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Construction Biocapacity Measurement Using the Conservation Hierarchy Framework: A Selective Literature Review Focused on Assessing Building Materials and Construction Chemicals for Low Environmental Impact

Cecilia Wandiga, Executive Director
Centre for Science and Technology Innovations (CSTI)

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Construction AND Biodiversity

Green building beyond energy efficiency and water conservation

Materials that are less toxic

Construction designs that increase the diversity of plants and wildlife

Establishing biodiversity goals for the built environment

Photo: Crystal clear waters at Mzima Springs.

When was the last time you saw the bottom of the Nairobi River?

Conservation Hierarchy Framework

	Zero Extinction of Species	Protection of Ecosystems	Preservation of Genetic Diversity
Avoid	Destroying urban wildlife corridors for birds, monkeys, animal crossings	Integrate the conservation of rare indigenous habitats and species into the site plan and design	Avoid hunting and poisoning of species by building safety measures to reduce the risk of human/wildlife conflict
Minimise	Prevent poaching by establishing wildlife surveillance (e.g. CCTV with night spectrum lens) and reporting mechanisms on site	Install silt traps and filters on all drainage systems, build soakaways on construction sites	Hire ecologists and botanists as part of the construction design and monitoring team.
Restore	Create habitat specific feeding programs in collaboration with Kenya Wildlife Services	Maximize indigenous species on site. Kenya Museum of Natural History can provide advisory services. Improve the permeability of surfaces to ensure soil moisture and ground water recharge.	Introduce indigenous and genetically diverse species into the different habitats on the site. Oxford Nanopore kits are an affordable way to collect biodiversity DNA samples for sequencing and tracking.
Offset (off site measures)/Inset (on site measures)	Offset: Relocate displaced species to a nearby habitat for which there is no planned development	Inset: Monitor site level emissions and toxic chemicals that are known to be toxic or very toxic to different species. Air, water, and soil sensors are an affordable way to capture real-time data.	Inset: Create online/digital or physical spaces via which the community can observe and contribute to the conservation of biodiversity on the site.

Perimeter Fencing

- **Avoid** spiked fences and thin wires
- **Minimise** areas that impede natural habitats
- **Restore** vegetation that attracts a variety of species – shrub and tree corridors

Photo: African Grey Hornbill

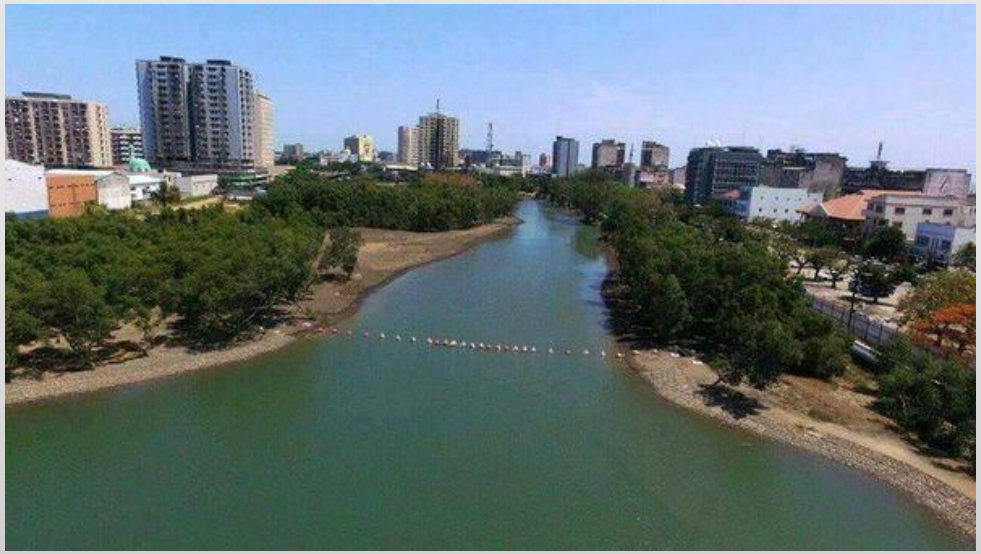
How many birds do you see in a day?
https://issuu.com/nature_kenya/docs/kb_7_cover

Clean Rivers and Green Corridors

Beira Mozambique, Chiveve River Restoration

https://www.elastudio.co.za/project/chiveve-river-beira-mozambique/

Photo source:
https://www.facebook.com/ConselhoMunicipalDaBeira/posts/rio-chiveve-com-novo-visual/1158653644213949/



Seoul, Cheonggyecheon River Corridor

https://naturalwalkingcities.com/green-corridors-essential-urban-walking-and-natural-infrastructure/

The Challenges of Glass Buildings

- Silica is abundant but not renewable
- Sand harvesting can destroy topsoil
- Quality sand is typically found along rivers, Cameroon example

Photo: View Park Towers, Nairobi, Wikimedia file https://commons.wikimedia.org/wiki/File:Viewpark_Towers,_Nairobi.jpg

The Challenges of Solar Panels

- Reduce CO2 emissions by 15.9%
- Reduce energy demand by 21.2%
- Increase biodiversity loss by 25.0%

Nematchoua, et al., 2020

Photo: Tanjent Energy bird wire mesh avoids trapping birds below solar panels

Red List Chemicals in Construction

- Antimicrobials, Alkylphenols and related compounds, Asbestos compounds, Bisphenol A (BPA) and structural analogs, California-banned solvents, Chlorinated Polymers (including Chlorinated polyethylene (CPE), Chlorinated polyvinyl chloride (CPVC), Chloroprene (neoprene monomer), Chlorosulfonated polyethylene (CSPE), Polyvinylidene chloride (PVDC), Polyvinyl chloride (PVC), Chlorobenzenes, Chlorofluorocarbons (CFC) and hydrochlorofluorocarbons (HCFC), Formaldehyde (added), Monomeric, polymeric and organophosphate halogenated flame retardants (HFR's), Organotin Compounds, Perfluorinated compounds (PFC's), Phthalates (orthophthalates), Polychlorinated biphenyls (PCB's), Polycyclic aromatic hydrocarbons (PAH's), Short-chain and medium-chain chlorinated paraffins, Toxic heavy metals (Arsenic, Cadmium, Chromium, Lead (added), Mercury, Wood Treatments containing creosote or pentachlorophenol.

Goodwin Robbins, et. al., (2019), Table 1.

Focus on Chemical Categories

- Six Classes approach is easier to remember than a list of chemicals https://www.sixclasses.org/
- Demand biobased substitutes, e.g. bio-based flame retardants

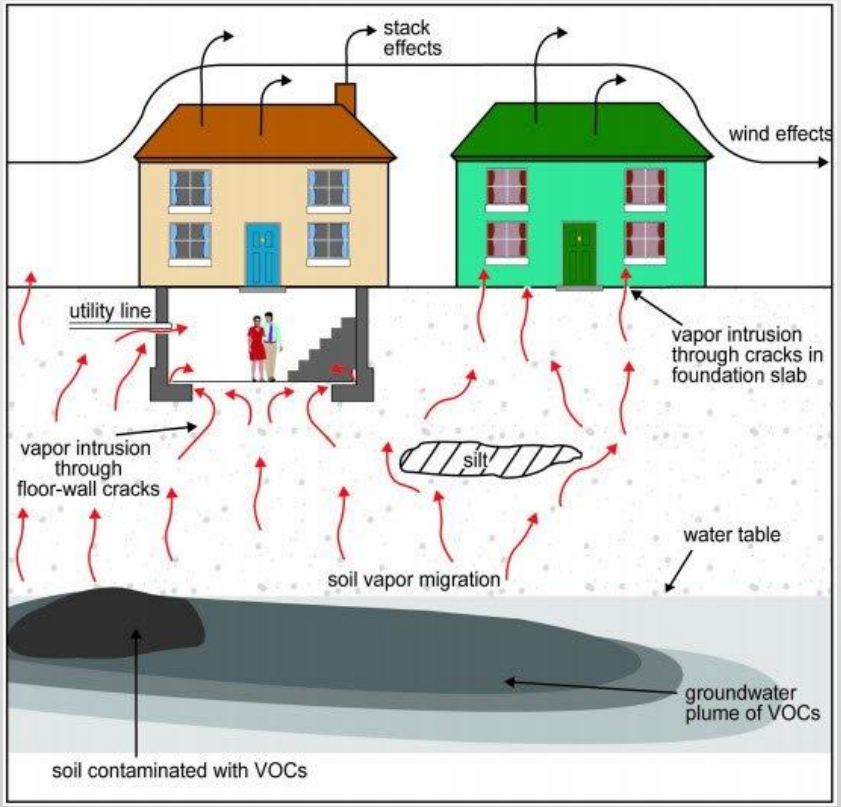


Photo: EPA vapor intrusion from toxic chemicals negatively affects soil, water, and air quality

Start with Easy Fixes

- **Avoid** – removing indigenous plant species
- **Minimise** – conflict zones by designing spaces that integrate wildlife
- **Restore** – connections between ecosystem landscapes, e.g. river bank ecosystem connects to multiple tributary streams (fish and bird corridors)
- **Inset** (instead of offset) – planting trees in a different location does not fix the on-site biodiversity loss. Lichens and mosses are carbon sinks.

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Thank you for your attention!

Contact: info@csti.or.ke