For my part I know nothing with any certainty, but the sight of the stars makes me dream
- Vincent van Gogh

Delft - A view from my house (Nov 5 at 01.00) - full moon

The Hague - A street full of light (Okt 6, at 21.00)

Nightscape

An exploration of the future for the nocturnal urban landscape design

Nightscape

1. The loss of the night

2. Method + graduation process

3. Human and ecological need for darkness

4. Darkness corridors in The Hague

5. The dark urban landscape experience
- Human perspective
- Bat perspective

6. Guidelines for nocturnal ecology

7. Guidelines for nocturnal human experience

8. The design implementations

9. Reflecting back on research question

1

THE LOSS OF THE NIGHT

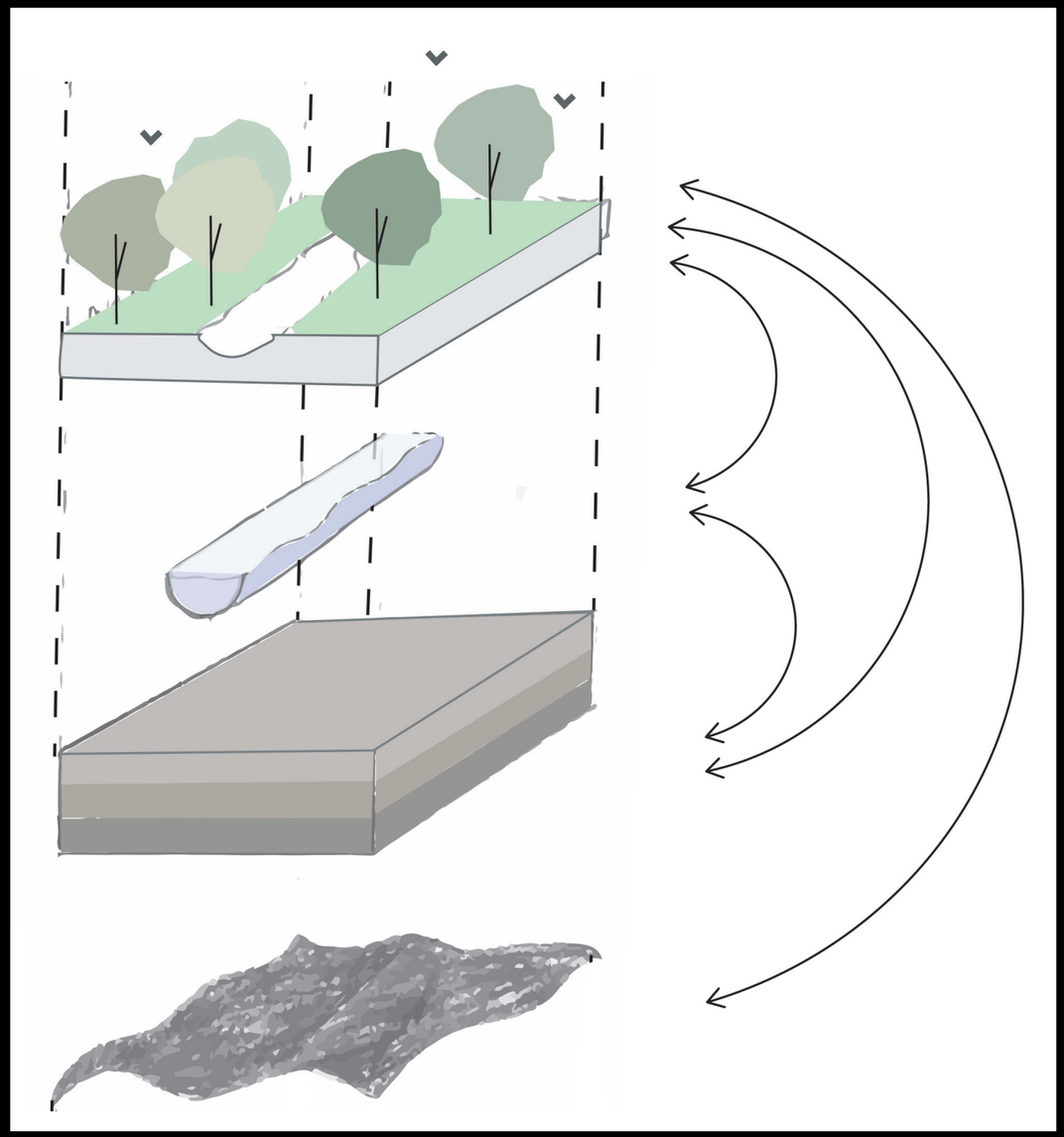
CONTEXT OF THE RESEARCH: THE NATURAL LAYERS OF THE CITY

<u>The green layer</u>
Ecological
Fragmentation
Less green
etc

<u>The blue layer</u>
Aquatic ecology
Water pollution
Flooding
etc

<u>The brown layer</u>
Soil ecology
Soil pollution
Drought
etc

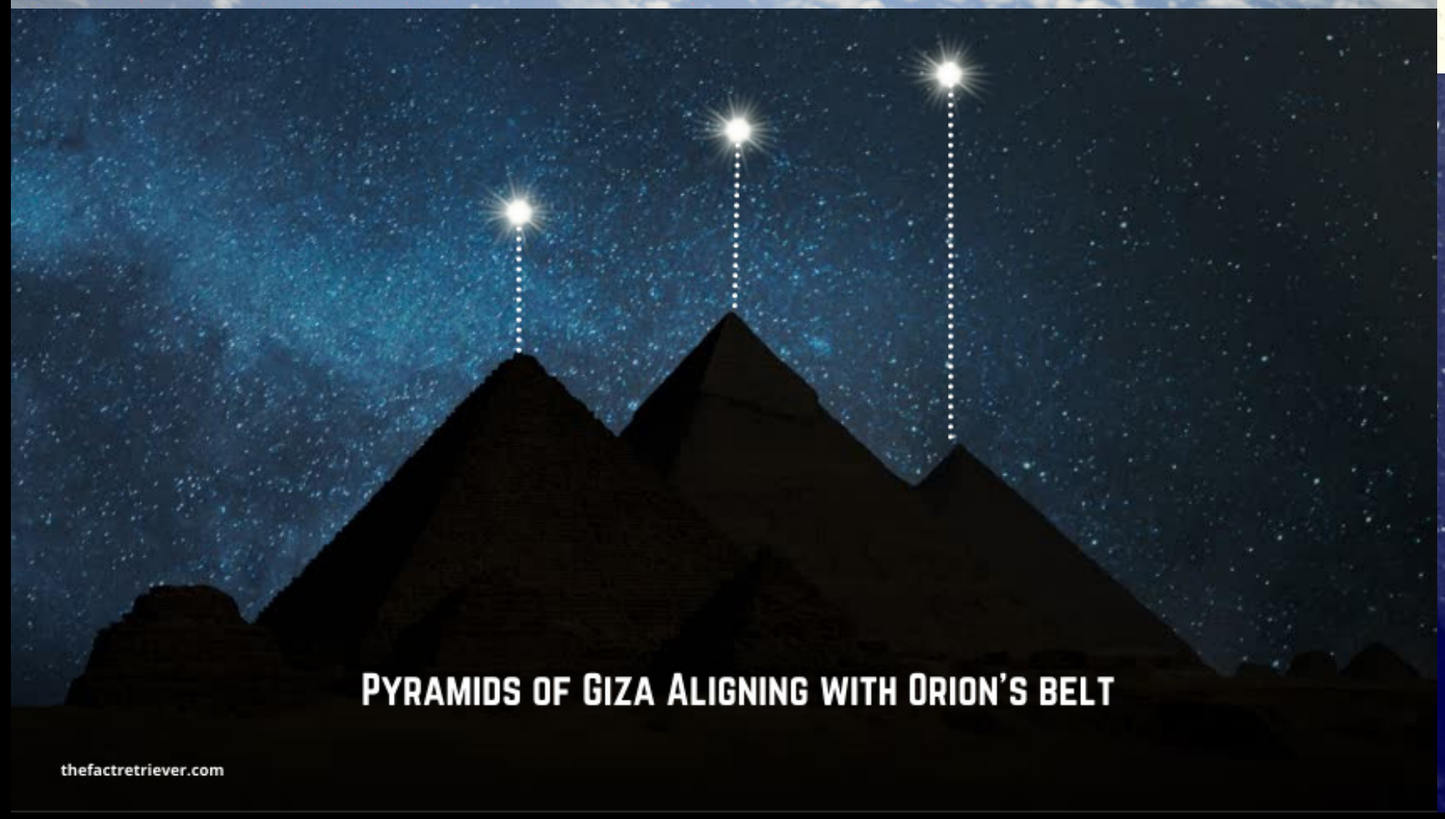
<u>The dark layer</u>
Light pollution
Nocturnal ecology
Circadian rythm
etc



Connected complexity

https://unsplash.com/photos/8Hjx3GNZYeA

https://www.martek-marine.com/blog/can-you-name-10-tools-we-used-to-navigate-the-seas-before-ecdis/

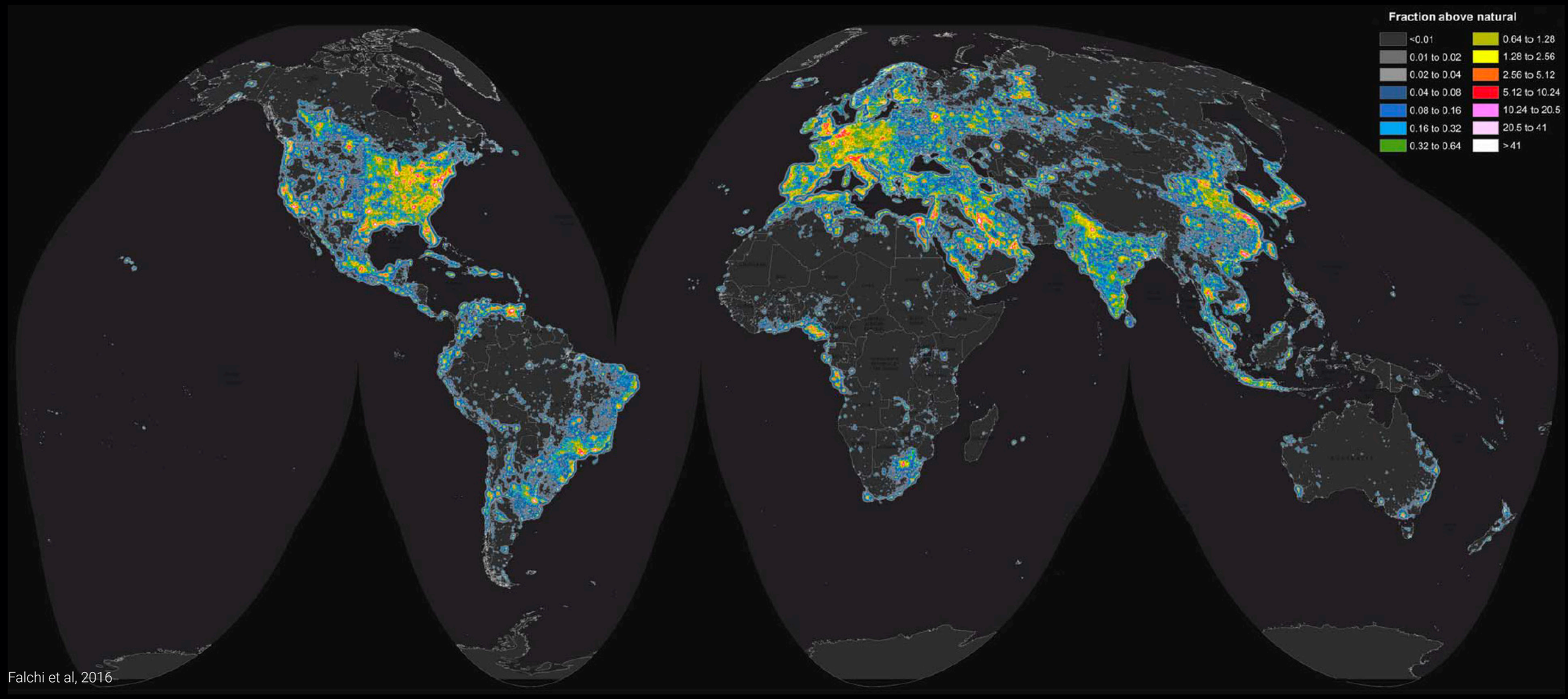


https://www.sci.news/biology/nocturnal-animals-stars-orientation-05775.html

We are all astronauts on spaceship earth

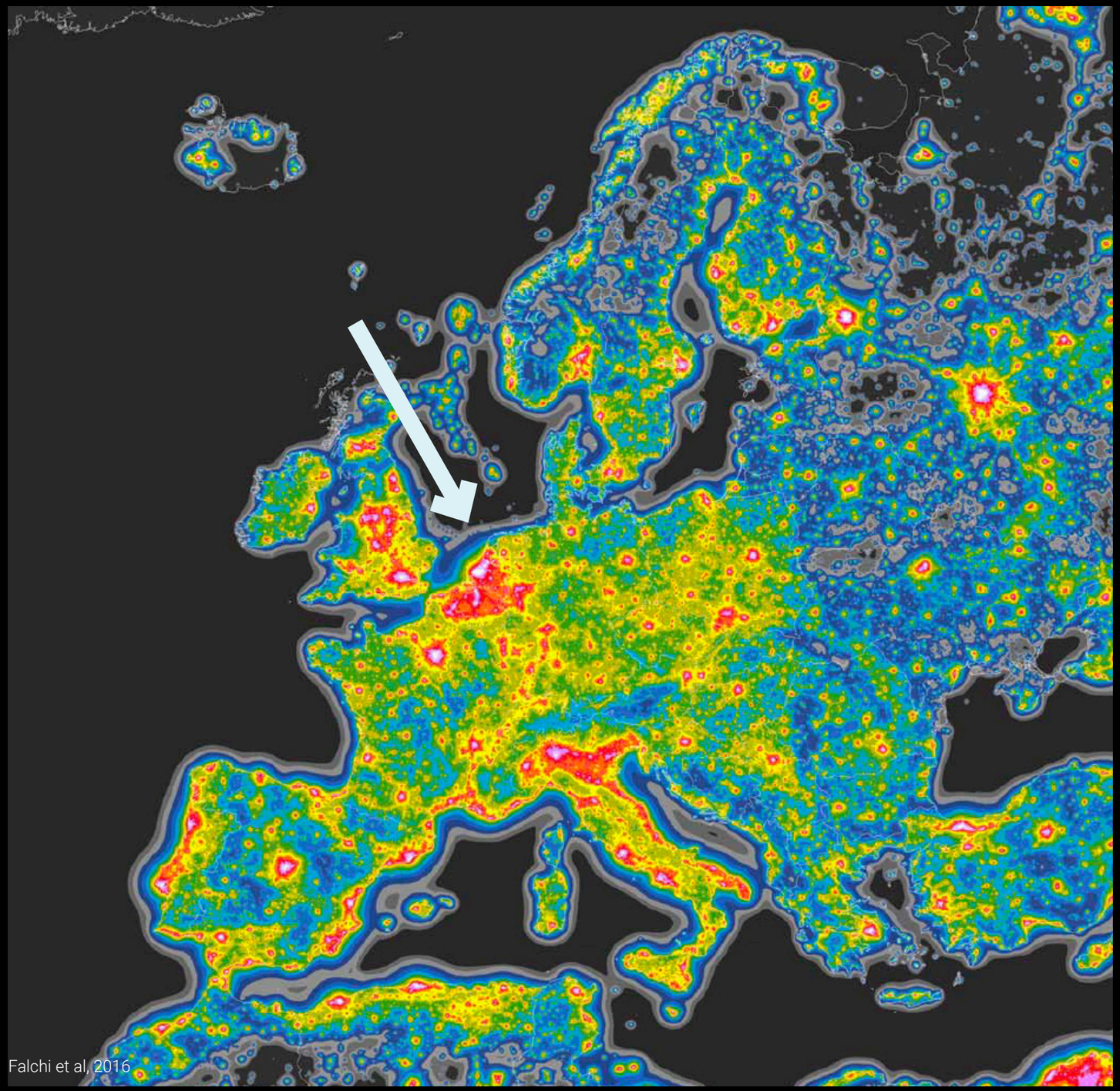
(Architect Richards Buckminster Fuller, 1968)

GLOBAL ARTIFICIAL SKY BRIGHTNESS



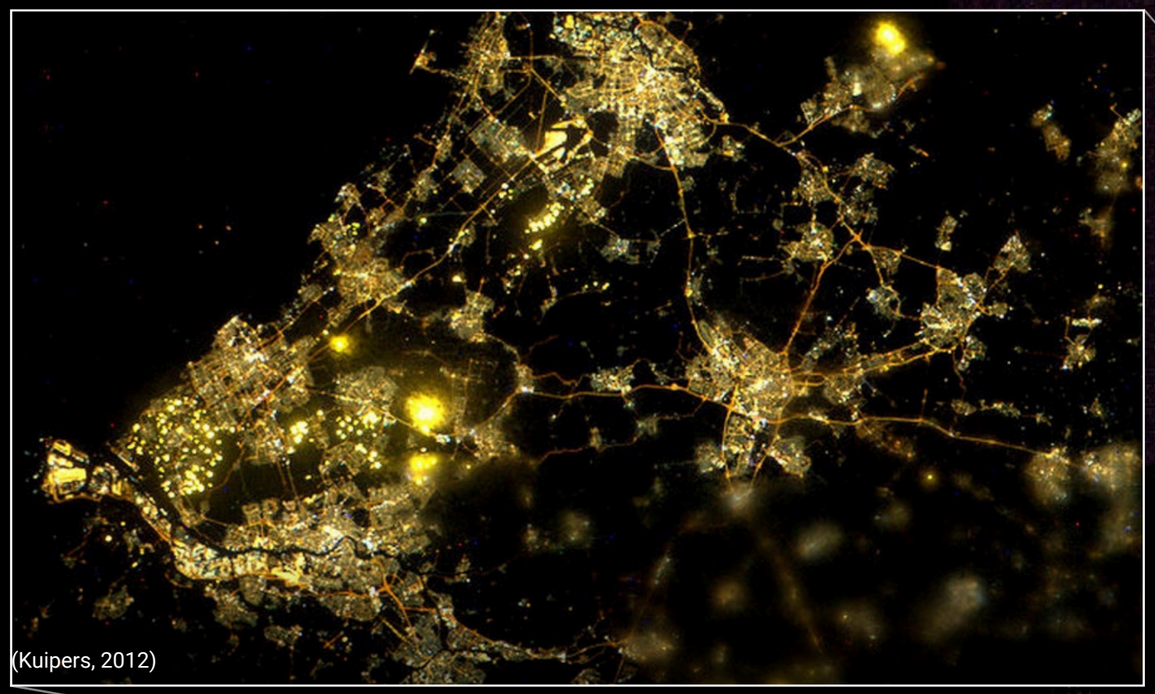
Falchi et al, 2016

EUROPE BY NIGHT



Falchi et al, 2016

THE NETHERLANDS BY NIGHT



(Kuipers, 2012)

(Kuipers, 2012), https://www.theatercolleges.nl/wp-content/uploads/2013/08/kuipers-totaalbeeld-e1377067947223.jpg

2

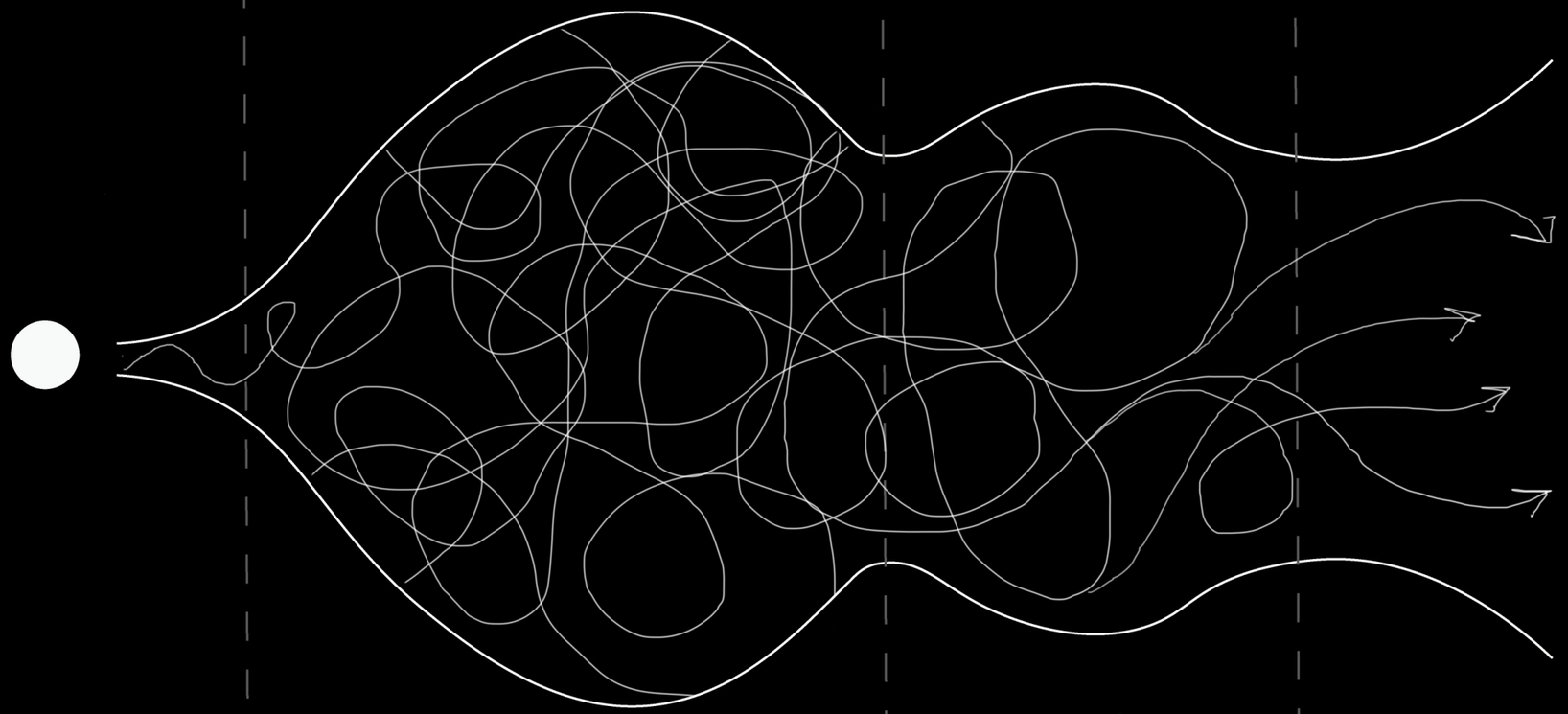
METHOD + GRADUATION PROCESS

FASCINATION

RESEARCH + EXPLORATION

DESIGN

OUTCOMES



- Fascination for the night sky
- Problem statement

- Discovering the complexity
- Somewhat getting lost in the information
- Dark landscape experiences
- Books and literature

- Trying to go from abstract to tangible
- Going back and forth between research and design (having lots of questions)
- Discovering possibilities

- Masterplan of design location
- lighting concepts
- Considering the future of lighting
- Toolbox of darkness corridor for the urban context

Problem statement: There is no spatial darkness corridor and lighting strategy that contributes to a dark urban landscape experience that evokes awareness for the importance of darkness, while improving the nocturnal ecology (with the focus on bats)

RESEARCH QUESTION: How can a new spatial darkness corridor and lighting strategy contribute to a dark urban landscape experience and evoke awareness for the importance of darkness, while improving the nocturnal ecology (with the focus on bats)

Global light pollution issues and research

local case study

- Focus on The Hague as case study
- Fieldwork on location
- Local experience of the night
- Local design
- Local species

Global guidelines to design a dark corridor for the urban context

Applying toolbox to the local scale in the urban context

CONTEXT OF THE TOPIC - DEVELOPMENT OF LIGHT

800.000 years ago
Invention of fire

400 BC
Invention of oil lamp

1417, London
First public streetlighting

1802
The first coal ignited gaslight system

1817, London
Big scale street lighting system

1878, Paris.
Electrical arc lights

1879
Thomas Edison invents the incandescent electric lamp

1930
Sodium lamps for streetlights are invented

Now
The top of the iceberg is being explored

Future
The subject of this thesis. Endless possibilities

CONTEXT OF THE TOPIC - THE NOCTURNAL DIALOGUE

Humans use the landscape

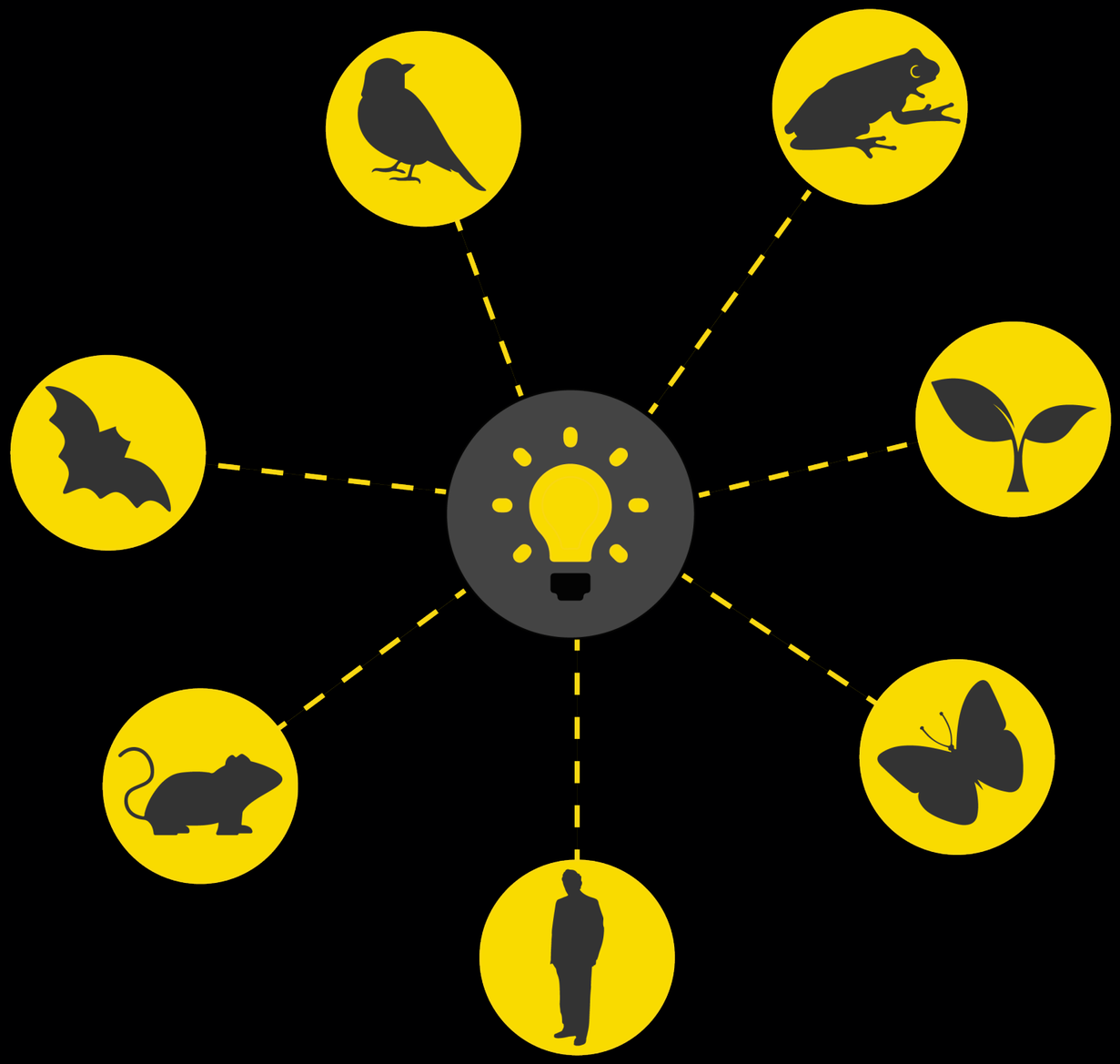
Bats use the landscape

https://www.freepik.com/premium-vector/set-creative-minima-list-modern-illustrations-lineal-style_13551528.htm#query=landscape&position=25&from_view=keyword

3

HUMAN AND ECOLOGICAL NEED FOR DARKNESS

Many negative effects of light



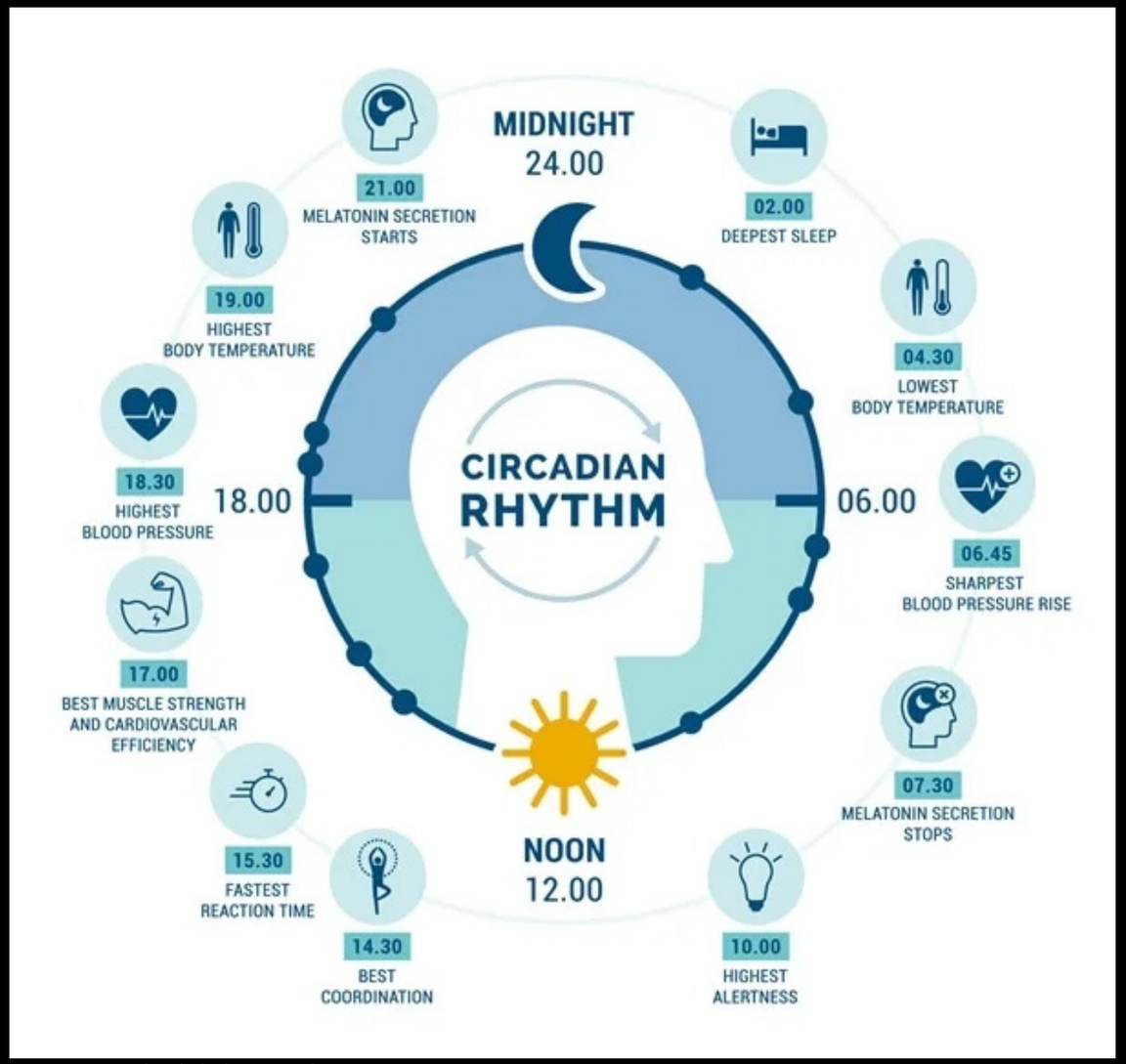
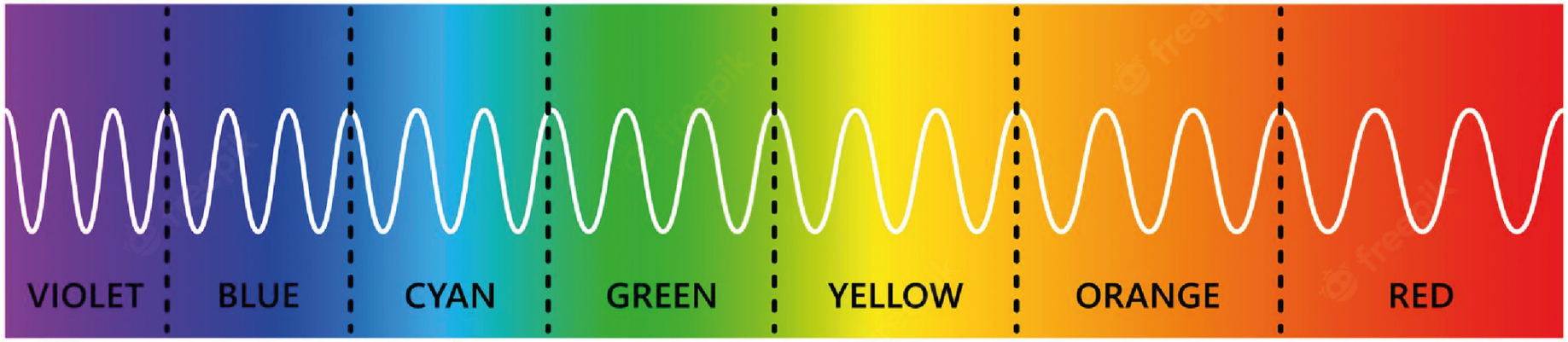


Image source: elenabsl/Shutterstock.com

VISIBLE SPECTRUM



380-510 nm (Between infinate and 6000K)

- causes 300% more skyglow
- Less melatonin production in mamals (disturbances of the circadian rythm)
- More impact on insect populations
- More blinding effects for humans

510-590 nm (Between 6000K and 3500K)

- Little impact on migratory birds

590-740 nm (Between 3500K and 1700K)

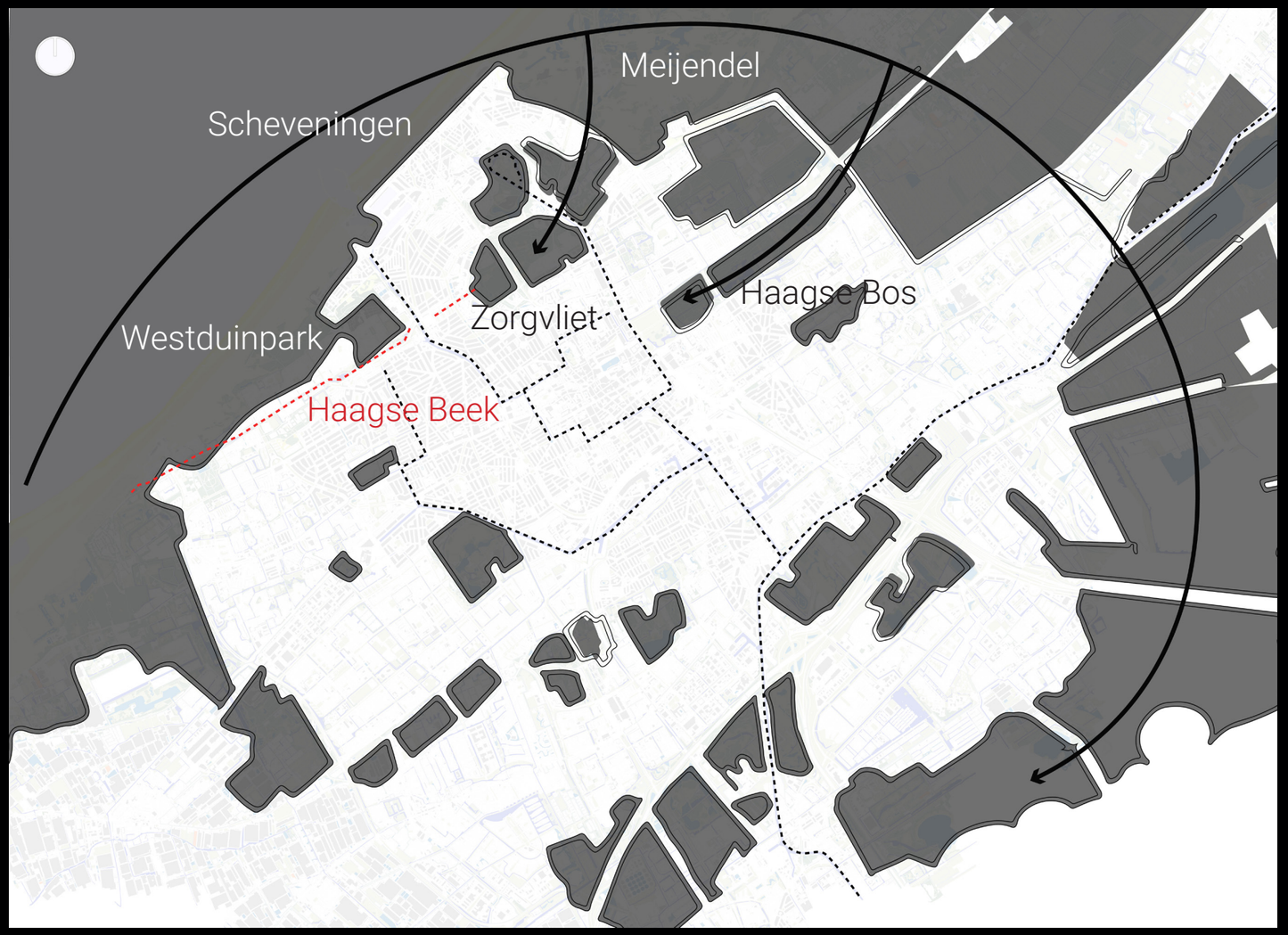
- Little impact on bats
- Little impact on insects
- Little impact on skyglow
- Little impact on mouses

4

DARKNESS CORRIDOR IN THE HAGUE

DARKNESS CORRIDORS - REGIONAL SCALE

Image from Atelier LEK



Potential darkness corridors

- Dark areas embrace The Hague
- Potential to reach inside
- Dark ribbons cross the urban fabric
- Haagse Beek is an ancient landscape structure
- Haagse Beek: possible carrier for green-blue-darkness connection

REGIONAL VISION

LOCATION OF HAAGSE BEEK AND GREEN-BLUE-DARK CONNECTION

5
ANALYSIS
The Dark Urban Landscape Experience: a human perspective

EFFECT OF LIGHT REACHING INSIDE DARK AREAS

Image made by author (May, 2022)

THE EXPERIENCE OF THE AREA









DARK URBAN LANDSCAPE EXPERIENCE COLLECTION

Visibility of colours

- Light coloured plants are well visible in the dark background of the nocturnal landscape
- Contrasts is visible due to different white, gray, blue and purple tones

Visibility of shapes

- Contours of trees were very visible and some shapes seemed to melt together
- Clear colours are absent and shapes are less sharp

Experience of visibility of stars

- Peaceful
- quiet
- magical
- overwhelming when not used to seeing stars in daily life
-

Type of smels

- specific trees
- grasses
- damp/wet air/water
- flowers

Experience of the smells:
Smell senses become more intense due to the lack of sight at nght. The smell contributed to the orientation of changing landscapes. At the borders of forests and grasfields, smells changed, thus indicating a change of the landscape.

Type of sounds

- leaves of trees
- the wind
- animals in bushes
- Insect sounds (zooming)
- cars
- other humans
- birds

Experience of the sounds:
The natural sounds were experienced as mysterious and gave the feeling of a pure connection to nature. The dynamics of the surroundings were experienced in terms of sound. The sounds of birds and insects are more apparent during the night. Cars were experienced as annoying.

Orientation and walkability

- Orientation and walkability was easy when the pathways were visible due to lighter colours of materials
- Walkability is difficult when transitions of materials are too different
- When given enough time to adjust the eyes to the dark, walkability improves due to better vision in the dark

- The touch of leaves agaist the face can be a surprising and refreshing feeling
- The touch of the humid air and plants makes one feel awake and alive
- Every sense of touch is more intense

3 MAIN EXPERIENCES

The dark urban landscape experience

The contemplative experience

The contrasting experience

The transformative experience

ANALYSIS
The Dark Urban Landscape Experience: bat perspective

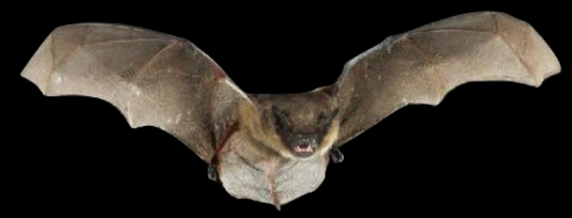
Spotting bats

Long ear bat
Grootoorvleermuis

Common pipistrelle
Dwergvleermuis

Whiskered bat
Baardvleermuis

Common noctule
Rosse vleermuis



Serotine bat
Laatvlieger

Parti-coloured bat
Tweekleurige vleermuis

Daubenton's bat
Watervleermuis

Pond bat
Meervleermuis

Greater mouse-eared bat
Vale vleermuis

Legend

Symbols

- Winterverblijf van Gewone Dwergvleermuis
- GD — Kraamkolonie van Gewone Dwergvleermuis
- L — Kraamkolonie van Laagvlieger

Vliegroutes en gebieden

- Vliegroute Watervleermuis
- Vliegroute Gewone dwergvleermuis
- Vliegroute Rosse vleermuis
- Vliegroute Laatvlieger
- Algemen migratieroute
- Foerageergebieden
- Geschikte gebouwen winterplaatsen Gewone Dwergvleermuis

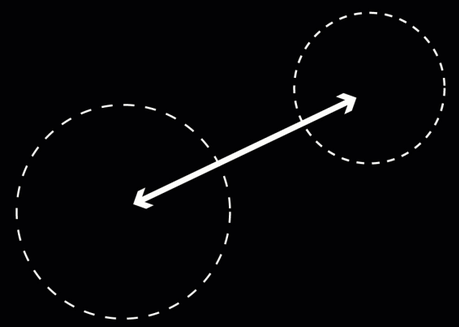

Westduinpark
Harbor of Scheveningen
Bosjes van Poot
Haga ziekenhuis
Zorgvliet

6

PART 1: DESIGN GUIDELINES FOR NOCTURNAL ECOLOGY

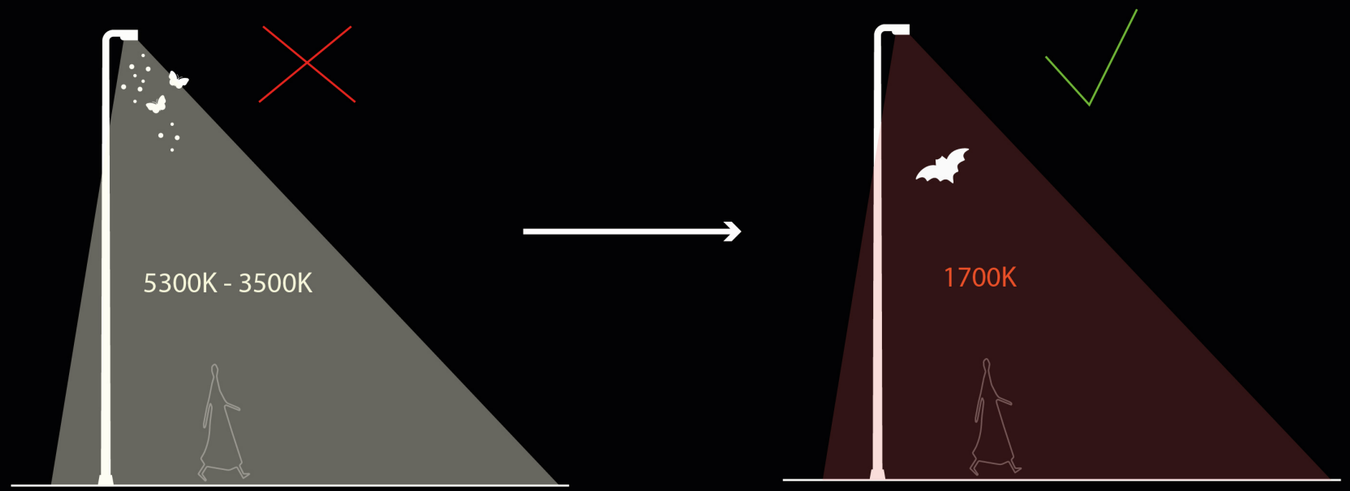
PART 1:
NOCTURNAL ECOLOGY

1



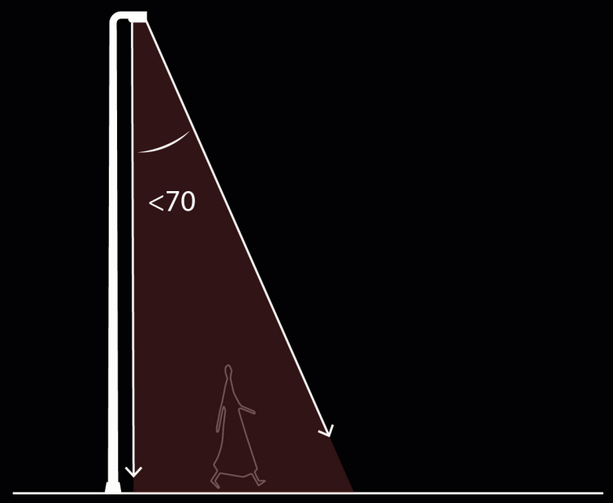
Prioritize nocturnal ecology when nocturnal animal routings or foraging areas are present in the area (**location** is important)

2



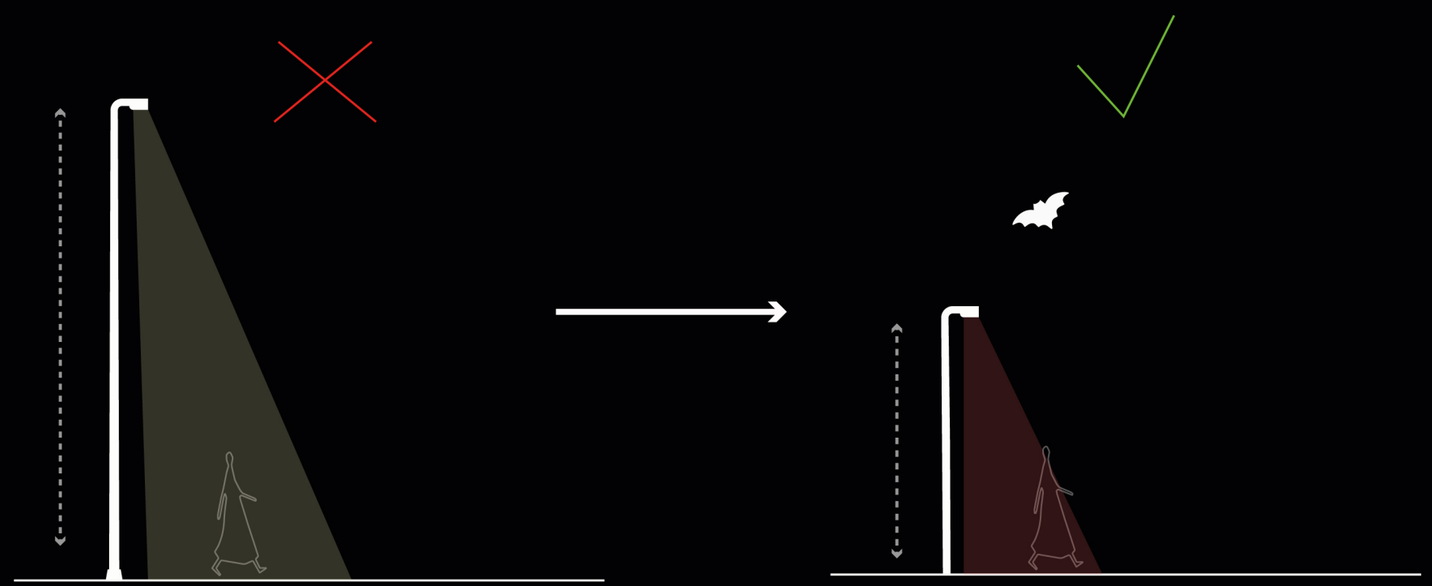
Friendly light for bats and insects (around 1700K, no more than 3500K) when light is necessary.
Cold white light (>5300K), neutral white light (3500-5300K) and warm white light (<3500K) should be avoided, or lux value should be <1 lux (for reference: moonlight is 0,2 lux and my measurements of streetlight in The Hague was between 8 and 10 lux).

3



Light **direction** should go towards the intended direction (down and direct light). To prevent light pollution, use a light angle <70 degrees

4

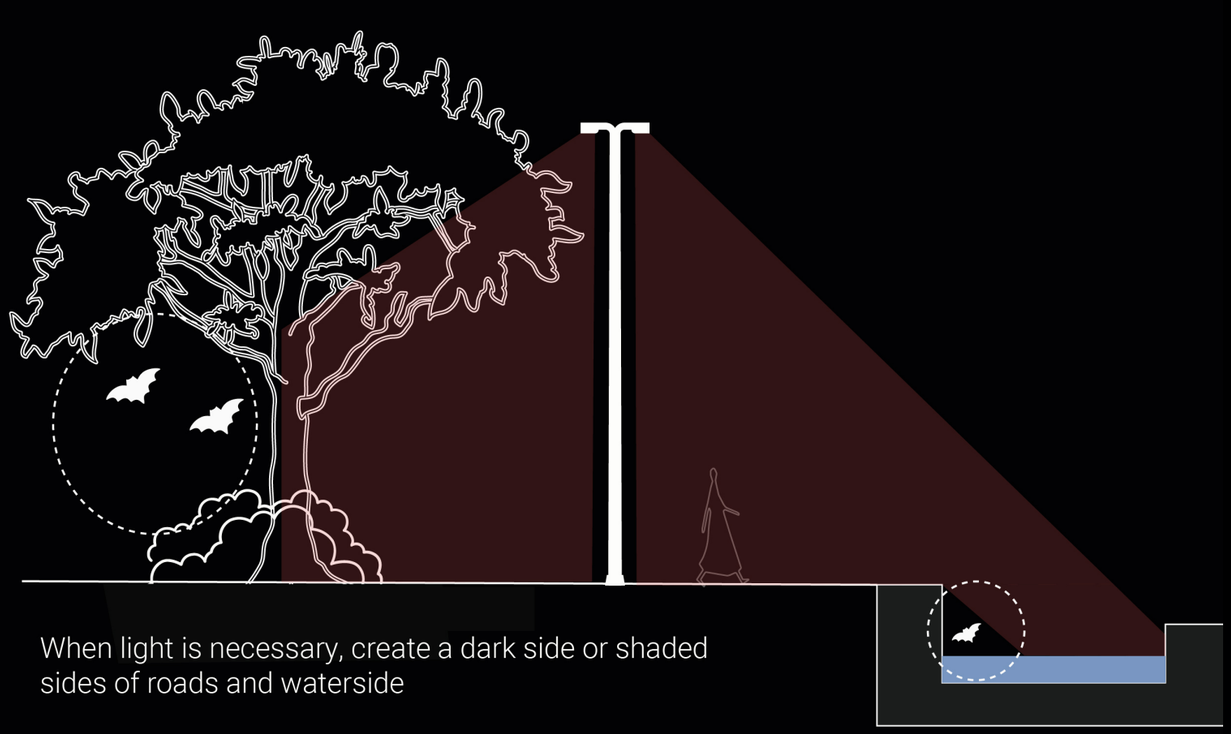


Light on lowest pole **height (<8m)** is best to avoid disturbances for flying animals like bats

5

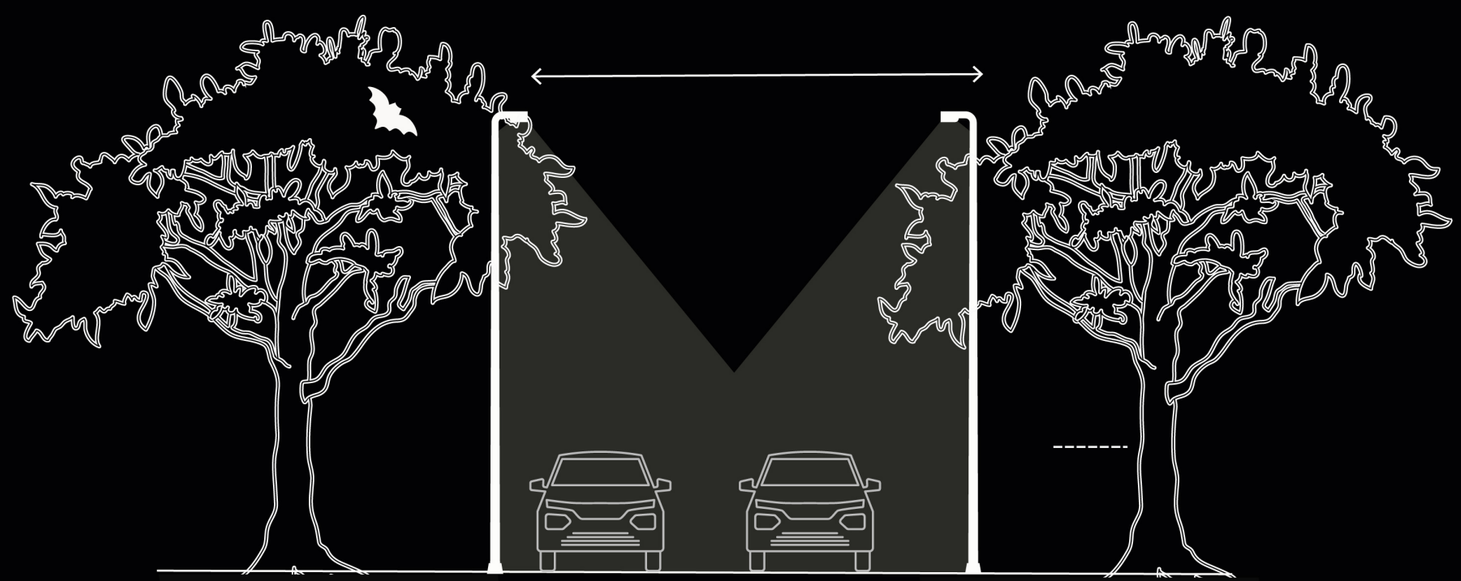
Light nearby bat residents and alongside flying routes and foraging areas should **correspond** to the flying times of bats (nearby lights should stay off)

6



When light is necessary, create a dark side or shaded sides of roads and waterside

7

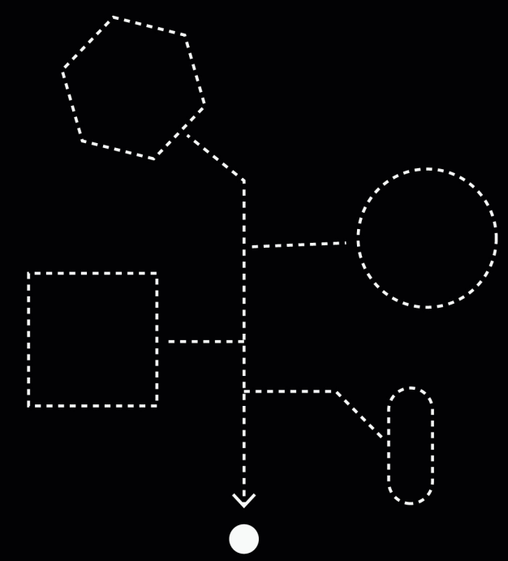


When roads cross flying routes, tree tops should reach to the other side in order for nocturnal life to cross over. When needed, add extra hop-over for bats by adding extra trees or making roads smaller. Animals can cross over via tree tops, so it is important to **reconnect** important nocturnally active areas

8

Use **vegetation** (like Cestrum nocturnum) that attracts insects at night, though native plants are preferred

9



A **network** of residence, flying route and foraging areas should be established by a combination and consideration of the above mentioned toolbox for nocturnal ecological life, which not only bats will benifit from

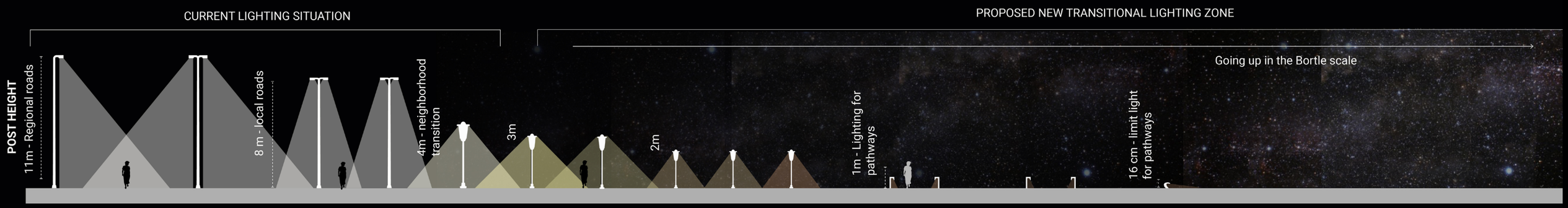
7

PART 2: DESIGN GUIDELINES FOR NOCTURNAL HUMAN EXPERIENCE

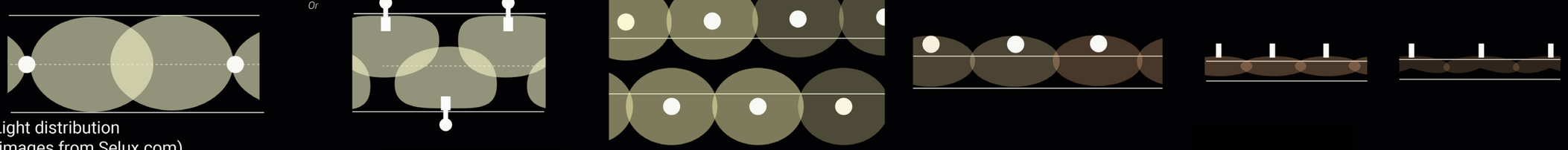
Figure 3.24. Need for softer transition zone. Image From (https://www.rijkswaterstaat.nl/wegen/wegbeheer/natuur-en-milieu/verbinden-natuurgebieden/vleermuisvriendelijke-verlichting)

TRANSITION ZONES FOR THE HUMAN EXPERIENCE

TRANSITION ZONE



Top view



Light distribution
(images from Selux.com)

Use street wide regular for big roads

Or use asymm. street for big roads

Use symmetric for intimate feeling in small scale neighborhood

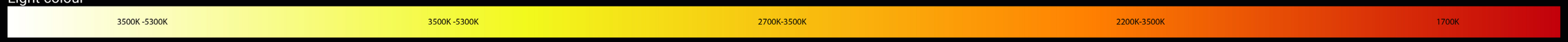
Use asymm. street to transition into longer shape for pathways

Use asymmetric street and pathway

Use narrow pathway

Intensity in lux

Light colour



Use alternative luminaires with installed smart city functions

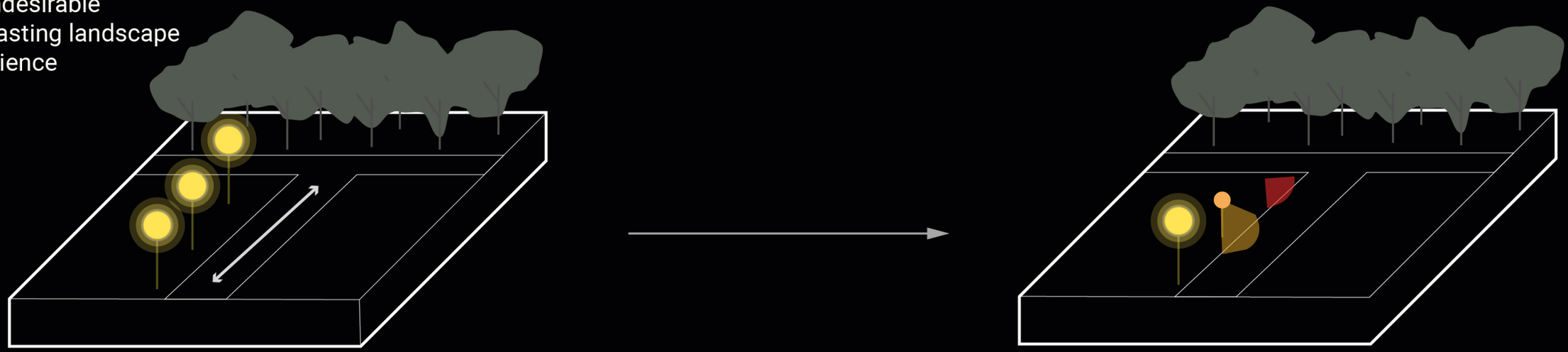
Replace current streetlight with Selux Night Sky Communities Some options with lowest temperature for around 11m-8m lamp post height:
- TAL (2700K)
- TESSIA (2700K)
- ARCA (2200K)

Use Selux Night Sky Communities:
- Elo lightstack (2700K - 2200K)

Use Selux Night Sky Communities:
- Elo Bollard (2200K)
- Line (2200K)

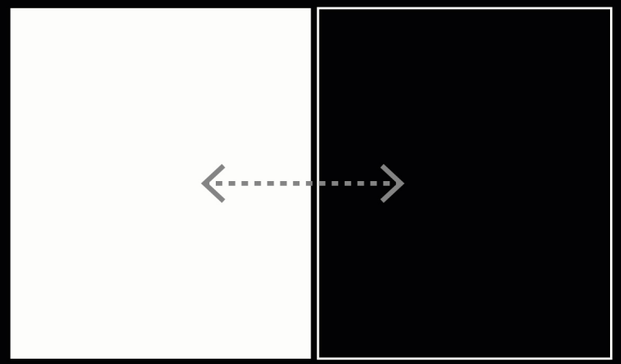
- Use bat light
- PC Amber
- Newly developed insect + bat friendly light of Selux is being developed

(Current situation)
- An undesirable contrasting landscape experience



Lights on a **perpendicular** direction to a dark area have a major influence on the experience of the area, as light reaches inside a dark area from the outside. It should gradually transition to guide people into the dark area without a sudden contrast and should nnot negatively influence the experience (glare and light trespass). This can be done both in lamp post height, light intensity and colour. While lamp posts gets lower, intensity gets less (from 10 lux to 5 lux) and colour shifts from white (5300K) to warm white (3500K) to yellow (2700K) to orange (2200K) to red (1700K).

10



Prioritize the development of transitional zones when contrast between light and dark area is high, transition is needed

11

Lighting should emphasize on 3 main dark landscape experiences:

Contrasting landscape experience

- Subtle switch from relative light area to dark area
- Open landscape to close landscape
- Different materials underfoot
- Light-coloured vegetation or objects against the dark backdrop
- Sudden touch by leaves or humid air

Contemplative landscape:

- Unity
- Darkest areas
- Peace and quiet
- Smell of flowers and natural soft sounds

Transformative landscape:

- Change of smell indicating a change in the landscape
- Change of light colours and light intensity
- Change in lamp post height
- Sound indicates the dynamic of the environment

8

DESIGN IMPLEMENTATIONS

GREEN-BLUE- DARK CORRIDOR

Legend

- Focus area to improve transition from neighborhood to darkness corridor
- Focus areas to create eco and nocturnal friendly side on the bridge
- Focus areas to create hop-overs to bridge gaps
- Focus areas to use the landscape to enrich with flower meadows
- Darkness corridor
- Transitional zone around darkness corridor
- Darkness connection
- Haagse Beek

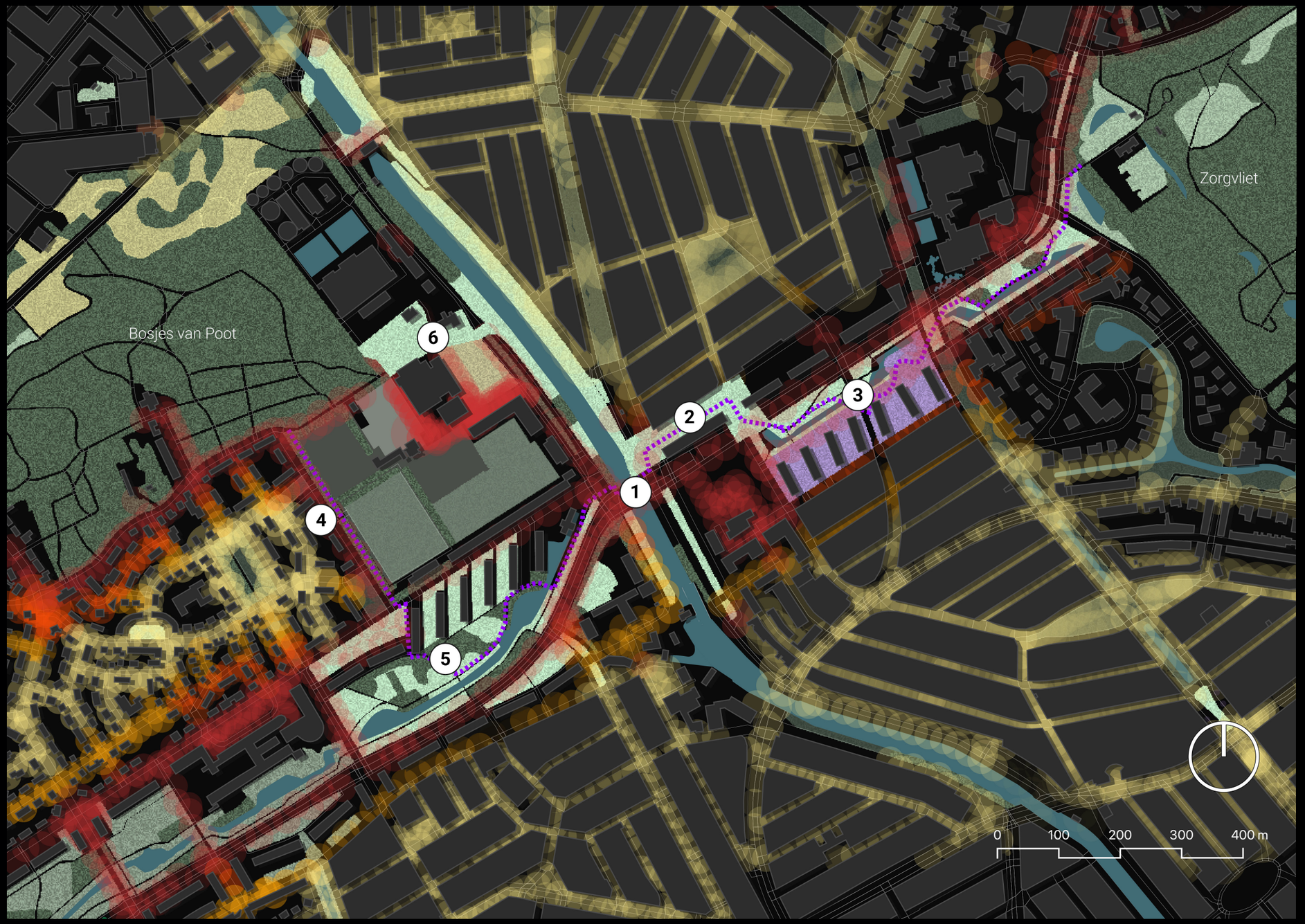
Meijendel

Zorgvliet

Bosjes van Poot

0 100 200 300 400 m

NEW LIGHTING ZONES/MASTERPLAN



Legend

Lighting

Zone 1: Darkness corridor

Zone 2: Transition

Darkness route

Zone 3: current lighting system

Landscape acupuncture

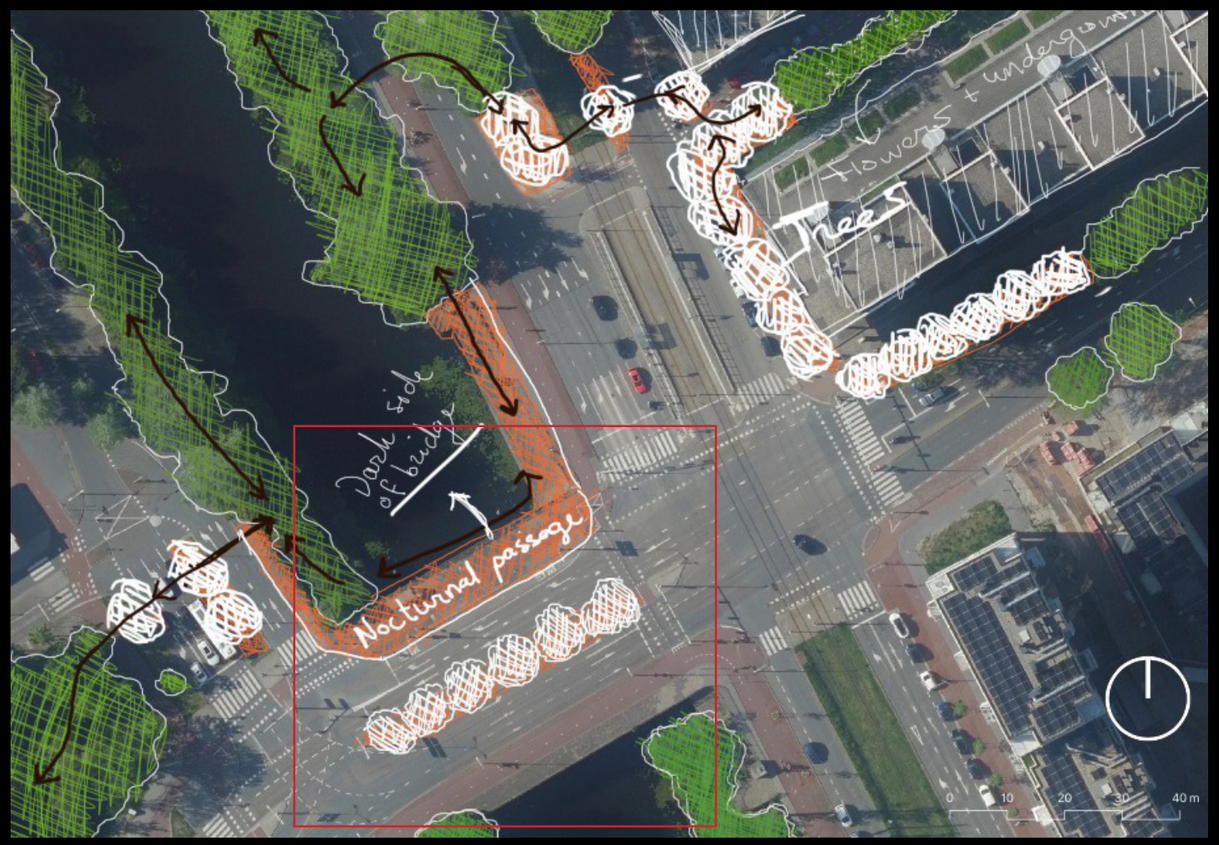
1. Green-dark bridge
2. New green/dark conection
3. Insect flower field as stepping stone
4. Improved darkness connection alongside sportsfields
5. Ambient bioluminescent light in dark areas for human guidance into darkness
6. Making use of fragmented nature to connecto to darkness corridor

INTERVENTION 1


Eco friendly light
Densify around trees and edges
Night blooming meadow
Night blooming meadow
Regional road
2,5m Tree lane
2,5m Bike lane
2,5m Path way
10m dense edge
15 m half-open habitat of night blooming meadow
2,5m Path way
7m natural brook bank with shelter for bats and amphibians
8m Haagse Beek
6m natural brook bank with shelter for bats and amphibians
Night blooming meadow and urban area

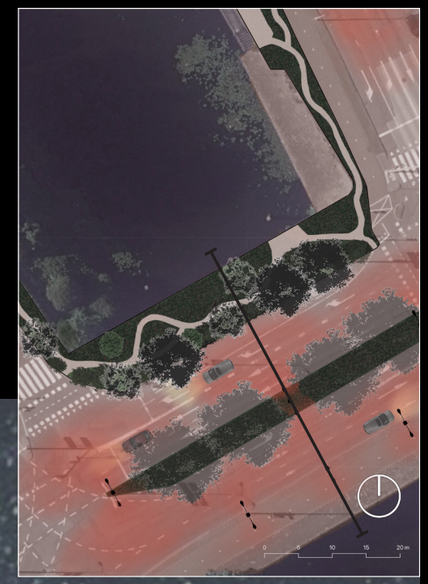
INTERVENTION 2

Current situation



Desired situation

THE NOCTURNAL PASSAGE ON THE BRIDGE



1:200

Add trees for animals

No upward light to create dark tree tops for bats

Add space to enjoy the view

Create dense green edges

Add night blooming flowers

9m green-dark connection

2,75m buslane

2,75m carlane

2,75m carlane

2,75m carlane

3,9m middle part with eco light

2,75m carlane

2,75m carlane

2,75m carlane

1.5 m

3,5m bikelanes

3,5m pathway

INTERVENTION 3

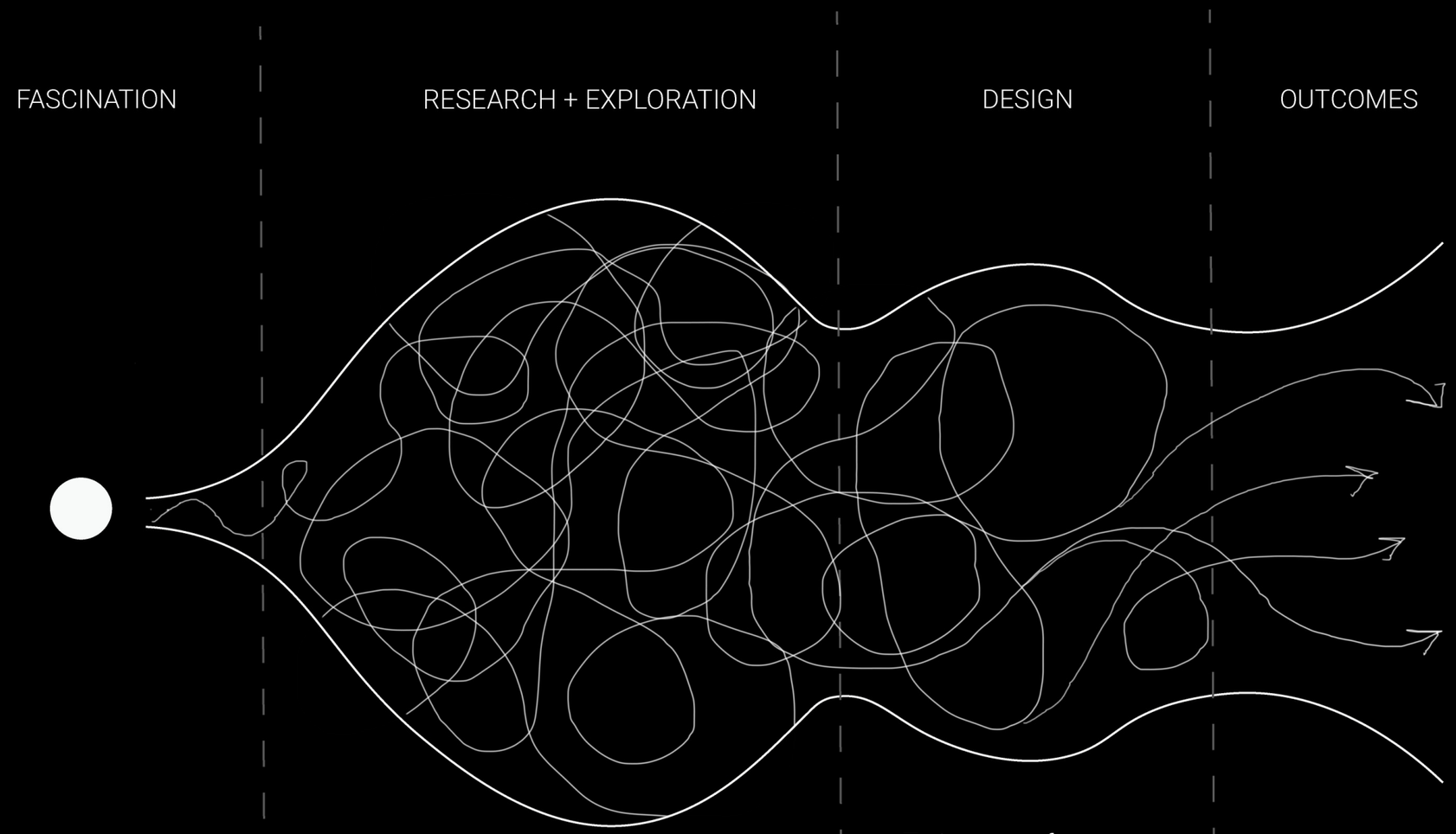
Good green structure for bats and nocturnal life

Bosjes van Poot

9

CONCLUSION AND RESEARCH QUESTION

Developing guidelines and the implementations into a local design for The Hague, establishing the Green-Blue-Dark network that contributes to a dark urban landscape and a thriving nocturnal ecology



- Fascination for the night sky
- Problem statement

- Discovering the complexity
- Somewhat getting lost in the information
- Dark landscape experiences
- Books and literature

- Trying to go from abstract to tangible
- Going back and forth between research and design (having lots of questions)
- Discovering possibilities

- Masterplan of design location
- lighting concepts
- Considering the future of lighting
- Toolbox of darkness corridor for the urban context

RESEARCH QUESTION: How can a new spatial darkness corridor and lighting strategy contribute to a dark urban landscape experience and evoke awareness for the importance of darkness, while improving the nocturnal ecology (with the focus on bats)

In a dark time, the eye begins to see
- Theodore Roethke (1963)