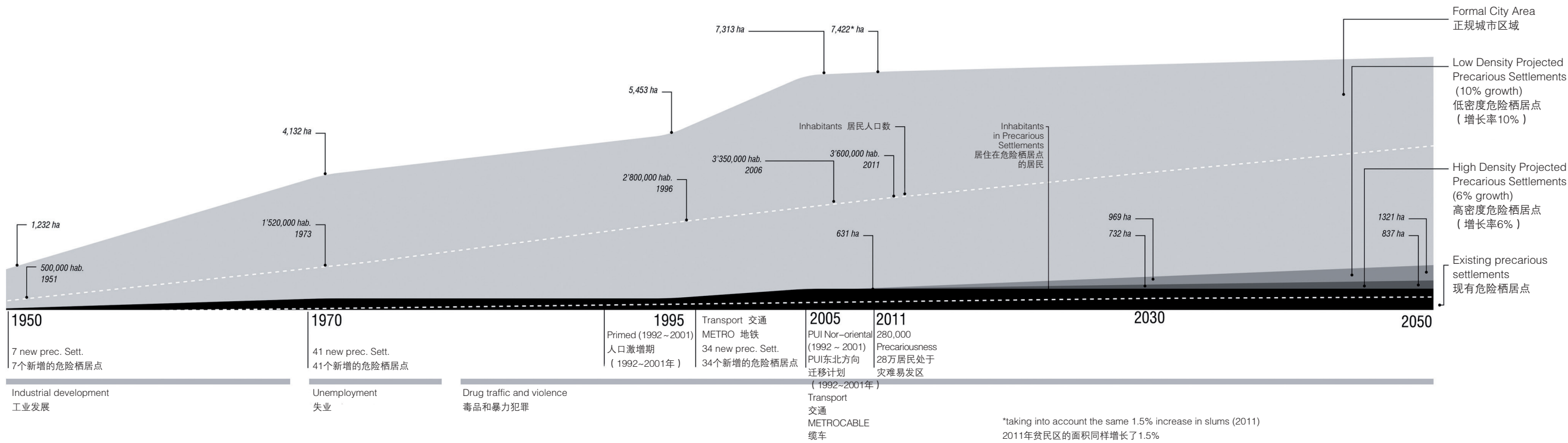
将景观作为对现代城市化及设计研究进行理论阐述的基础框架, 可以调和各类客户、行为者、利益攸关方的不同意见, 并将建成环境与自然过程看作是相辅相成, 催生潜在设计策略的媒介。这种富

Timeline 时间轴



探索与过程

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3. 危险栖居点增长时间表 (图片来源: 参考文献[2])  
3. Timeline of precarious settlement growth (Source: Refs. [2])

于变化的环境必然使多学科团队凝聚在一起: 例如, 非政府组织与大学的研究型实验室进行合作, 其设计方案进一步在政府层面进行推广。

新的方法论策略

“生活在阿布拉山谷的28.4万人正面临着山体滑坡的危险。到2030年, 这一数字将超过34.4万。我们需要做些什么?”

在哥伦比亚阿布拉山谷中, 那些不稳定山坡上不断增加的栖居点成为了麦德林市所面临的一个棘手问题。一个研究团队运用理论性框架和方法提出了应对这一

问题的多种解决途径, 可作为上述基于景观的理论框架的一个优秀范例。麦德林市和阿布拉山谷现行的总体规划诞生于《生命2030规划》, 旨在提高现有核心建成区

的密度, 并将未来居住地向临近山谷陡坡的现有建成区边缘引导。2011年, 一篇长达135页名为《移动的地表: 麦德林市的危险栖居点与地质灾害》的报告对该研究

和设计项目进行了总结<sup>[2]</sup>。2011年夏秋, 位于麦德林市的行政、金融和技术大学 (EAFIT) 及其Urban城市与环境研究中心, 联合美国哈佛大学设计学院的社会机构实验室以及诸多顾问参与了该项目的设计 (图2)。

近年来, 伴随着阿布拉山谷坡地的快速城市化, 因山体滑坡造成重新安置和死亡的居民数量与日俱增。这一情况是非法的土地开发商的土地侵占与坡体的地质不稳定性两者的共同作用造成的 (图1)。在短短的60年内, 麦德林市域范围内的人口由1950年的50万人增至2010年的355万人。据估算, 约占增长人口10%的55 000户居民生活在灾难易发的危险栖居点, 其中有45 000户居住在高危地区。历史数据真实揭示了山体滑坡造成居民死亡和重新安置的严峻性: 1850~2011年间已造成850人死亡及11.5万间房屋损毁 (图3, 4)。

麦德林市试图将山谷坡地高危地区的现有居住者及其房屋进行转移并重新安置。考虑到这一举措所需的运作与社会成本, “移动的地表”研究项目采用景观学框架为这一重大问题提供了一种微妙的解决途径。以2010~2030年间, 将会有6.7万名低收入移民和迁入者涌入阿布拉山谷寻找居所假设, 该研究采用了一种基于景观的驱动框架, 着眼于以下问题<sup>[2]</sup>, 并试图形成新的分析类别、词汇和策略:

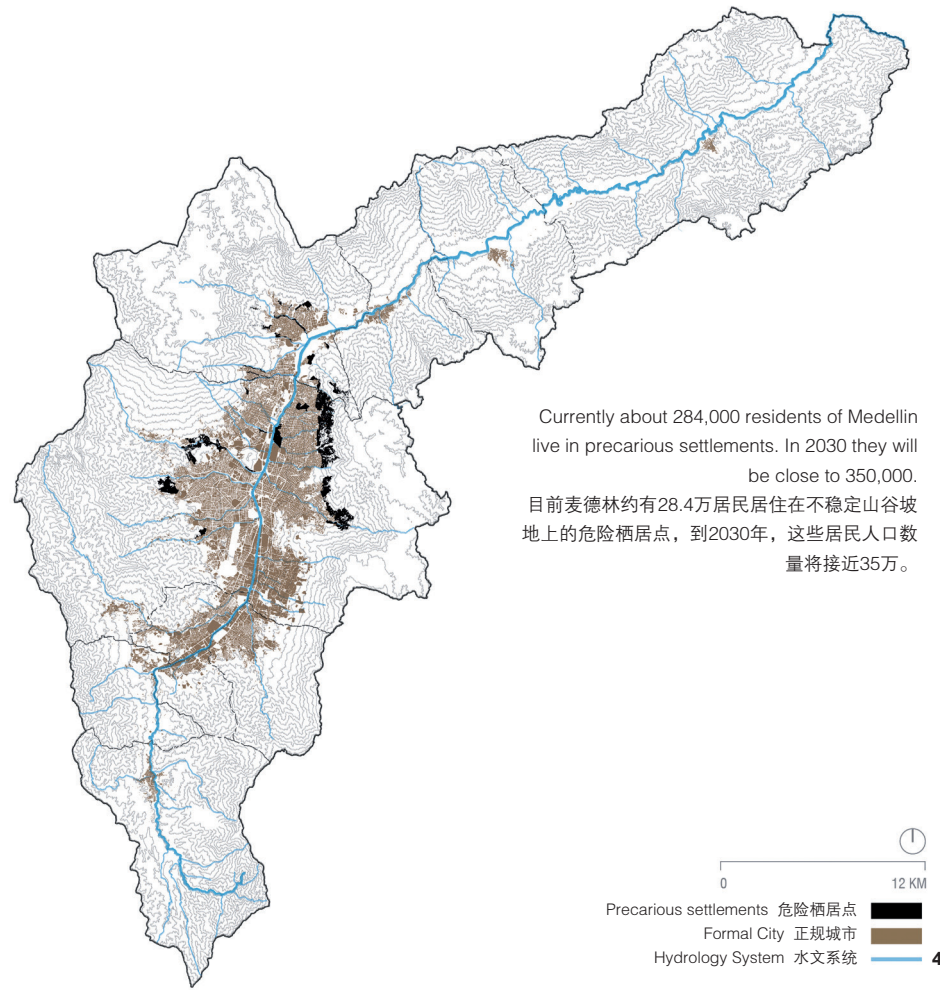
- 1) 如果不加以管理, 在不稳定的坡地上将新增13 400个临时栖居点。这些人还可以去哪里建立居所?
- 2) 如何将这些新的居民引导到更加安全的区域?
- 3) 此外, 如何使不稳定的阿布拉山谷坡地不再出现非法土地侵占现象?

曾尝试通过传统区域划分机制严格规定可建及禁建居住区域的做法并没有成功。非法开发商对特定平坦开敞空间的不法侵占以及其他的违法行为, 导致灾害易发区之上危险栖居点肆意蔓延。然而, 随时间演进的景观策略在社会、环境和经济方面的潜力, 为这一问题提供了新的解决途径。不同于以往直接划定可建及禁建居

Experiments and Processes

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**Precarious Settlements in 2011**  
2011年的危险栖居点



住区域，“移动的地表”研究项目旨在形成一种更有效的山谷坡地利用模式，并“探讨了引入诸如农业和度假类型的新型山区经济，作为减缓山谷坡地危险栖居点蔓延的最佳方式这一议题”<sup>[2]</sup>。

虽然这一多学科背景的团队在后期主要依靠数字通讯来推进项目，但是主要团队成员于2011年8月在麦德林市所进行的为期一周的工作，明确了主要研究问题并提供了项目初始动力。兼具本土和国际、私人 and 公共、专业 and 学术的研究团队构成，既实现了基于本土知识运用的国际合作项目的预期目标，又维系了学术研究自由以及实际操作中与当地政府沟通间的平衡。

**移动的地表**

“移动的地表：麦德林市的危险栖居点与地质灾害”研究项目将“城市”看作一种过程，而非一个场地<sup>[3]</sup>。正因如此，对2030~2050年未来城市化趋势进行定量的地理预测是该项目中的关键部分，其需要独特的空间呈现手段。将这些预测结果与标记地质不稳定的橄榄岩坡地的地图进行叠合，从而能够得到高危居住区域的范围。研究选取了三个具有独特代表性的风险区，对它们进行更小尺度的研究（图5）。例如，对贝罗市（研究区1）所进行的更详细的研究不仅揭示了未来将有多少户居民处于风险区（4万户），还揭示了危害可能发生的时间和地点（图6，7）。

这种预测的地理精确度为设计策略的提出创造了平台。通过绘制随时间变化的城市化过程，并辅以对坡地的全面地质评估，促进建立“为现有栖居点建立疏散、坡面稳固和迁置程序机制，以及保护和指导新栖居点免于不稳定山谷坡地影响的策略”<sup>[2]</sup>。

“移动的地表”研究项目最终对2030~2050年危险地区栖居点的增长率进行了预测，并形成了基于景观的“已占地修复策略和未占地预测机制”<sup>[2]</sup>。研究报告在结尾部分提出的策略图表<sup>[2]</sup>，共分为两部分（图8），旨在为形成更多详细策略奠定基础：第一部分强调生活在危险地区居民的安全问题，第二部分对2030~2050年危险栖居点进行了预测。

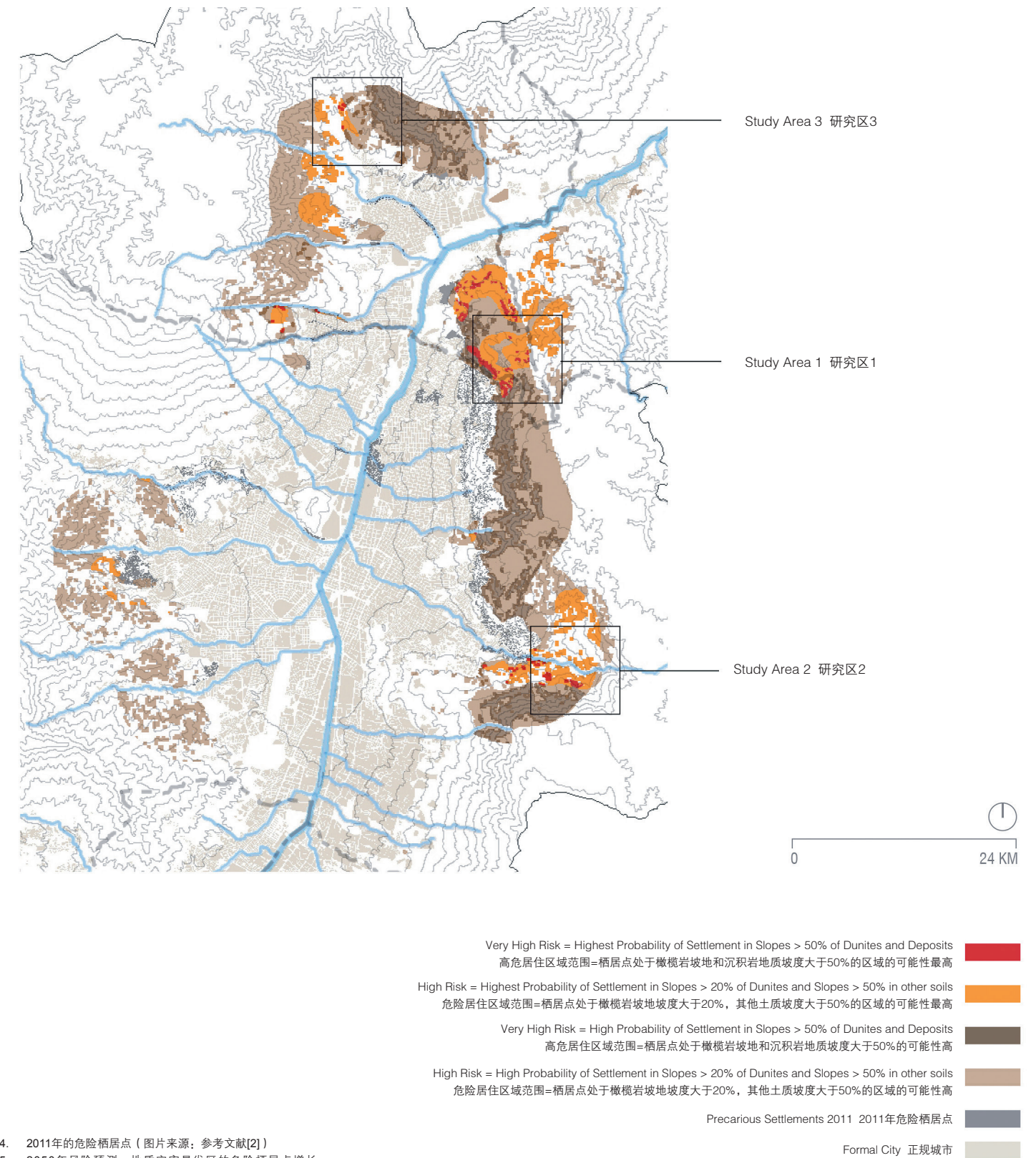
对高危地区的现有栖居点，建议采取疏散、坡地稳固和迁置措施。其中，每个措施都包括4个可能的实施等级，并与其他策略一并进行成效反馈。例如，生物性固坡工程是稳定大型陡坡地带的一种方法。这些坡地可能会逐渐建设登山步道，以服务于旅游经济。在这一经济模式中，地方或政府利益攸关方会降低居民向这些区域中移居的可能性。

该策略图表中的策略并不是禁止居民迁入或穿越阿布拉山谷，而是用了一半的篇幅来对如何引导居民迁往安全区域进行了说明。教育和社区领导培训是高危居住地重新引导策略中不可或缺的部分，他们可依照《移动的地表》和《生命2030规划》中的地图对具体区域进行改善。

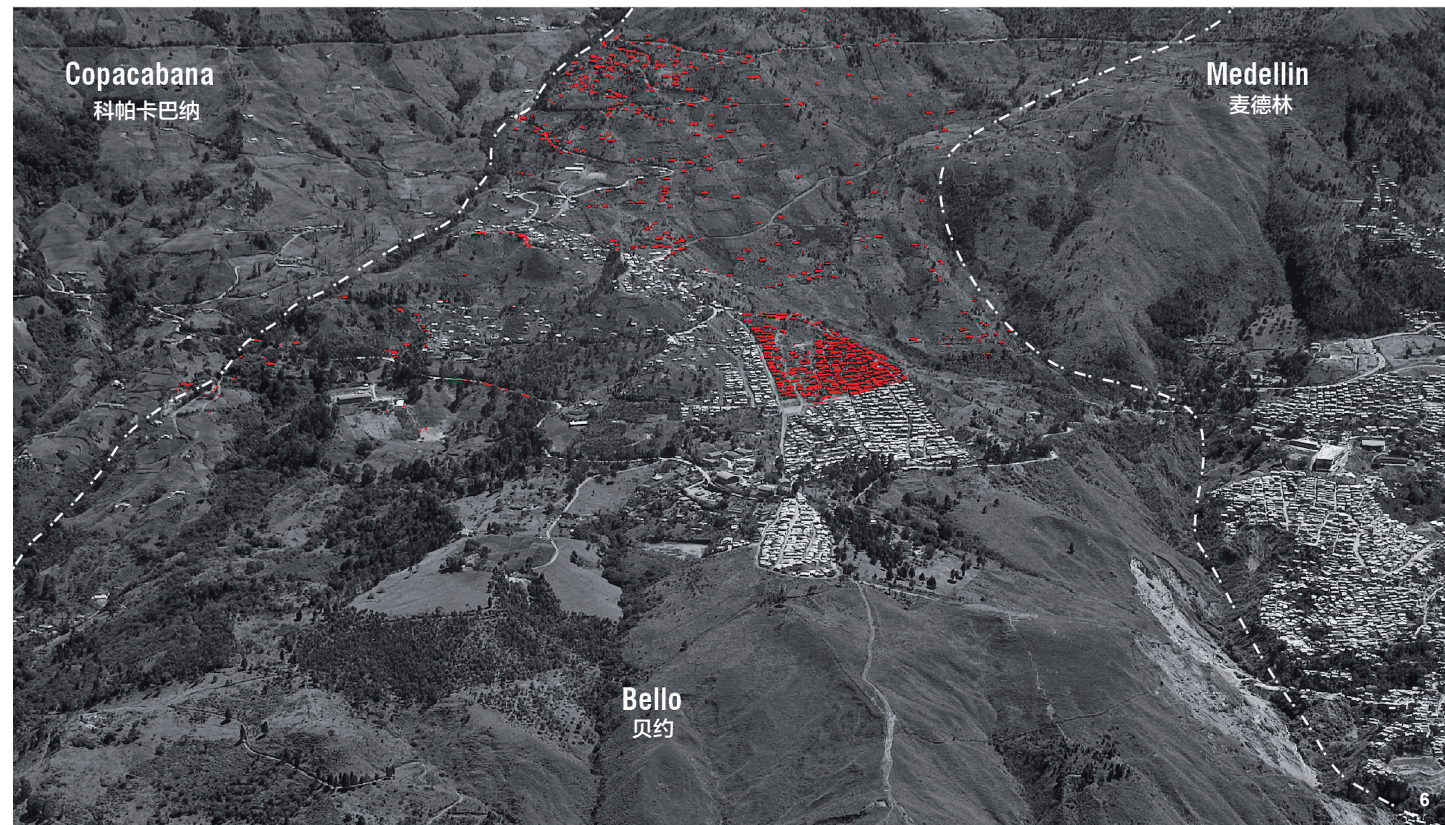
**非正式城市的绿色基础设施**

在2012年春季学期中，“移动的地表”项目哈佛大学研究团队的领导者克里斯蒂安·威尔斯曼副教授，在设计学院开设了一门名为“非正式城市的绿色基础设施”的研究课程。该课程对“移动的地表”项目中提出的广泛策略进行了进一步深化。课程研究报告《适应性地形：麦德林山区的基础设施策略》包含了与侵蚀、地质风险、水资源管理和粮食生产等主题相关的机会主义设计策略。该课程的所有

**2050 RISK PROJECTIONS: Precarious Settlement Growth in Geologically Hazardous Areas**  
2050年风险预测：地质灾害易发区的危险栖居点增长



4. 2011年的危险栖居点（图片来源：参考文献[2]）
5. 2050年风险预测：地质灾害易发区的危险栖居点增长（图片来源：参考文献[2]）。
4. Precarious settlements, 2011(Source: Refs. [2]).
5. 2050 Risk Projections: precarious settlement growth in geologically hazardous areas (Source: Refs. [2]).



成果也在《移动的地表》的策略图表中有所呈现。在这一春季课程的开展中，EAFIT大学Urban城市与环境研究中心负责人亚历山大·埃切维里，作为“移动的地表”项目麦德林研究团队的领导者曾多次到访。相关研究领域的诸多专家也在这一课程中举办了讲座。

最近，在Urban城市与环境研究中心、EAFIT大学和汉诺威莱布尼兹大学等各方的齐心协力下，一份长达301页的最新报告宣告完成，这使得“移动的地表”项目中的研究方法所产生的推动作用仍在持续。该报告题为《重居山区》，对《移动的地表》中提出的广泛的预防性策略进行了深化。

### 迭代性理论构建、方法论发展和策略部署

在阿布拉山谷这类案例中，为应对相互重叠的环境过程、社会重置空间、基础

设施以及栖居点建立所产生的复杂性和多变性，需要开发独特的理论框架、方法策略和因地制宜的语汇。《移动的地表》和其他以设计研究为目的、基于跨学科的团队构成与合作的研究报告，代表了这类发展的一种交互影响发展模式。在未来，为了对这些策略的成效进行不断检验，景观设计学和其他相关学科必须在一系列尺度和地理条件下的新兴城市化地区中实施这些策略。这一涉及理论建立、方法论发展与策略部署的迭代过程，能够不断为理论和实践创造新的机遇。LAF

#### 注释

此处对当代城市化的特征描述旨在将批判性城市理论的近期研究发展与景观设计学及相关学科联系起来。该理念引用自《全球城市化》一书的书名。该研究报告仅少量发表，但在www.lulu.com网站上可以获取该报告的赠印本。Urban团队由亚历山大·埃切维里与安娜·埃尔维拉·维勒兹担任负责人，玛雅·沃德·凯利特和桑迭戈·欧比亚担任助手。哈佛大学设计学院社会机构实验室由克里斯蒂

安·威尔斯曼副教授担任负责人，艾斯玲·奥卡罗尔与康纳·奥西亚担任助手。本文言论不代表哈佛大学设计学院社会机构实验室的观点。

《移动的地表》中对“危险栖居点”的定义援引自联合国人居署：危险栖居点“无法保证：能够在极端气候条件下提供庇护的耐用房屋；足够的生存空间（这里指一间房屋中所容纳的人数不超过三名）；居所便于达到安全用水地，水源充足且水价可承受；居所能够达到卫生条件良好的私人/公共厕所，且该厕所的使用人数在合理的范围内；以及，居所保证不会遭受强拆。”高危地区是通过地图叠加法，以及来自地质学古文迈克尔·赫莫林的建议得出的。这些高危地区很可能成为危险栖居点，并会发生地质性不稳定问题。克里斯蒂安·威尔斯曼现为汉诺威莱布尼兹大学景观与设计系教授。

- 研究区1在2007年的情况（图片来源：参考文献[2]）
- 研究区1在未受干预的情况下2030年的预期发展（图片来源：参考文献[2]）。
- Study Area 1 in 2007 (Source: Refs. [2])
- Study Area 1 in 2030 without intervention (Source: Refs. [2]).

Reconciling the unprecedented complexity, variety, scale, and rate of urbanization in the 21st century demands new theoretical frameworks, new methodological strategies, and new categories of analysis from designers, urbanists, and policy-makers alike.<sup>⑥[1]</sup> Developing these new tools helps destabilize design and urbanism's outmoded categories of analysis inherited from the 20th century, setting the stage for alternative urban futures. Projective research and proactive design strategies along with ongoing strides in mapping theory and technique is helping breakdown longstanding disciplinary divides among architecture, landscape architecture, and planning. Emerging urban conditions cannot be theorized with leftover 20th Century vocabulary, nor can more environmentally sensitive and socially just futures be attained using past methodologies and analytical categories. Emerging urban conditions must

be theorized using new vocabulary and cross-discipline cutting methodologies.

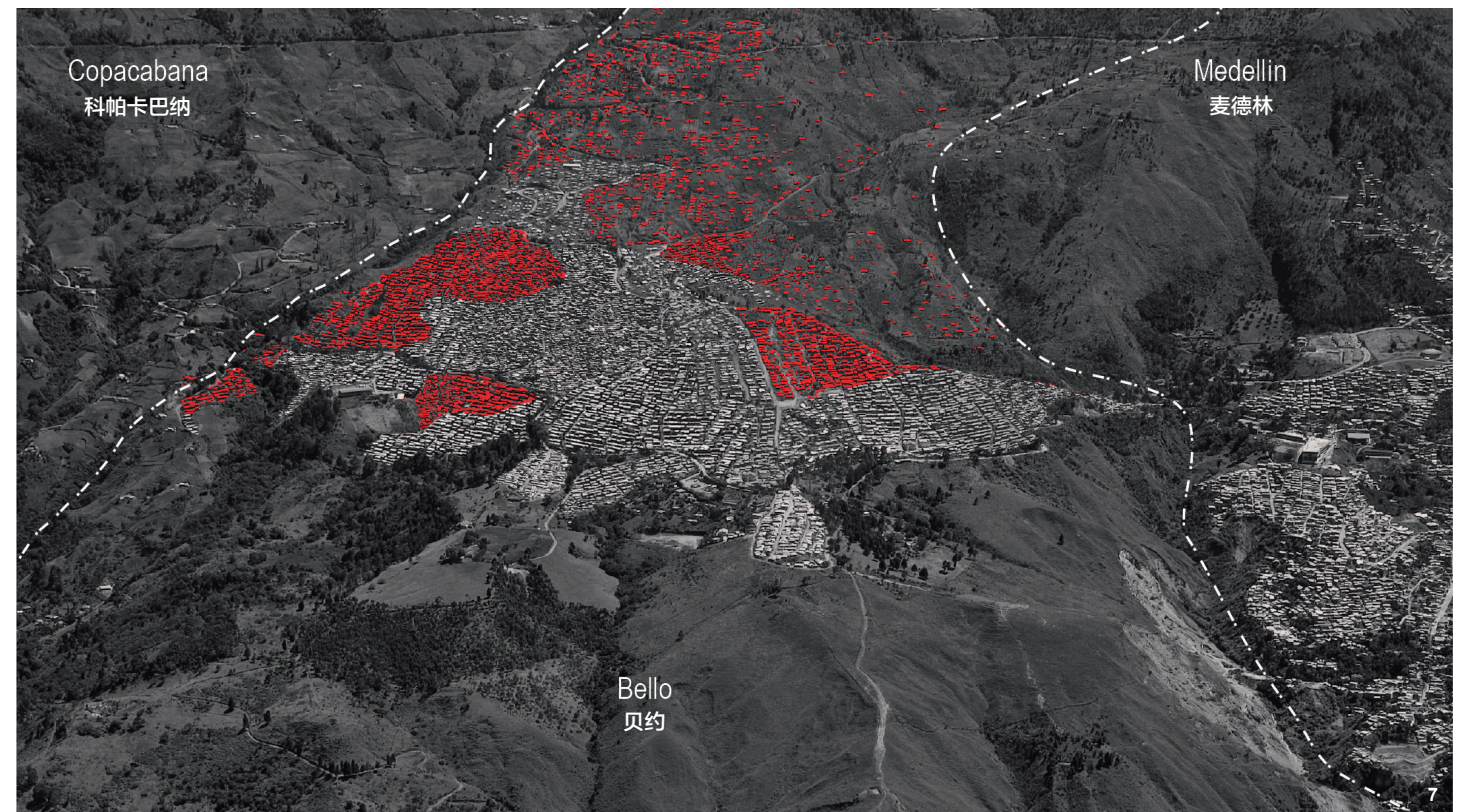
Over the past decade and a half, academics and practitioners in architecture, landscape architecture, planning, and related fields have demonstrated the use of landscape as a major framework for theorizing processes of urbanization and as a unique operative method for implementing design strategies. Its flexibility and time-based nature helps it reconcile frictions created by the clash of environmental, social, and economic forces produced by contemporary urban processes. Landscape in the age of planetary urbanization<sup>⑦[1]</sup> differs from its 19th century North American precursor that helped equalize class differences and mitigate pollution levels. It also transcends the McHargian approach of the mid to late 20th century that disproportionately championed environmentalism and segregated many

natural and urban processes. It considers urban processes as fluctuating in space and time, from the global to the continental to the local scale and does not discriminate among disciplines.

The use of landscape as a primary framework for theorizing contemporary urbanization and for design research mediates varied views of clients, actors, stakeholders, and considers built settlements and natural processes as complimentary and ripe with potential for design strategies. This variegated milieu necessitates assembling multidisciplinary teams: NGOs collaborating with research laboratories at universities who then promote design strategies within municipal governments, as one example.

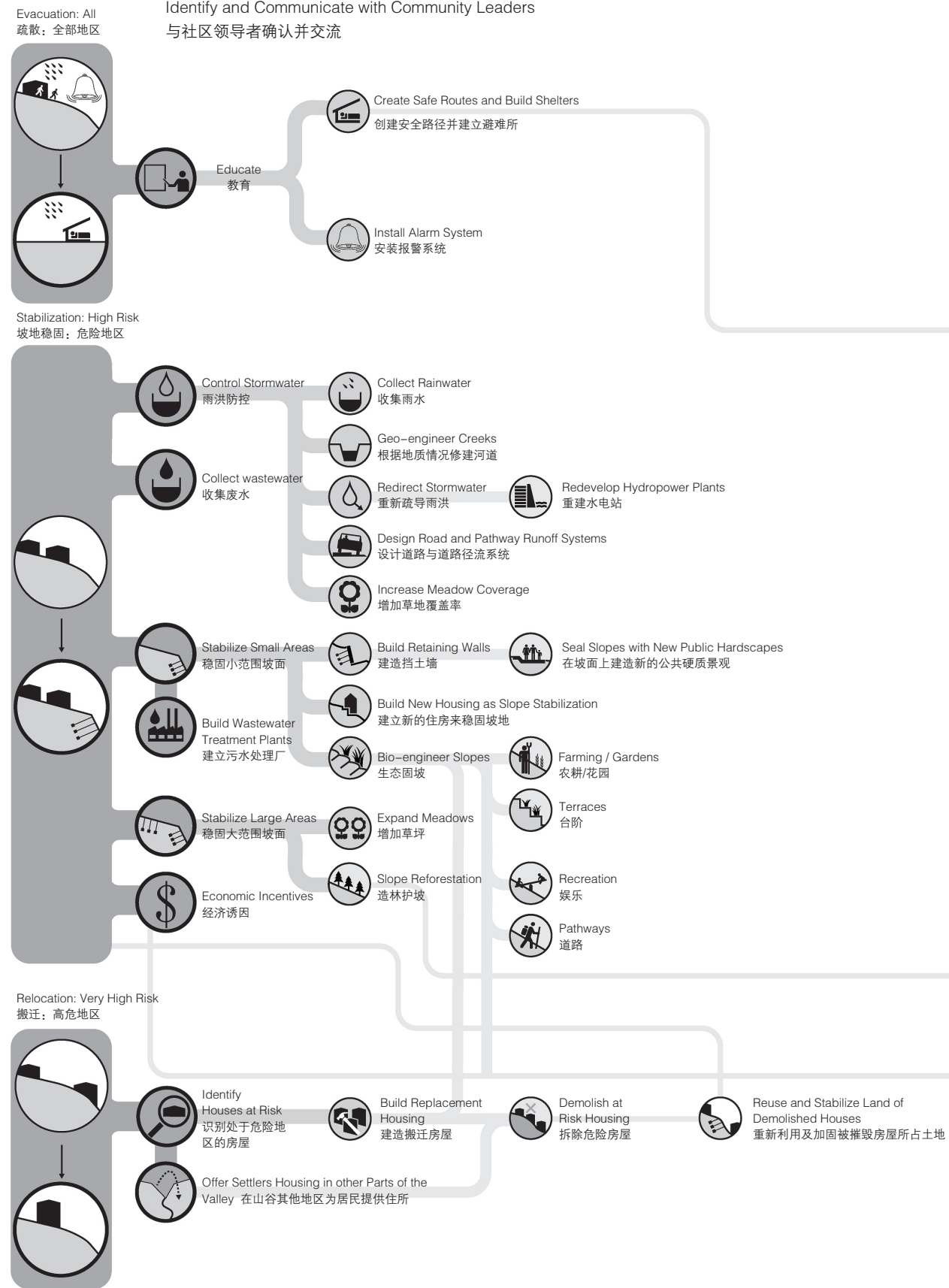
### New Methodological Strategies

“On the Aburra Valley slopes 284,000 people are at risk of landslides. By 2030 there

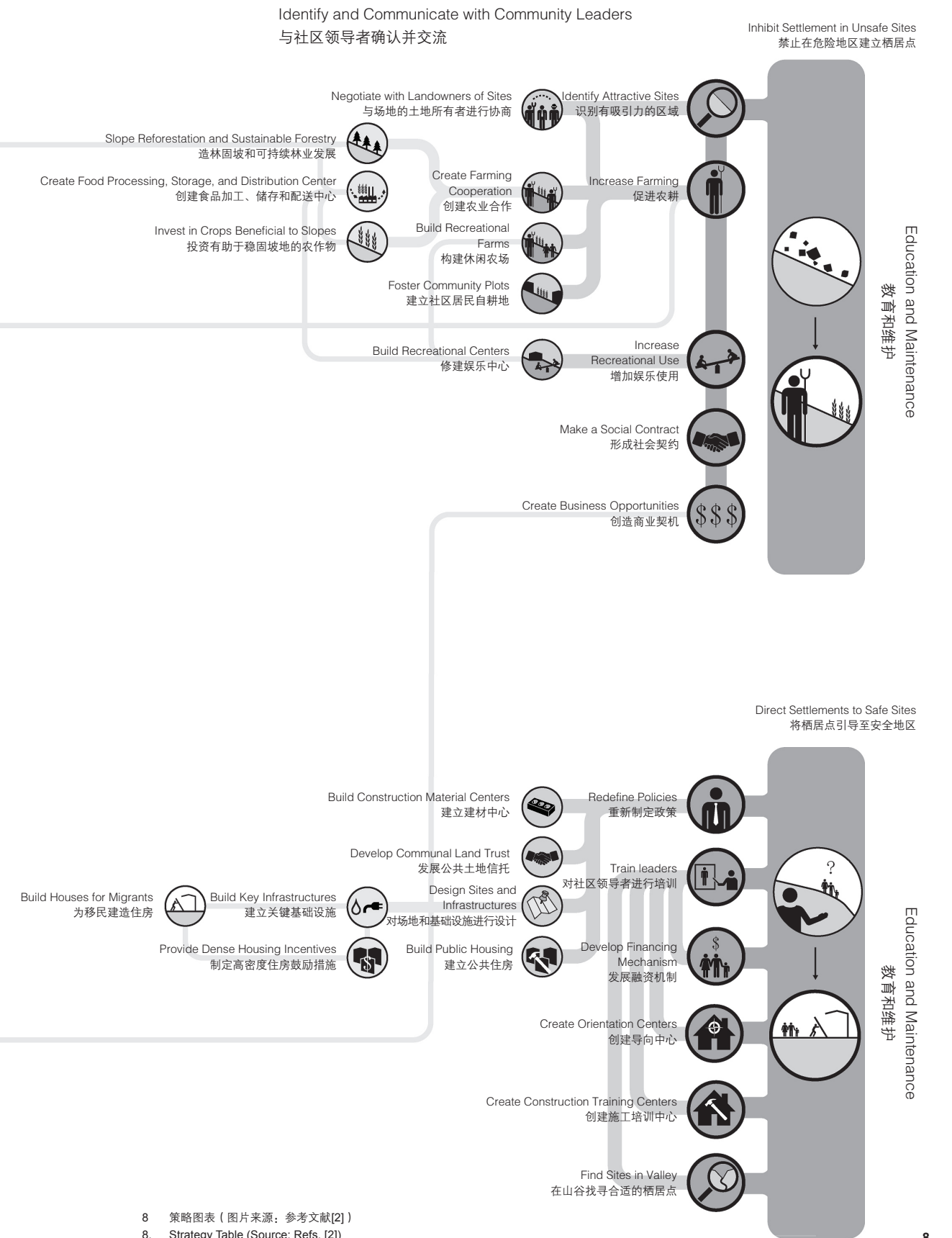


Identify Risk Zones for Specific Strategies  
识别灾害风险区的具体策略

Existing Precarious Settlements 2010  
2010年危险栖居点



Future Precarious Settlement 2030 ~ 2050  
2030~2050年危险栖居点



Education and Maintenance  
教育和维护

Education and Maintenance  
教育和维护

will be more than 344,000. What needs to be done?”

The theoretical framework and methodology used by a team of researchers to strategize multiple approaches to the urgent situation in Medellín created by the increasing settlement of unstable slopes in Colombia's Aburra Valley is an apt example of the landscape-based framework described above. Born out of the *Bio 2030 Plan*, Medellín and the Aburra Valley's current master plan that seeks to densify the settlement's built up core and reinhabit the edges of the built up area bordering the steep valley slopes, the research and design project is summarized in the 135 page publication *Shifting Ground: Precarious Settlements and Geological Hazard in Medellín* from 2011<sup>[2]</sup>. EAFIT University, in conjunction with Urbam, Center for Urban and Environmental Studies, both in Medellín, and the Social Agency Lab of the Harvard University Graduate School of Design along with numerous consultants, developed the project during the summer and fall of 2011<sup>④</sup> (Fig. 2).

The urbanization of the Aburra Valley slopes and consequential displacement and death of residents by landslides has accelerated in recent years, largely the result of land invasions and occupation by illegal land developers combined with geologically unstable slopes (Fig. 1). Medellín's population, as defined by its municipal boundary, exploded from 500,000 people in 1950 to 3,550,000 just 60 years later in 2010. An estimated ten percent of this growth lives in precarious settlements, or 55,000 housing units, with 45,000 of these in high-risk areas<sup>⑤</sup>. Historical figures demonstrate the real threat of death and displacement by landslide: 850 deaths and the destruction of 11,500 homes between 1850 and 2011 (Fig. 3, 4).

In considering the operating and social costs of moving settlers and homes out of

high-risk areas, as mandated by the city of Medellín, *Shifting Ground* employs a landscape framework to devise a nuanced approach to the issue. Assuming that between 2010 and 2030 an additional 67,000 low income migrants and in-migrants will flow into the Aburra Valley seeking housing, the research employs a landscape-driven framework, focusing on the following questions<sup>[2]</sup> to try and develop new categories of analysis, vocabulary, and strategies:

1) If unmanaged, 13,400 settlements will be erected on the unstable hills. Where can they go instead?

2) How can the new settlers be directed to safer areas?

3) And, how can the unstable Aburra valley slopes be protected from illegal land invasions?

Previous attempts to strictly enforce where settlers can and cannot build through traditional zoning mechanisms failed, with illegal developers claiming ownership of designated open space and other breaches of the law leading to unchecked growth of precarious settlements. However, the social, environmental, and economic potential of landscape strategies deployed over time provide new approaches to the issue. Rather than determining where to build and where not to build, *Shifting Ground* “seeks to generate a paradigm shift towards a more productive use of the valley slopes” and “explores the assumption that the introduction of new hill-based economies such as farming and recreation is the best protection from further settlement of the valley slopes.”<sup>[2]</sup>

Though the diverse team later came to rely on digital communication to move the project forward, a one-week workshop with the major team members in August 2011 in Medellín defined the main research questions and provided the initial momentum. The

local and international, private and public, professional and academic composition of the research team helped achieve a level of objectivity while still operationalizing intimate local knowledge, and leveraged the security of academia while still maintaining practical ties to local government.

### Shifting Grounds

By necessity, *Shifting Ground: Precarious Settlements and Geological Hazard in Medellín* regards the urban as a process, not a site<sup>[3]</sup>. Towards that end, quantitative geographic projections of future urbanization trends to 2030 and 2050 are a critical component of the project, requiring unique mapping methods. Overlaying these projections on maps of geologically unstable dunite slopes results in a range of risky areas for settlement. Three study zones, each representing unique risk areas, were selected for study at a closer scale (Fig. 5). For example, examining the Municipality of Bello (Study Area 1) in greater detail shows not only how many homes will be at risk — 40,000 — but also when and where they might potentially be harmed (Fig. 6, 7). The geographic precision of this forecast sets the stage for design strategies to emerge. By mapping urbanization processes over time, alongside a thorough geological assessment of the slopes, “mechanisms to establish evacuation, stabilization and relocation procedures for existing settlements, and strategies that protect and direct new settlements away from unstable valley slopes” become possible<sup>[2]</sup>.

Ultimately *Shifting Ground* projects growth rates of precarious settlements for the years 2030 and 2050 and develops landscape-based “remedial strategies for occupied areas and anticipatory mechanisms for areas that have not yet been invaded.”<sup>[2]</sup> The strategy table provided at the end of the

report<sup>[2]</sup>, meant to serve as a starting point for developing more detailed strategies, is divided into two primary halves (Fig. 8). The first addresses the immediate safety of settlers living in hazardous areas and the second anticipates future precarious settlements in 2030 and 2050.

For existing settlements in high risk areas, the table recommends evacuation, slope stabilization, and relocation. Within each of these three components, four levels of possible operations are outlined alongside feedback loops with other strategies. For example, one method of stabilizing large swathes of steep slopes involves bio-engineering. Over time, these slopes might shape hiking paths, supporting the tourist economy. Local or governmental stakeholders in this economy would help decrease the probability of settlers moving into these areas.

The table does not seek to exclude settlers from migrating into or throughout the Aburra Valley, rather, directing settlers to safe sites comprises one half of the strategy table's projective side. Education and community leadership training are integral parts of redirection, and they could utilize maps produced by *Shifting Ground* and the *BIO 2030* master plan to promote particular areas.

### Green Infrastructure in the Non-formal City

In the spring term of 2012, Associate Professor Christian Werthmann, leader of the Harvard University team, taught a research seminar at the Graduate School of Design titled *Green Infrastructure in the Non-formal City*. The class developed the broad strategies put forth in *Shifting Ground* in greater depth. The resulting research report, *Adaptive Terrain: Infrastructural Strategies in the Hills of Medellín*, contains opportunistic design strategies related to topics of erosion, geological risk, water management, and food production, all of which are also present in the strategy table from *Shifting Ground*. The seminar included visits from Alejandro Echeverri, director of Urbam at EAFIT University in Medellín, who also lead the research team in Medellín for *Shifting Ground*. The course also included presentations from experts in related fields of study.

The momentum produced by the research methodology of the *Shifting Ground* project persists, as a new 301-page report was recently completed through the combined efforts of Urbam, EAFIT University, and Leibniz University Hanover<sup>⑦</sup>. This report,

*Rehabitar La Montaña*, further resolves the broad pre-emptive strategies born from *Shifting Ground*.

### Iterative Theory Building, Methodological Development, and Strategy Deployment

The complexity and variability of overlapping environmental processes, spaces of social reproduction, infrastructure, and settlement building in a case like the Aburra Valley demand the development of unique theoretical frameworks, methodological strategies, and appropriate vocabulary. *Shifting Ground* and the other research reports associated with the design research initiative, along with the interdisciplinary team composition and collaborations, represent a single iteration of one such development. Moving forward, landscape architecture and related disciplines must continue testing the efficacy of such strategies by deploying them in emerging force fields of urbanization at a range of scales and geographies. This iterative process of theory building, methodological development, and strategy deployment can continue launching new opportunities for theory and for practice alike. **LAF**

### NOTES

- ① This characterization of contemporary urbanization attempts to relate recent developments in critical urban theory with the discipline of landscape architecture and related fields.
- ② This concept references the title of *Planetary Urbanization*.
- ③ The research report was only produced in limited quantity, but additional copies are available upon request from [www.lulu.com](http://www.lulu.com).
- ④ The urbam team was lead by Alejandro Echeverri and Ana Elvira Vélez, with assistance from Maya Ward-Karet and Santiago Orbea. The Harvard University Graduate School of Design's Social Agency Lab was led by Associate Professor Christian Werthmann and assisted by Aisling O'Carroll and Conor O'Shea. The views expressed in this article do not represent the Social Agency Lab or the Harvard Graduate School

of Design.

- ⑤ The definition of precarious settlements in *Shifting Ground* is borrowed from UN-Habitat: “Are those that lack at least one of the five conditions: durable housing of permanent nature that protects against extreme climate conditions; sufficient living space, which means no more than three people sharing a room; easy access to safe water in sufficient amounts at an affordable price; access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people; and, security of tenure that prevents forced evictions.”
- ⑥ High-risk areas were determined through mapping methods and input from the geology advisor, Michel Hermelin, and indicate zones that are likely to experience precarious settlement and are also geologically unstable.
- ⑦ Christian Werthmann is now Professor of Landscape Architecture and Design at Leibniz University Hannover.

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