

景观服务新模式： 疏浚设计

BEYOND SERVICES: DESIGN WITH DREDGE

1 项目背景

“疏浚设计”计划是由Mahan Rykiel景观设计事务所（MRA）与康奈尔大学助理教授兼疏浚研究协会（DRC）会员布莱恩·戴维斯，以及马里兰州港口管理局（MPA）共同领导的一个应用型设计研究项目。自19世纪北美地区景观专业创建以来，当代景观实践的议题一直不断发展变化，并未囿于场地本身。由景观设计基金会发起、由来自全球各地的1 700余位从业者共同签署的《新景观宣言》，既是景观设计学科的拓展，也是这种新设计趋势的最好体现。“疏浚设计”计划将人为淤积的过程、产物和方法作为景观设计实践的主体，在与社区和专业人士的协作下，通过研究切萨皮克湾及周边地区的海平面上升问题、变迁的生态系统和文化景观，来更深入地理解最基本的景观材料——泥。

这种研究视角是MRA在专业设计实践中所倡导的强调研究并注重与开发合作伙伴进行互动设计的一种策略，这种策略与传统客户主导型景观设计服务最大的区别是其基于多客户利益及多效益的设计实践模式。这种新型模式旨在应对气候变化挑战，建立景观设计师在新兴业务市场中的位置，并通过专业发展和继续教育来提升从业人员的能力（图1）。透过这种扩展的服务模式，MRA及合作伙伴致力于创建一个指导相关专业实践的、务实的应用框架，来鼓励景观设计师参与、

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摘要

景观设计正处于复兴时期——一个重要的标志是景观设计师第一次被授予麦克阿瑟奖。透过大型景观项目，景观设计师需要对城市公园、滨水区，以及城市中心开发区得以提出新的构思。这些项目因巨大的规模和尺度，会对其所在的城市带来重要的社会、生态和经济影响。这种客户主导的服务模式影响着景观项目的进行，也影响了景观设计师的收入及声望，但这只是景观实践的其中一种模式。本文介绍的“疏浚设计”计划旨在扩展服务范畴并建立新型专业实践模式，它整合了研究、设计、实验、实践，和由社区及不同合作对象执行的适应性管理。这种模式并非意在推翻或否定现有的景观设计模式，而是力求拓展景观设计的可能性，并鼓励更多的设计师关注景观设计中的不同媒介，同时探索各种尺度下非自然的淤积过程及处理。这一横跨多专业的协作机制有助于在从业者、社区成员、学者、监管者和专业人士之间建立一套整合的概念框架、规划优先等级和应用景观策略，以推进巴尔的摩－切萨皮克湾地区的疏浚物韧性设计管理，并为其他港口城市和沿海社区在新型实践模式和新兴景观基础设施方面的探索提供借鉴。

关键词

淤积物；设计研究；景观基础设施；专业实践；韧性；服务

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ABSTRACT

Landscape architecture is in the midst of a renaissance. For the first time, a landscape architect was awarded the McArthur Foundation Fellowship. Large professional service contracts are being tendered to practitioners to reimagine urban parks, waterfronts, and downtown development districts. The scope and scale of these projects are significant, as are the impacts these commissions are having on the social, ecological, and economic fabric of the cities in which they are taking place. However, inasmuch as the client-driven professional service model through which these landscapes take shape is essential to the financial health and prestige of landscape architects, it represents only one model of landscape practice. The Design with Dredge program seeks to expand beyond services and into a model of professional practice that proactively collocates research, design, experimentation, activism, and adaptive management with community and strategic partnerships. The model does not attempt to supplant or undermine the business of landscape architecture. What it does do is to widen the aperture of possibilities and extend the field of action for landscape architects who wish to engage more directly with the medium of landscape and specifically with anthropogenic sediment processes including large- and small-scale dredging operations. This broadened professional nexus creates opportunities for practitioners, community members, academics, regulators, and industry experts to advance shared conceptual frameworks, planning priorities, and applied landscape strategies for resilient dredged material management in the Baltimore-Chesapeake Bay region, providing a precedent for others who may wish to explore new modes of practice and emerging landscape infrastructure issues facing port cities and coastal communities.

KEY WORDS

Sediment; Design Research; Landscape Infrastructure; Professional Practice; Resilience; Service

编辑、翻译 田乐
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1. “疏浚设计”计划联合设计研究框架
1. Collaborative design research model for the Design with Dredge program

讨论并解决经济发展、生态管理和社区身份认同等方面的问题。

人为淤积物及相关处理作业为这种主动的景观实践提供了一个全方位的切入点。地势形成过程产生的淤泥，特别是人为挖出的淤泥，是景观设计的核心，它是各种河口生态系统和沼泽湿地的基质，但过多的淤积物也会造成环境污染；它无疑也是城市和基础设施建设的一部份，很多滨海城市正是建立在这些陆地建设中的冲刷物以及海洋疏浚作业的残余物之上（图2）。

在此视角下，简·本奈特将淤积物称为“活性物质”：一种具有媒介性的材料，其不止受到人类活动的影响^[1]。对于景观设计师而言，淤积的形成不仅激发了景观都市主义^[2]、景观基础建设和景观方法^[3]的理论，也促进了对景观设计更深入的思考 and 实践。随着疏浚物处理的实际体量和经济效益在美国国内和全球的不断增加^[4]，景观专业的投入显得更加重要。因此，提出新方法来应对这个复杂的景观新议题便是景观设计师当前的使命。

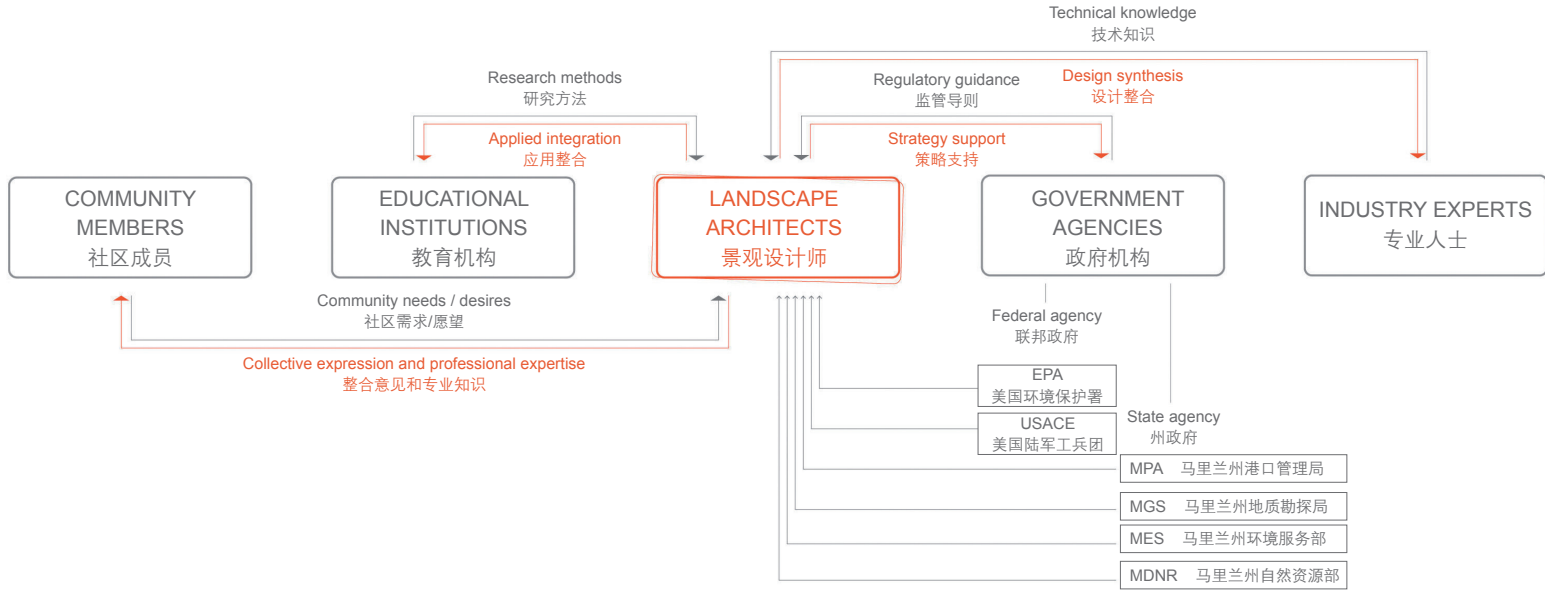
在巴尔的摩，港口和城市受到旧有生产活动、新兴思潮和生态意识等多方面因素影响，构成了复杂的河口环境（图3）。在这种不稳定的环境中，自然和人为的淤积活动会导致河道及航道堵塞，为了使其运行顺畅，每年需要清理约114.7万立方米的淤积物。而整个切萨皮克湾地区（包括通往巴尔的摩港口、诺福克港口、切萨皮克和特拉华运河的航道）每年要清理的淤积物至少有350万立方米^[5]。除了这些大规模的疏浚工程外，马里兰州和弗吉尼亚州政府还因需要开展了另外200余项规模较小的疏浚作业，这些均对区域的淤积形成、生态环境、经

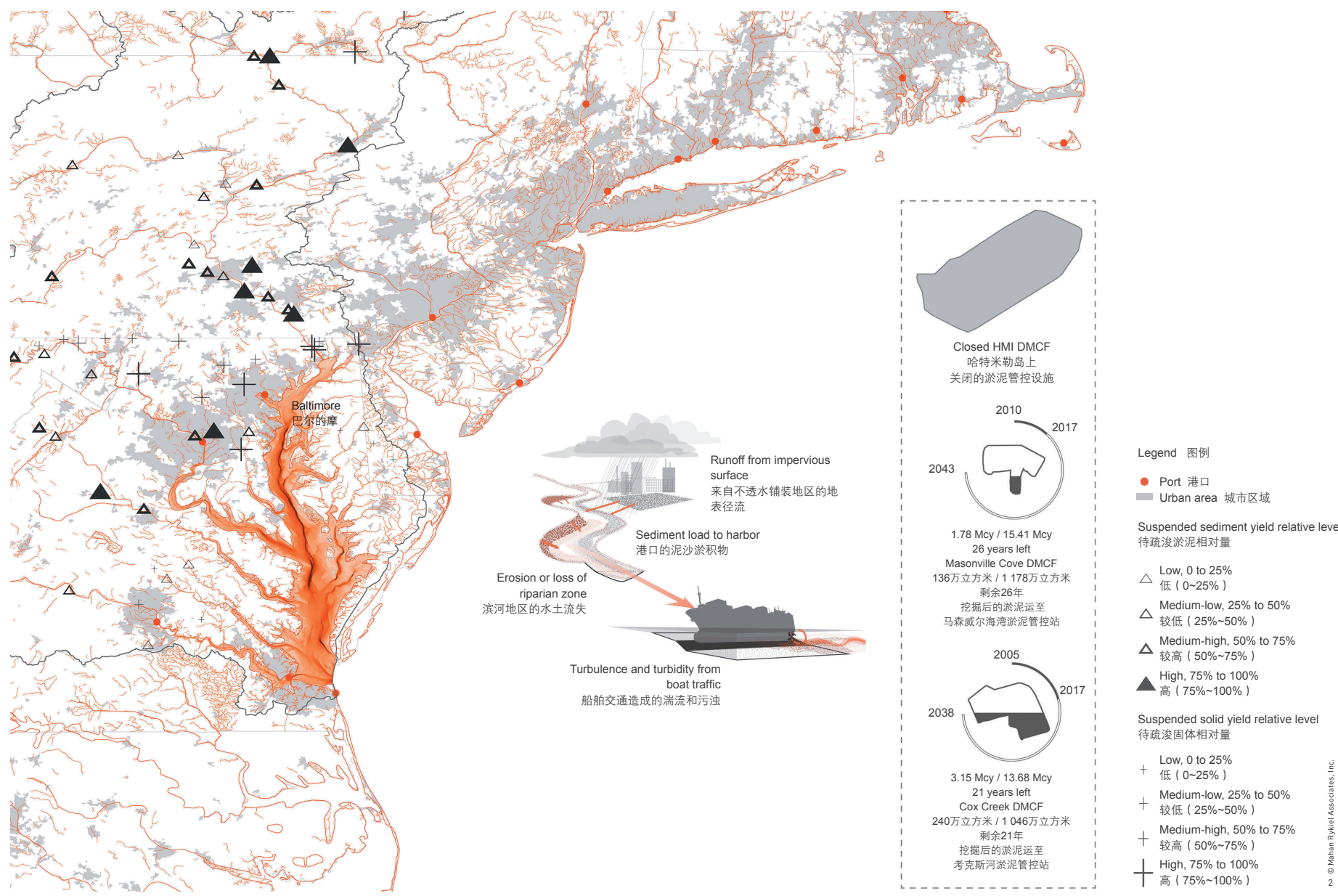
济及当地社区带来了影响^[6]（图4）。

尽管公众大多将淤积物视为垃圾，且各州和联邦政府出台的相关监管法规也相当复杂或尚未整合完全，但沿海城市正是建立在这些粘土、淤泥和沙砾之上。淤积物存在于水体与陆地之间的特性，对韧性景观基础设施有着极大的价值，然而其潜力还未被充分发掘。随着海平面上升、风暴肆虐、海岸下沉，不论美国全国或是马里兰州都急需一套更新的疏浚物处理方案，以提升整体环境韧性，保障州内不同群体的利益。

“疏浚设计”计划正是对这一呼吁的积极响应。以景观设计师为主导，社区、学者、监管及政府机构、专业人士共同参与的跨领域合作，重新将巴尔的摩港口和切萨皮克湾地区的淤积物视作打造韧性城市和田园景观的基石和重要资源。该计划整合了先进的泥沙科学、监管架构、经济发展规划和社区计划，开发了一套概念性的协作模式、明确的规划优先等级与务实的景观策略，以实现对疏浚物的弹性管理（图5）。

“疏浚设计”团队提出一套不受时空限制的研究方法，运用地形投影、系统制图、历史调查、案例研究、类型学研究、适宜性分析模型、材料测试、参与式实践和设计预测等方式，鼓励各群体共同参与、打破监管限制，并提高该计划中巴尔的摩和切萨皮克湾地区合作机构的技术能力。本文将通过三个项目来讨论这种高度整合的专业实践模式。这三个项目虽然在规模、目标、方法和影响等方面大相径庭，但它们都与海湾的淤泥及人为清淤过程息息相关，并明确地展现了景观专业在其中的价值和角色。



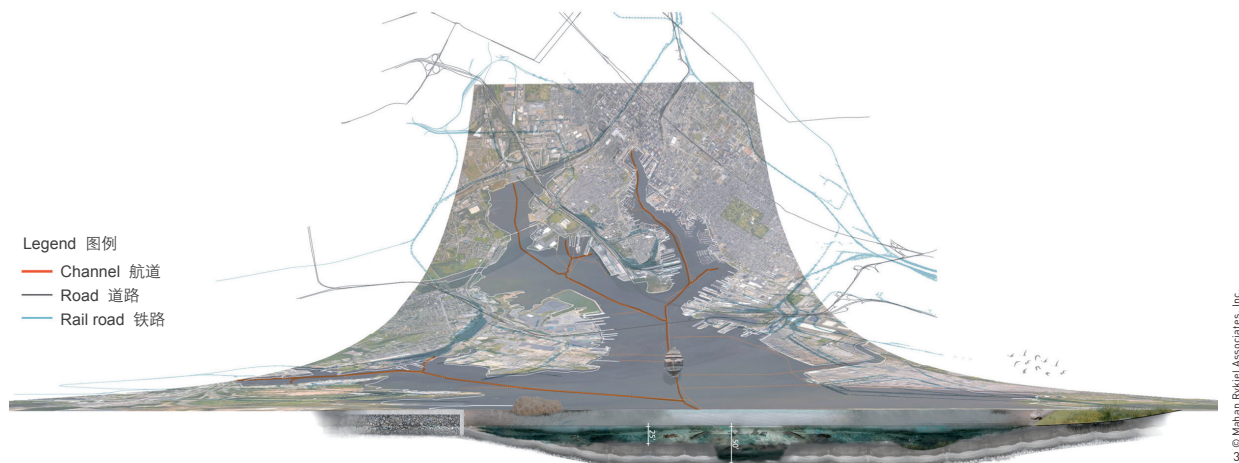


2 设计过程

三个项目分别是位于特纳车站的薄层淤泥铺填计划、位于哈特米勒岛的生态系统修复及适应性管理项目，以及针对中湾地区有益性利用的适宜性研究。透过这三个尺度、景观类型和参与群体皆不相同的项目，为淤积物景观及景观基础设施的研究及新型协作设计方法的制定奠定了基础。这些实验性的景观专业实践，探索并整合了与人为疏浚物处理相关的各种目标、方法和潜在影响。

为了更好地理解这些项目，有必要简述相关的监管背景。于2001年出台的《马里兰州疏浚物管理法案》要求提出一套能运行至少20年的疏浚计划，以保障切萨皮克湾和巴尔的摩港联邦航道的水上贸易。马里兰州法规禁止将疏浚物倾倒在开放水域，并规定巴尔的摩港口的疏浚物只能被移除或在港口内进行有益性利用及创新性再利用^[7]。随着现有疏浚物管控设施日渐达到处理上限、新的管控设施与巴尔的摩港的滨水开发项目存在利益冲突，港口疏浚物的处理成本不断增加。

与此同时，据最新的气候科学预测，到2050年，马里兰州将是美



国第二个会长期遭受洪水灾害侵袭的州^[8]。对此，马里兰州于2017年出台《减少废弃物及资源回收行政法令》（编号：EO 01.012017.13），特别强调疏浚物的创新性再利用和有益性利用及资源永续经营的合作机制。为了支持这一政策目标并扩大创新性再利用和有益性利用的范畴，马里兰州环境部（MDE）于2017年发布了相关监管指导文件，说明了疏浚物的最终用途和许可流程。

2.1 特纳车站案例

在特纳车站社区实行的薄层淤泥铺填计划延伸应用了既有的监管架构，有效地利用巴尔的摩港航道的疏浚物来修复弗莱明公园的滨水岸线。弗莱明公园位于马里兰州的巴尔的摩郡，是一处面积约8.1hm²的开放空间，其滨水岸线近800m，属于帕塔斯科河的熊溪支流。^[9]（图6）。巴尔的摩郡公园与游憩部拥有公园的所有权和运营权。一直以来，公园都供以非洲裔美国人为主的特纳车站社区居民所使用^[10]。该社区在数十年间长期志愿参与“马里兰州疏浚物管理计划”的各项公民监督措施，确保了全州疏浚工作的公开透明。社区与各方的合作及淤泥处理科学的宝贵经验成为了推动弗莱明公园项目的重要动力，并持续赢得了外界的支持^[11]。

通过与社区密切合作，“疏浚设计”团队从生态、文化和监管等方面对弗莱明公园的场地现有条件进行了分析。团队将地形、水深、植被和土壤类型等地理空间数据叠合到一个三维模型中，针对公园中不同高程的潮间带（沉水植被区、矮草沼泽区、高草沼泽区和高地改善区），铺填不同厚度的薄层疏浚物，以达到复育滨水岸线的目的（图7，8）。

透过对场地历史照片资料的分析，团队展示了其中一些具有文化意义的行为模式（如在木栈道边捕蟹、垂钓和聚集，图9），社区居

民希望能够在项目中得以重现。目前，配合州政府机构的监管要求，MRA和“疏浚设计”团队正在为切萨皮克湾地区制定首个城市薄层淤泥铺填作业许可流程。弗莱明公园设计中采用的合作方式、社区参与和多重效益策略（包括生态、经济和社会效益）提供了一种针对不同场地的、流程导向型的实践范例，展现了景观设计师如何将淤积物转变为城市环境中一种重要公共资源的过程（图10）。

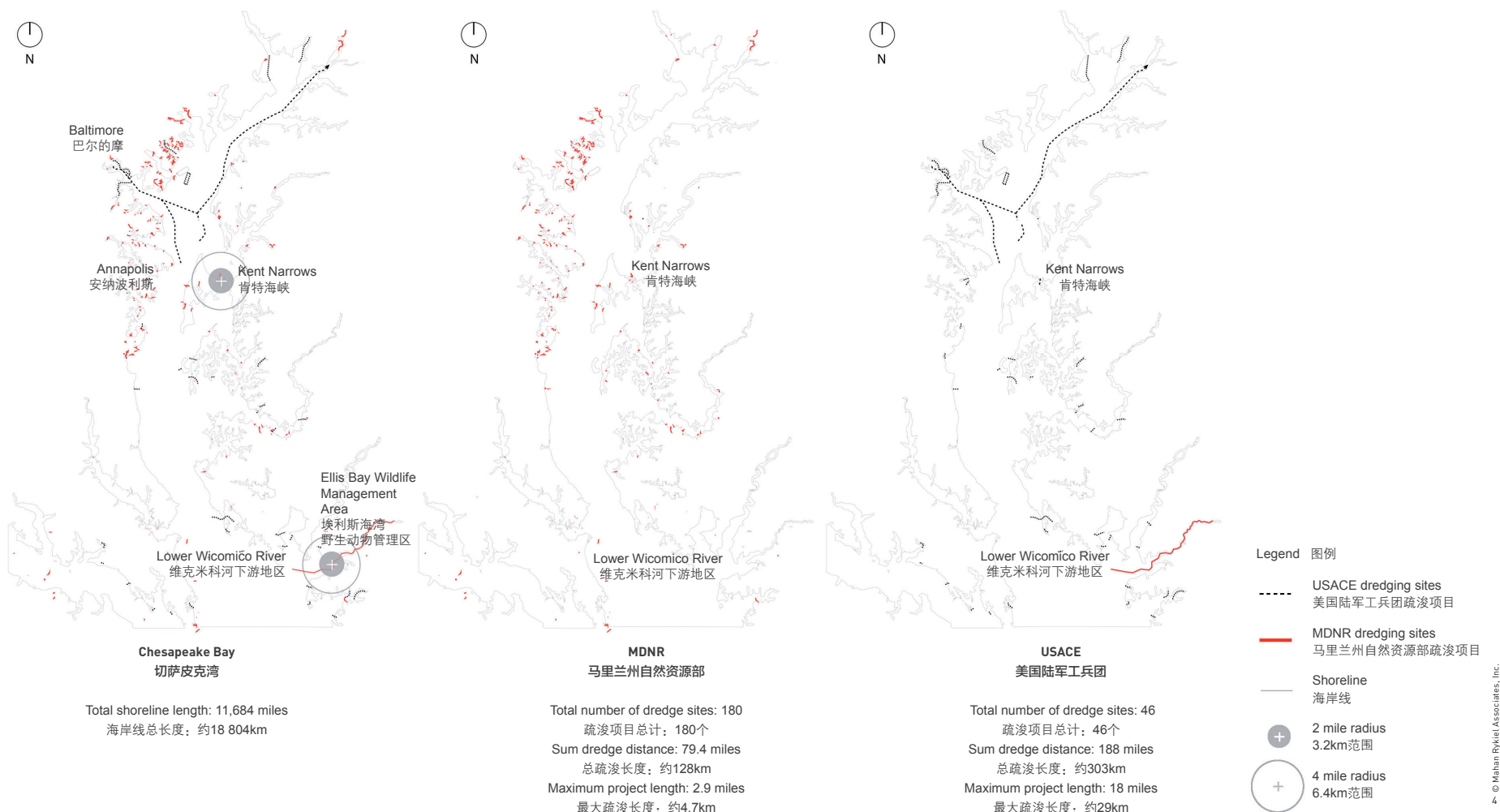
2.2 哈特米勒岛案例

哈特米勒岛生态系统修复及适应性管理计划可视作是将弗莱明公园的设计方法应用在更大尺度上的州级项目。哈特米勒岛是一个占地面积约445hm²的疏浚物管控场所，于2009年关闭（图11）。在那之前，巴尔的摩港口航道中的疏浚物都在此安置处理。项目原计划将场地转变为马里兰州自然资源部（MDNR）的一个休闲场所。然而，疏浚物的不断酸化阻碍了水体和土壤修复工作的推进，致使巴尔的摩港每年的运营和维护成本一直居高不下，其他疏浚物管理工作也无法顺利开展。

应用景观思维于此种大尺度项目将会是提升效率的契机。团队与湿地和土壤学家合作制定了一种综合性场地研究策略，将传统科研方法（如对土壤物理和化学性质断面研究及植被群落组成和覆盖度调查）与景观专业方法（如环境变迁说明图绘制、场地机械承载力分析、实施路径及作业图解，以及对场地美学特质的体验性表现）相结合。这既有利于团队了解场地丰富的景观特质，也有助于他们充分考量设备操作和维护费用问题（图12~14）。

为了节省港口管理局的运营成本，团队建立了一个面积为9.3hm²的试点，以便了解并促进哈特米勒岛淤积物熟化和栖息地的转变。团队同时考量了维护和设计需要，以及港口管理局沃尔沃EC300E型长臂

2. 切萨皮克湾地区人为清淤过程
3. 巴尔的摩港口景观基础设施包括错综复杂的交通、工业、文化及生态网络。
2. Regional anthropogenic sediment manipulation processes in the Chesapeake Bay watershed
3. Landscape infrastructure in the Baltimore Harbor is comprised of a layered network of multi-modal transportation, industrial, cultural, and ecological systems.



水上挖掘机的作业强度和半径，期望达到场地淤积物的填挖平衡（图15）。项目团队与机械操作员一起现场模拟并改进了实验设计，以确保持项目的可行性及效能（图16）。

试点项目将建造一系列直径为7m、高2.4m的圆形地块，并计划于2019年春夏期间播种多年生草本和一年生花卉植物；同时开展为期三年的适应性监测/管理工作，并评估在不同淤积物熟化程度下的栖息地重建状况。这种整合了维护、设计和适应性监测与管理工作的新型景观实践范例也印证了布莱恩·戴维斯和托马斯·奥勒斯于2014年在《从设计到景观》^[12]一文中，以及最近朱利安·拉克斯沃斯在《杂草丛生：介于景观设计与造园的实践》^[13]一书中指出的景观专业变化趋势。通过聚焦于长期被忽视的港口淤积物及相关处理工具和技术，哈特米勒岛案例提出了一套大规模处理疏浚物的有效方法（图17）。

2.3 中湾区案例

有别于专注于场地的设计项目，中湾地区适宜性研究旨在为长期监管马里兰州海湾地区小规模疏浚项目的MDNR开发一套工具，透过区域性的探索，分析适宜利用淤泥进行修复的场地。这些项目长期缺少资金和开发许可权限，大多位于依赖航道运输的沿海地区，面临着湿地减少、破坏，以及因地层下陷、海平面上升和气候变化引起的灾难性洪泛等危机。这些问题都或多或少地与淤积物有关，而这些海湾地区挖掘出来的疏浚物却可能成为其他地方的重要资源。

在与MDNR合作开发这一工具时，项目团队采用了景观设计学、工程学，以及沿海科学和规划学科中已有的技术和概念性作法，包括区域性淤积物管理、适宜性分析，以及早期建立的马里兰州海岸韧性评估系统^[14]、关键物种栖息地、海岸线资讯记录等。这些要素在多重指标

- 4. 由MDNR和美国陆军工兵团开展的切萨皮克湾地区疏浚作业地图
- 4. Map of dredging operations in the Chesapeake Bay overseen by MDNR and USACE



Volume
The total volume of dredged material in innovative reuse and beneficial use projects varies. Volumes can range from as little as 5,000 cubic yards in small-scale thin layer placement projects to upwards of 40 million cubic yards in large-scale restoration projects like Poplar Island.

体积
实行创新性再利用和有益性利用的淤泥总量不尽相同：小尺度项目如利用几千立方米淤泥的薄层铺填计划，大尺度项目如运用几千万立方米淤泥的白杨木岛修复工程等。



Stakeholders
Committed stakeholders help advance innovative reuse and beneficial use projects in direct and indirect ways. Among the ways that stakeholders support projects are through advocacy, funding, outreach, and implementation.

利益相关者
涉及的利益相关者以直接或间接的方式推进创新性再利用和有益性利用项目，具体方式包括舆论呼吁、筹措资金、宣传推广和具体实施。



Social value
Social justice issues are explicitly and / or implicitly part of every innovative reuse and beneficial use project. Among the social benefits that can be provided by projects are access to open space, flood risk reduction, pollution abatement, and equitable development.

社会价值
每个创新性再利用和有益性利用项目中都或多或少地涉及社会公正问题。项目带来的社会效益包括营造开放空间、降低洪水风险、减少污染和促进社会公平。



Ecological value
Ecosystems are modified during innovation reuse and beneficial use projects. These modifications can be designed to maximize targeted ecological functions including but not limited to habitat creation, nutrient cycling, biodiversity preservation, and carbon sequestration.

生态价值
创新性再利用和有益性利用项目均会对生态系统带来影响。可以通过设计使生态系统达到最佳运行，包括但不限于栖息地创建、养分循环、生物多样性保护和碳封存。



Visibility
Many innovative reuse and beneficial use projects are not publicly visible. However, increased visibility ensures greater oversight, transparency, and strengthens stakeholder engagement.

公开性
许多创新性再利用和有益性利用项目都未向大众公开。但是，提升公开性可确保项目获得更广泛的监督、透明度更高，并鼓励利益相关方的参与。



Cost
The costs of innovative reuse and beneficial use projects are typically shared between local and federal government. Additional cost-sharing arrangements can be developed when projects provide co-benefits (social, ecological, and / or economic) to targeted stakeholders.

成本
创新性再利用和有益性利用项目的成本通常由地方和联邦政府共同承担。其他多重效益（包括社会、生态或经济效益）项目的额外成本则另外采用特定利益相关者分摊制度。

Urban parks 城市公园



Landfill cover 填埋覆盖



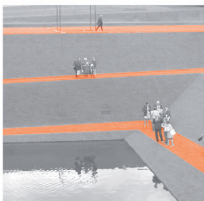
Coastal resilience 沿海韧性



Brownfield remediation 棕地修复



Public art 公共艺术



Road construction 道路建设



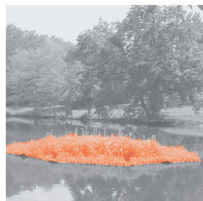
Restoration product 生态修复产品



Island restoration 岛屿修复



Floating island 浮岛



Wetland restoration 湿地修复



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- 从景观视角探讨疏浚物的最终用途和多重效益。
- Proposed set of landscape criteria and end-uses for dredged sediment that prioritize multiple benefits and partners.

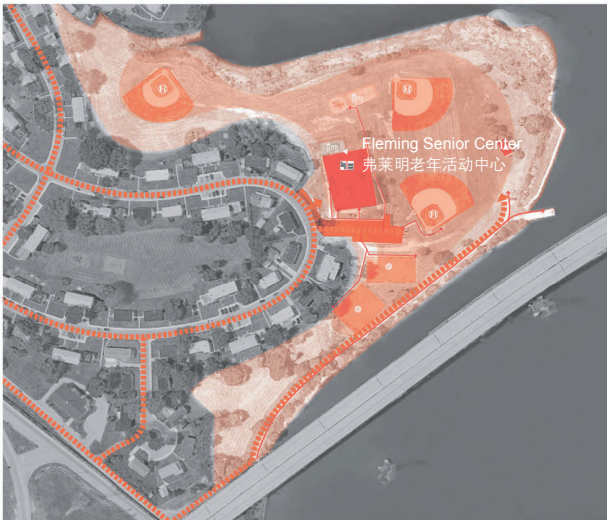
地理空间架构下进行细化，框架包括一系列设定了加权值的可调整指标，即地形指标、疏浚地邻近性指标、有益性利用指标和沿海风险指标（图18）。以上指标由项目团队和MDNR共同制定，以最大限度地提高疏浚物利用计划的经济、环境和社会效益。这些指标可根据特定的项目条件或周期、管理单位确定的优先等级或具体的项目类型，通过加权值的设定进行灵活调整。MDNR和项目团队将数据集和评估系统进行关联分析，为模型制定出重要的分析指标信息。

MDNR要求项目团队在构建该适宜性研究模型时要考虑两个重点区域：安妮女王郡的肯特海峡，以及流经维克米科郡和萨默塞特郡的维克米科河下游地区。团队根据初步场地评估结果与MDNR过往项目经验，利用该适宜性评估工具为这两个地区分别制定了场地可行性的排序清单（图19）。目前，MDNR正在对场地实施进一步评估，以验证初

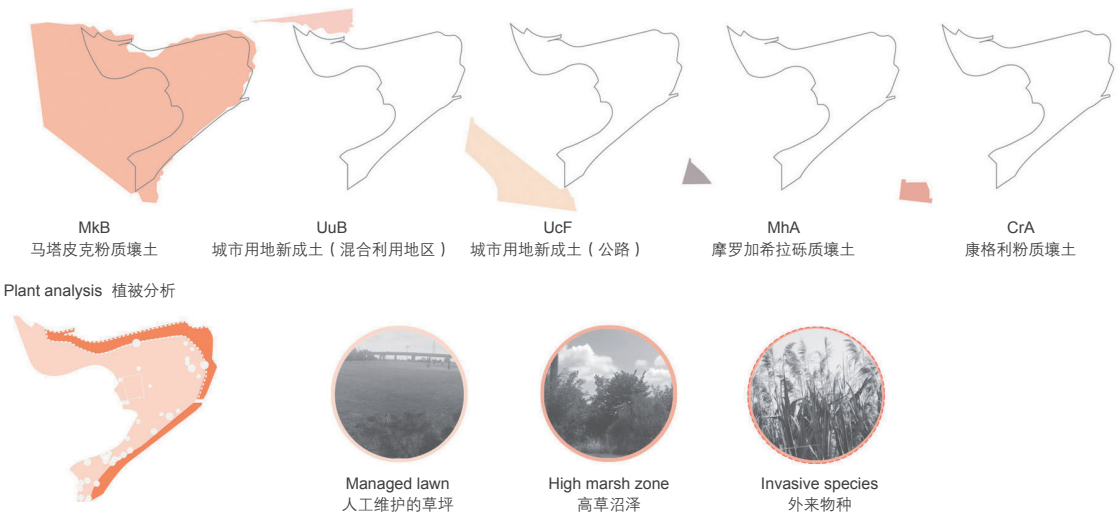
步评估结果。尽管与实地评估结果会有一定出入，但在机构资源有限的情况下，此工具仍具有很高的稳定性及实用价值。

3 讨论

可以说，文中呈现的项目及设计过程都还未完成且并不是完美无缺的。然而，这些仍在进行中的项目将会持续吸取其他新型景观实践模式的经验，并自我创新及完善。可以看出，每个项目都是在考虑场地独特性及时间因素的前提下，根据多方的特定需求与愿景量身打造的。这三个案例以及其他“疏浚设计”项目为在切萨皮克湾地区开展新型景观设计实践奠定了基础。这是一种高度整合的实践形式：其跳脱了传统的单一客户主导模式，以落地实施和应用结果为导向，体现



Soil analysis 土壤分析



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出了自我价值，同时考量并满足了不同群体的利益。在群众、州及地方政府机构、学者和个体专业人员的共同努力下，已成功在切萨皮克湾地区建立起一个合作架构，并预计在三年内形成一套有序的运行机制。

与此同时，该计划也面临着严峻的中长期挑战。首先，必须改变人们仍将淤积物视为环境污染物的看法。美国环境保护署（USEPA）规定了切萨皮克湾水域每日处理淤积物（及其他营养物质）的最大负荷总量，但是并没有对能够滋养湿地生态系统的“有益性”淤积物和不透水表面或农田流入并污染河道的“有害性”淤积物加以区分，导致产生诸多监管弊端，无法切实有效地处理并转移切萨皮克湾地区的淤积物。人们也往往将这两种淤积物混为一谈，以致常常曲解了试图对淤积物进行创新性再利用或有益性利用的公共及政治意图。而巴尔的摩港口与切萨皮克湾地区淤积物之间的差别化处理使得这些问题变得愈加复杂。马里兰州这套双重标准的施行是为在《清洁水法》执行前，保护公众免受堆积于巴尔的摩港口淤积物污染的危害。然而，大部分受污染的淤积物已从巴尔的摩港口运出；现行的马里兰州环境部导则要求对疏浚物进行严格检测并采取风险预防措施，以确定疏浚物合法的最终用途。这种区别化的监管只会加深公众对于巴尔的摩港口淤积物的负面看法。

当前，大尺度淤积物和基础建设项目主要由工程师、地质学家和环境建筑公司完成，这些已培养良好默契的专业人士及项目委托方通常不熟悉景观设计领域，也对景观设计师的实践方法知之甚少，在此传统模式下，景观设计师必须积极地体现他们的价值和地位。更糟糕的是，他们对景观设计师的误解可能会使人们无法意识到景观设计学科对于复杂景观基础建设的重要专业贡献，导致景观设计师在淤积物

改善计划中难以获得一席之地（图20）。

现在，那些努力发挥自身能力、积极与各方接触的景观设计师和学者拥有了一个证明景观设计学科在基础建设中有着不可或缺地位的机会。文中呈现的案例展示出了景观设计师全程参与淤积物人为改造时所运用的创新理念和实践方法，以及可能在社会、生态和经济方面带来的多重效益。这些新的方法和服务模式可供未来学者和从业者沿用、检验和探索。假以时日，景观设计学科终将证明本学科在景观基础项目中是不可或缺的，且证明景观设计正是这些项目的核心本质。

淤积物人为改造过程已被视为景观设计的一环，学者和从业人员目前正在积极地让此议题再次得到正视。19世纪，弗雷德里克·劳·奥姆斯特德在其著名的波士顿后湾公园项目中即体现了泥沙利用的重要性；尽管20世纪的景观设计议题不断扩展，却鲜有人再关注于淤积物处理。可能仍需数年时间，淤积物处理才能重新被景观主流重视。但本文所介绍的理论架构、设计过程、研究方法和合作模式能够让人们更深入地理解淤积物处理的意义并证明其和景观专业不可分割的关系。**LAF**

项目信息

项目地址：美国马里兰州
项目委托：马里兰州交通部、马里兰州港口管理局
景观设计：Mahan Rykiel景观设计事务所
首席设计师：Isaac Hametz
设计合作：Brian Davis
项目团队：Anchor QEA科学与工程公司、马里兰州环境服务局
设计时间：2016年至今
施工时间：2018年至今
所获奖项：2018美国景观设计师协会研究类荣誉奖

6. 位于马里兰州巴尔的摩的弗莱明公园场地分析图
6. Site analyses for Fleming Park, located in Baltimore County, Maryland.

1 Background and Problems

The Design with Dredge program is a collaborative platform for applied design research led by Mahan Rykiel Associates (MRA) in partnership with Brian Davis, assistant professor of Cornell University and member of the Dredge Research Collaborative (DRC), and the Maryland Port Administration (MPA). It is situated within the evolving milieu of contemporary landscape practice in North America, which since its professionalization on the continent in the 19th century has embraced a set of professional concerns that lie beyond the boundary of site. This is most reflected in the New Landscape Declaration developed by the Landscape Architecture Foundation and signed by more than 1,700 practitioners from around the globe, which captures the contemporary call to action and the expanded field of landscape architecture today. The Design with Dredge program positions anthropogenic sediment manipulation processes, materials, and methods as a subject of landscape architectural practice. The program works with communities and industry in the context of sea level rise, changing ecosystems, and cultural landscapes of the Chesapeake Bay and beyond, through a focus on the most basic of landscape materials — mud.

This positioning is part of MRA's proactive approach to professional practice that leverages research and development, strategic partnerships, and design activism to move beyond the conventional landscape architectural service model and its emphasis on client-driven outcomes to a collaborative work model that emphasizes multiple clients and multiple outcomes. The firm formulated this approach, which is described as the Collaborative Practice model to address the interconnected challenges of anthropogenic climate change, establish a role for landscape architects in non-traditional markets, and strengthen its staff capacity through professional development and continuing education (Fig. 1). In the context of this expanded service model, MRA and its partners work to define applied and pragmatic frameworks for professional engagement that focuses on questions of economic development, ecological stewardship, and community identity. Anthropogenic sediment and its operations provide a panoptic entry point for this type of proactive landscape practice. Translocated primarily through landforming processes, a core competency of landscape architecture, sediment, and specifically dredged sediment is unequivocally of and about landscape. It is the in-situ substrate of estuarine ecosystems and coastal wetlands, yet in oversupply, it is a pollutant with harmful environmental effects. Sediment is also undeniably urban and infrastructural; it is the stuff on which many coastal cities are built, an erosional byproduct of

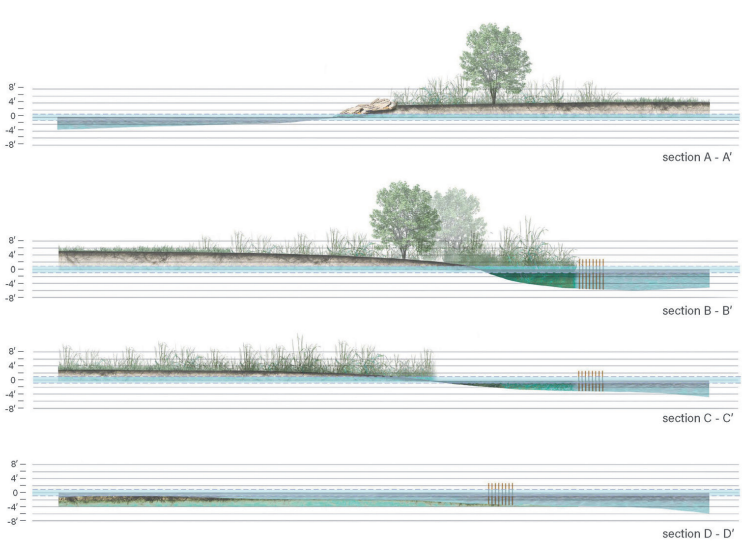
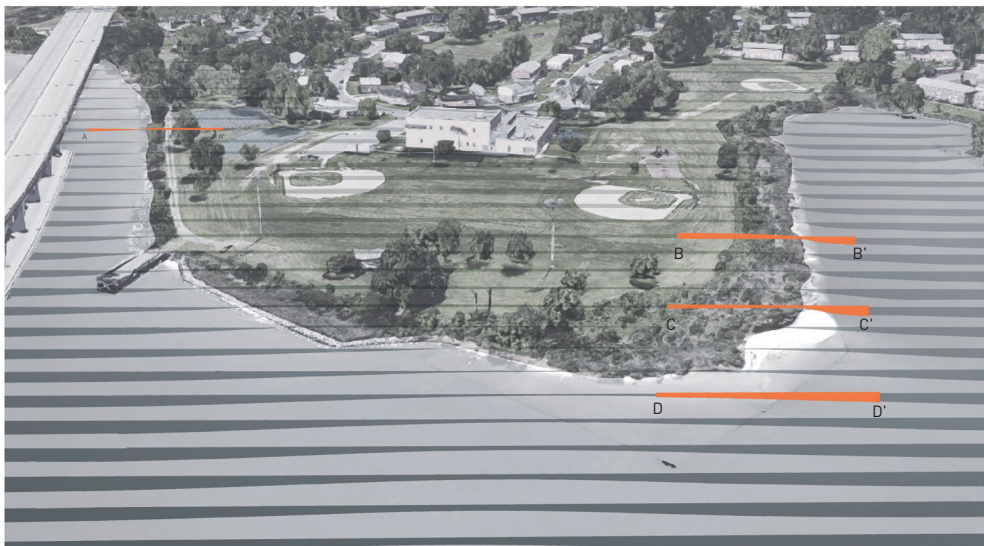
terrestrial construction projects and residue of marine dredging operations (Fig. 2).

Understood through this layered lens, sediment is what Jane Bennett describes as Vibrant Matter, a networked material with agency that extends beyond the province of humans^[1]. For landscape practitioners, this formulation of sediment provides a theoretical positioning tied to the disciplinary dialogue of landscape urbanism^[2], landscape infrastructure, and landscape instrumentality^[3]. It also presents a professional proposition for proactive practitioners interested in engaging sediment processes as the subject of design inquiry and activism. Both are significant for Landscape Architecture as a whole, as dredging operations are expanding in the United States and across the globe as measured by both the dollar value of dredging expenditures and the volume of material being dredged^[4]. As such, there is an opportunity and imperative for landscape architects to establish new working methods that grapple with this complex area of landscape concern.

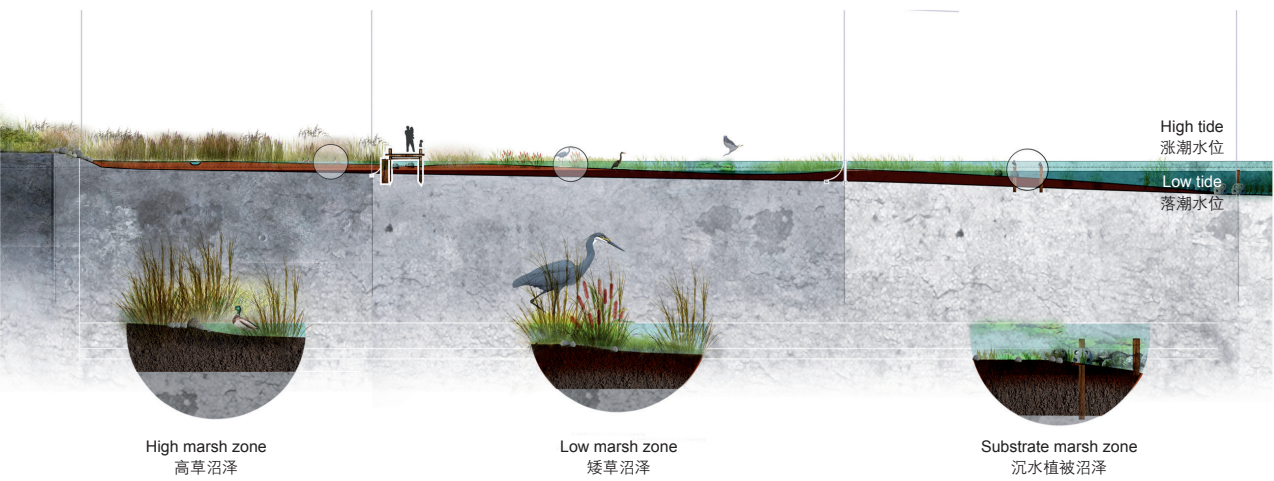
In Baltimore, the port and the city are part of a complex estuarine environment where legacies of labor, innovation, and ecological justice overlap (Fig. 3). Every year in this dynamic environment, natural and anthropogenic siltation processes infill waterways and federal shipping channels, necessitating the removal of 1.5 million cubic yards of sediment for navigation. Throughout the Chesapeake Bay, which includes the approach channels to the port of Baltimore, the port of Norfolk, and the Chesapeake and Delaware canal, more than 4.55 million cubic yards are removed annually^[5]. In addition to these large-scale dredging operations, state agencies in Maryland and Virginia carry out another 200 or so smaller-scale dredging operations pro re nata, which influence regional sediment dynamics, ecosystems, economies, and local communities (Fig. 4)^[6].

Perceived predominantly as a waste product by the public and regulated by layers of state and federal legislation, these clays, silts, sands, and gravels are the substrate of coastal cities. Yet, they remain literally and figuratively liminal: trapped between land and water, and largely untapped for their potential in constructing resilient landscape infrastructure. However, with rising sea levels, surging storms, and subsiding coasts there is an urgent national need in the United States and an acute call for action in Maryland for innovative dredged material management practices that support multi-dimensional resilience that align with the interests of the state's diverse groups of stakeholders.

Design with Dredge program is a direct response to this call, providing a platform for cross-disciplinary collaboration between landscape architects, as leaders, and community members, academics, regulatory and policy officials, and



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7. 综合海岸线分析图：通过地形和水深勘测确定弗莱明公园潮间带最优改善区位。
 8. 弗莱明公园的栖息地修复和沿海韧性提升方案：通过铺填不同厚度的淤泥，复育不同高程的潮间带，包含沉水植被区、高草沼泽和矮草沼泽。
7. Integrated shoreline analysis of topography and bathymetry to identify high potential locations for intertidal zone improvements at Fleming Park.
 8. Proposed habitat restoration and coastal resiliency opportunities at Fleming Park using variable thin layer lifts of sediment to nourish the substrate zone, low marsh, and high marsh areas.

industry representatives, proactively recasting and reimagining Baltimore Harbor and Chesapeake Bay sediment as a primary building block and essential resource for constructing resilient urban and rural landscapes in the region. The program utilizes design as a synthesis method to integrate the most up-to-date sediment science, regulatory frameworks, economic development agendas, and community programs to develop shared conceptual frameworks, planning priorities, and applied landscape strategies for resilient dredged material management (Fig. 5).

The Design with Dredge team has worked across space and time to deploy research methods that include cartographic projection, systems mapping, historical investigation, case studies, typology studies, suitability modeling, material testing, participatory action, and design projection to engage stakeholders, probe regulatory boundaries, and enhance the

technical capacity of program partners in Baltimore and the Chesapeake Bay. In this article we will discuss this hybrid model of professional practice through three projects that are radically different in terms of their scales, objectives, methods, and impacts. Though radically different, they are bound by the mud of the Bay and ongoing anthropogenic sediment manipulation processes that are unequivocally of and about landscape.

2 Design Process

The three projects are the Turner Station urban thin-layer community resiliency project, the Hart-Miller Island (HMI) ecosystem restoration and adaptive management project, and the Mid-Bay beneficial use suitability study. This collection of projects was intentionally curated to cross scales, landscape



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types, and stakeholder groups, to create a platform to study and prototype new collaborative working methods for sediment landscapes and landscape infrastructure. The constellation should thus be read as a laboratory of professional landscape practice that explores and engages the varied objectives, methods, and potential impacts associated with dredging and anthropogenic sediment systems.

In order to understand these projects, however, it is necessary to contextualize them within their regulatory framework. The 2001 Maryland Dredged Material Management Act calls for a rolling 20-year capacity / placement plan for dredging projects to ensure that federal navigation channels in the Chesapeake Bay and Baltimore Harbor remain open for waterborne commerce. Maryland statutes prohibit the open water placement of dredged material and restrict the placement of dredged material from the Baltimore Harbor to disposal, beneficial use, and / or innovative reuse within the Harbor^[7]. As dredged material containment facilities (DMCF) fill up and new DMCF's compete with waterfront development interests in the Baltimore Harbor, the cost for placement of Harbor channel

dredged material is increasing.

At the same time, the most up-to-date climate science predicts Maryland to be the second most chronically flooded state in the nation by 2050^[8]. In response, the 2017 Waste Reduction and Resource Recovery Executive Order (EO 01.012017.13) was issued, which specifically highlights Innovative Reuse and Beneficial Use (IRBU) of dredged material and partnership building as tools for sustainable materials management. In support of this policy objective and to expand opportunities for IRBU, the Maryland Department of Environment (MDE) issued a 2017 regulatory guidance document that identifies end-uses and permitting pathways for dredged material.

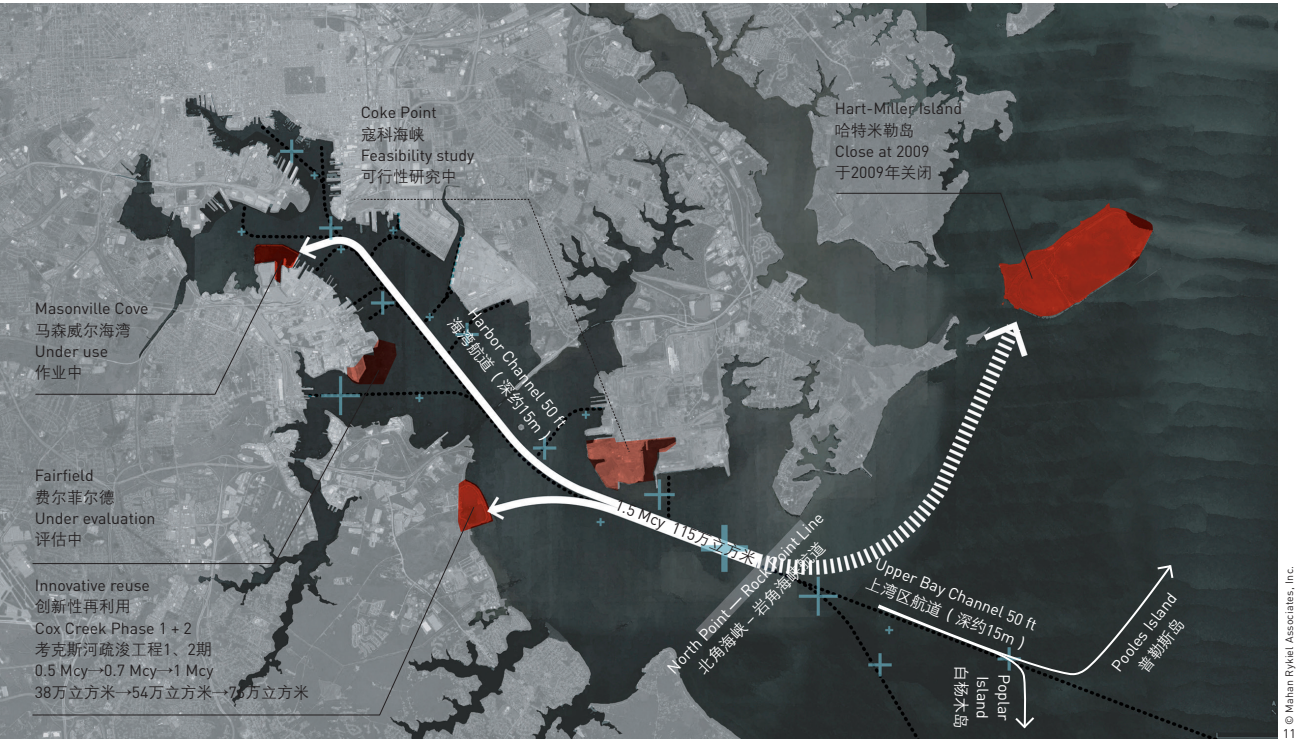
2.1 Turner Station

The Turner Station urban thin-layer community resilience project aims at capitalizing on this expanded regulatory framework to beneficially use dredged sediment from the Baltimore Harbor shipping channels to restore the shoreline of Fleming Park. Located in Baltimore County, Maryland, Fleming Park is a 20.1-acre open space with 2,600 feet of

9. 弗莱明公园海岸线结构分析图与历史照片：这些原始的、具有文化价值的、具有文化价值的使用方式可以通过海岸线更新与公园设计的方式恢复。
10. 弗莱明公园设计方案：通过景观设计，将巴尔的摩港挖掘出的淤泥加以再利用，可以为特纳车站和切萨皮克湾地区带来社会、生态和经济方面的多重效益。
9. Analysis and historic photos of shoreline structures at Fleming Park that uncovered cultural use patterns that could be recovered with a renewed shoreline and park design.
10. Proposed design of Fleming Park highlighting how dredged sediment from the Baltimore Harbor could be reused in the landscape to support multiple social, ecological, and economic benefits for the Turner Station community and Chesapeake Bay.



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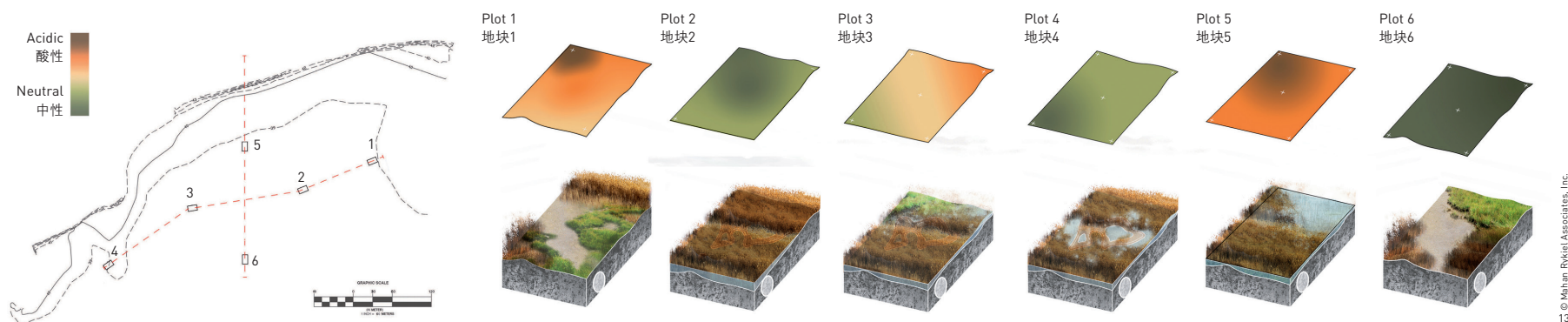
shoreline on the Bear Creek tributary of the Patapsco River^[9] (Fig. 6). It is owned and operated by the Baltimore County Department of Recreation and Parks and serves the historically African American Turner Station Community^[10]. For decades, the community has volunteered in a variety of citizen oversight capacities in Maryland’s Dredged Material Management Program, which was created to ensure transparency in managing statewide dredging operations. Their direct experience with both the stakeholders and science of sediment management served as a springboard for the Fleming Park project and continues to be an asset in mobilizing resources and support for the effort^[11].

Working closely with the community, the Design with Dredge team analyzed the existing site conditions at Fleming Park including its ecological, cultural, and regulatory dimensions. The team combined geospatial data including topography, bathymetry, vegetation, and soil type into a composite 3-D model of the park identifying opportunities to variably nourish the park’s intertidal zone with thin lifts of dredged sediment calibrated to target elevations that correspond to substrate zone, low marsh, high marsh, and upland improvement areas (Fig. 7, 8).

A historical resource review by the team uncovered archival photographs of the site, which revealed cultural use patterns



- 11. 哈特米勒岛环境分析图：巴尔的摩过去、现在和未来拟建的淤泥管控设施，及其处理能力。
- 12. 景观设计师和湿地科学家们在哈特米勒岛上进行土壤和植被断面研究。
- 11. HMI context map including placement capacity for past, current, and proposed DMCFs in the Baltimore Harbor.
- 12. Landscape architects and wetland scientists performing transect studies of soil and vegetation at HMI.



13. 断面研究结果：包括土壤pH值和植被覆盖类型分析。
14. 场地拼贴图：突显了哈特米勒岛现有的美学特质和感官体验机会。
13. Results of transect studies including soil pH and vegetative cover analysis.
14. Site collage highlighting the aesthetic qualities and experiential dimensions of existing conditions at HMI.

that the community wished to see reborn in the project including a boardwalk for crabbing, fishing, and public gathering (Fig. 9). In coordinating regulatory interactions for the project's design with state agencies, MRA and the Design with Dredge team are establishing the first permitting process for urban thin layer placement in the Chesapeake Bay region. The cooperative approach, community engagement, and co-benefits strategy (e.g. ecological, economic, and social benefits) deployed in the design of Fleming Park offers a site-specific, process-oriented precedent that highlights how landscape architects can leverage sediment as a civic resource in an urban environment (Fig. 10).

2.2 Hart-Miller Island

The HMI ecosystem restoration and adaptive management project serves as a large-scale, state-driven counterpart to the Fleming Park effort. HMI is a 1,100 acre DMCF closed in 2009 (Fig. 11). Prior to its closure, it was used by the Port of Baltimore to dispose sediment dredged from Baltimore Harbor shipping channels. It is intended to be converted

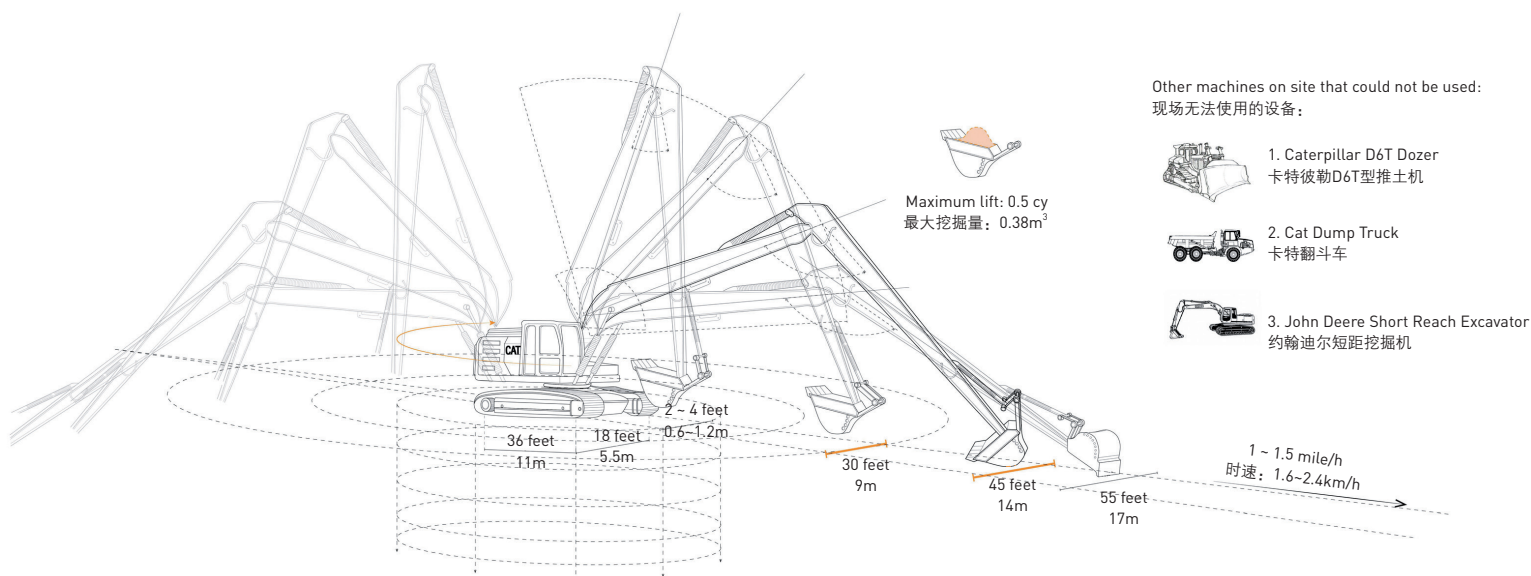
into a Maryland Department of Natural Resources (MDNR) recreation site. However, progress on the restoration has been retarded by water and soil quality issues owing to the dynamic acid-sulfate processes of dredged sediment. These delays have and continue to keep the Port of Baltimore entangled in costly annual operations and maintenance exercises, which draws resources away from their other dredged material management needs.

The team saw this inefficiency as an opportunity to apply landscape thinking to a large-scale sediment restoration project. The team collaborated with wetland and soil scientists to develop a hybrid site research strategy combining conventional scientific methods such as transect studies of soil (physical and chemical properties) and vegetation (community composition and percent cover), with landscape synthesis methods such as expository diagrams of environmental processes, instrumental analyses of machine tolerances, tool paths and operations, and experiential representations of the site's aesthetic qualities. This produced both a richly textured understanding of HMI as a landscape and an essential insight into the effects of its instruments on operations and maintenance expenses (Fig. 12 ~ 14).

To economize operations for the Port, the team developed a proposal for a 23-acre pilot project aimed at understanding and accelerating sediment ripening and habitat conversion at HMI. Twinning maintenance and design, the team based its formal experimental design strategy on the reach and radius of the Port's Volvo EC300E long-arm pontoon excavator and the ability to balance the cut and fill of on-site sediment (Fig. 15). The team mocked up and modified the experimental design in the field with the machine operators, ensuring that implementation of the pilot project is feasible and efficient (Fig. 16).

The 22.9-foot diameter, 8-foot high circular landforms will be built, variably seeded with perennial grasses and





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flowering annuals in the spring / summer of 2019, and adaptively monitored / managed for 3 years to evaluate the success of habitat establishment along a sediment ripening gradient. Working between maintenance, design, and adaptive monitoring / management presents a new operational paradigm for landscape that suggests a shift in professional practice outlined by Brian Davis and Thomas Oles in their 2014 article *From Architecture to Landscape*^[12] and more recently by Julian Raxworthy in his book *Overgrown: Practice between Landscape Architecture and Gardening*^[13]. By focusing on the humblest of harbor material and the tools and techniques used to manipulate them, the HMI project presents an efficient means and methods to work with sediment at scale (Fig. 17).

2.3 Mid-Bay

Moving beyond the site, the Mid-Bay suitability study was

developed as a tool to explore regional opportunities to align dredging and restoration. The suitability tool was developed for the MDNR who oversees small scale dredging projects in the Bay for the state of Maryland. These projects face constant funding and permitting constraints and are typically situated in coastal communities that not only rely on navigation channels but also face challenges stemming from wetland loss and destruction, and catastrophic flooding resulting from subsidence, sea level rise, and climate change. All of these problems are defined in part by sediment, which in the Bay is often simply a critical resource out of place.

In working with MDNR to develop tools, the team adapted established technical and conceptual approaches from landscape architecture, engineering, and coastal science and planning including regional sediment management, suitability analysis, and earlier tools created by the state of Maryland such as the

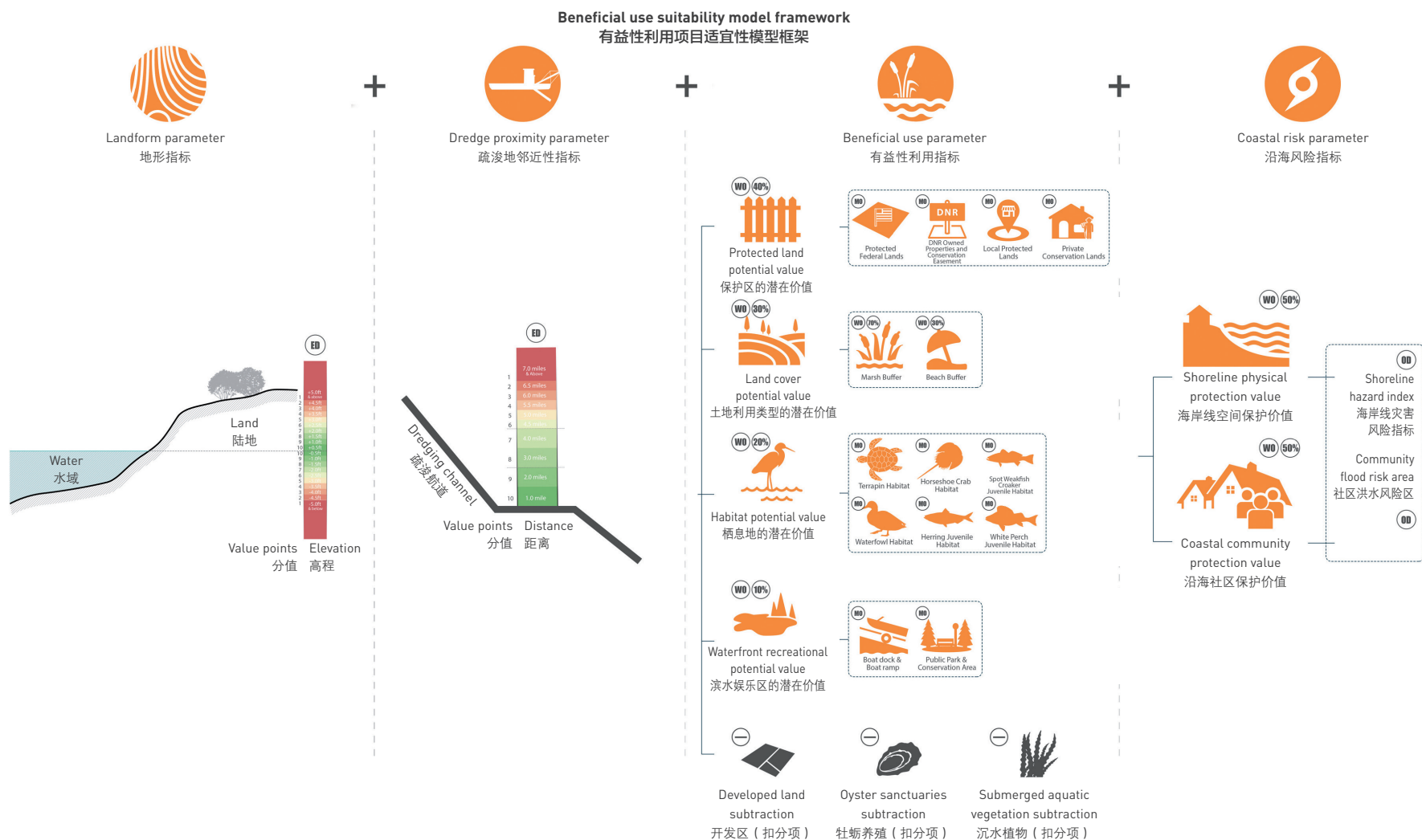
15. 哈特米勒岛地形塑造设备分析图：该设备用于指导团队进行设计策略制定、整合作业、维护，以及提升效率并降低设计影响。
16. 在哈特米勒岛上进行的现场实验设计（面积：0.4hm²）
17. 在哈特米勒岛上的实体单元进行的实验设计项目鸟瞰图：项目面积为9.3hm²，塑造了一系列直径约7m、高约2.4m的地块，种植了不同的多年生草本和一年生花卉植物。
15. Instrumental analysis of HMI landforming equipment, with which the team used to inform their design strategy integrating operations, maintenance, and design for optimum efficiency and impact.
16. Field mock-up of the 1-acre experimental design module at HMI.
17. Bird's-eye perspective of the proposed 23-acre experimental design project at HMI that includes 22.9 foot diameter, 8 foot high landforms variably planted with perennial grasses and flowering annuals.



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18. 为MDNR在切萨皮克湾地区的疏浚及修复项目制定的指标系统以分析有益性利用的适宜性。

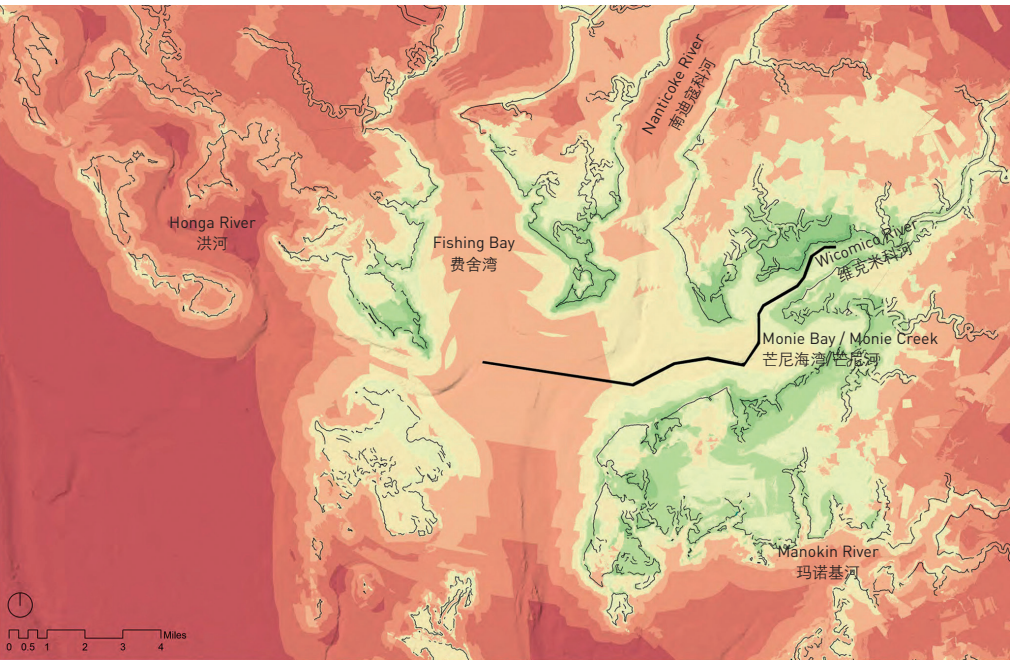
18. Parameters for beneficial use suitability model developed to align MDNR dredging and restoration project in the Chesapeake Bay

Maryland Coastal Resiliency Assessment^[14], habitat for critical species, and shoreline inventory data. These elements are spatialized and related using a multi-parameter geospatial framework that includes primary parameters which are weighted and adjustable. The model parameters are Landform, Dredge Proximity, Beneficial Use, and Coastal Risk (Fig. 18), which were mutually identified by the project team and MDNR to maximize the financial, environmental, and social benefits of aligning dredging with beneficial use, and conceived as adjustable with the understanding that on any given project or during a certain year or administration particular priorities might be emphasized or certain project types might be more possible. The weighted nature of the parameters allows for this to be accounted for in a basic way. Nested within each of these parameters are datasets and assessment tools that were identified as important by MDNR and the project team.

The team was asked by MDNR to consider two focus areas in developing the suitability model: Kent Narrows in Queen Anne's County and the Lower Wicomico River that straddles Wicomico and Somerset Counties. In each of these areas the tool produced an inventory of priority sites that seem plausible based on initial site assessments by the team and historical MDNR projects (Fig. 19). Currently MDNR is undertaking additional site assessment to verify the initial results of the model. While it is not expected to line up precisely with field assessments, initial returns suggest that it may be consistent enough to prove useful as a way of focusing limited agency resources.

3 Discussion

In considering the constellation of projects and design processes presented here, it would be fair to say that none are



Suitability map output 适宜性分析
Lower Wicomico River 维克米科河下游地区

将不同指标加权叠合后的成果分析图 **Integrated Map**

地形 Landform 10%
疏浚地邻近性 Dredge Proximity 35%
有益性利用 Beneficial Use 35%
沿海风险 Coastal Risk 20%

1 2 3 4 5 6 7 8 9 10
Low suitability 适宜性低
High suitability 适宜性高

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19. 以维克米科河下游地区为例进行的适宜性分析：MDNR对地形、疏浚地邻近性、有益性利用和沿海风险4方面因素的权重分别为10%、35%、35%和20%。这些标准可基于优先等级和政策目标进行调整，以确定其他淤积物管理方案。

19. Suitability model output of the Lower Wicomico River focus area using MDNR's preferred weighting system of 10% landform, 35% dredge proximity, 35% beneficial use, and 20% coastal risk. These parameters can be adjusted based on priorities and policy objectives to identify additional sediment management scenarios.

complete. However, each is ongoing and provides continuing opportunities to learn from and evolve new forms of landscape practice. Yet, it is clear that the objectives of each project are uniquely tailored to needs and desires of stakeholders, which change dramatically from site to site and over time. The three projects, as well as the broader Design with Dredge program, have established a trajectory for a new type of landscape architectural practice in the Chesapeake Bay. However, it aims for a distinctly hybrid form of practice — one that is motivated by action and applied outcomes, yet simultaneously self-reflective and desirous of an inclusive form of landscape that goes beyond the traditional client driven service model. In the Chesapeake Bay, the collective effort of citizens, state and local government agencies, academics, and private practitioners has established a framework for dialogue that in a period of three years has matured into a vibrant institutional ecosystem.

Despite that, significant challenges remain to the mid and long-term success of the enterprise. At the top of the list is the real and perceived role of sediment as an environmental pollutant. The US Environmental Protection Agency (USEPA) sets Total Maximum Daily Loads (TMDL) of sediment (and

other nutrients) that can enter the waters of the Chesapeake Bay. However, the law does not distinguish between “good” sediment in the system that nourishes wetland ecosystems and “bad” sediment that runs off of impervious surfaces and / or agricultural fields and into waterways. As a result, there are real regulatory limitations to how and where sediment can be translocated in the Chesapeake Bay. The public also conflates these two types of sediment, which colors public and political perception of projects that attempt to innovatively reuse or beneficially use sediment. Further complicating matters within the region is the regulatory distinction between Baltimore Harbor sediment and Chesapeake Bay sediment. This two tier system was established in Maryland to protect the public from placing sediment containing legacy contaminants that accumulated in the Baltimore Harbor prior to enforcement of the Clean Water Act. However, much of the polluted sediment has since been removed from the Baltimore Harbor and current MDE guidance requires careful testing and risk-based screening protocols to determine acceptable end-uses for dredged material. Nonetheless, the regulatory distinction remains as does the public stigma of Harbor sediment.

Landscape architects also face an uphill battle to define their role and value in these large scale sediment and infrastructure projects, which are typically serviced by engineers, geologists, and environmental construction companies. These allied professionals and the clients they represent are often unfamiliar with landscape architecture and its methods. Worse yet, they may hold misconceptions about landscape architects that undermine the discipline’s professional status as a legitimate partner in complex infrastructural undertakings, which makes entering and sustaining a market presence in the sediment space challenging (Fig. 20).

There is however, an opportunity for practitioners and scholars of landscape architecture who are willing to invest in building their own capacity and in establishing the relationships that are necessary to prove the discipline’s value as a trusted partner and ally in these infrastructural undertakings. The projects presented here offer a glimpse into the kind of innovative practices, methods, and co-benefit (social, ecological, and economic) outcomes that might be possible when landscape architects fully engage with anthropogenic sediment processes. As early adopters develop new methods and expanded service models, scholars and practitioners will have the opportunity to adopt the tried and true practices pioneered by their colleagues. At that point, the discipline will have reached a critical milestone in asserting itself as an essential partner in landscape infrastructural projects — projects that at their core

20. 巴尔的摩港淤积物处理链：疏浚作业旨在将联邦航道中的砂砾、淤泥和粘土循环利用，作为对水、陆均有裨益的资源。
20. Proposed sediment management cycle for Baltimore Harbor dredging operations that seek to recover the sands, silts, and clays of the federal navigation channel as a resource in aquatic and terrestrial beneficial use projects.

are inherently of and about landscape.

In positioning anthropogenic sediment manipulation processes as a subject of landscape architectural work, scholars and practitioners are attempting to recover a medium that has slipped from the sphere of professional concerns. Frederick Law Olmsted was concerned with mud in his 19th century masterwork, the Back Bay Fens. Yet it in the expansion of landscape architectural concerns in the 20th century, sediment fell out of professional focus. It may be years before sediment returns to the mainstream of landscape practice. However, the theoretical frameworks, design processes, research methodologies, and cooperative models presented here may offer an insight that proves useful to those interested in returning sediment to the subject of the landscape enterprise. **LAF**

PROJECT INFORMATION

Location: Maryland, USA
Client: Maryland Department of Transportation, Maryland Port Administration
Landscape Architecture: Mahan Rykiel Associates
Chief Designer: Isaac Hametz
Collaborator: Brian Davis
Project Team: Anchor QEA, Maryland Environmental Service
Design Period: 2016 to present
Construction Period: 2018 to present
Award: 2018 ASLA Honor Award of Research Category

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