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## MODULE 3

# MAPPING WILDLIFE CONNECTIVITY ALONG LINEAR INFRASTRUCTURE PROJECTS

ADB

Emerging Tools and Technologies Used in  
Terrestrial Biodiversity Assessments for  
Transportation Development Projects  
The Modern Road Ecologist's Toolbox





## Module 3: Mapping Wildlife Connectivity Along Linear Infrastructure Projects



- A. THE IMPORTANCE OF MAPPING WILDLIFE HABITAT SUITABILITY AND MOVEMENT CORRIDORS**
- B. PRINCIPLES AND CONCEPTS OF MAXENT AND CIRCUITSCAPE**
- C. PREPARING DATA AND GIS INFORMATION**
- D. MODELLING HABITAT SUITABILITY AND POTENTIAL MOVEMENT CORRIDORS**

Since... protected areas cannot fully conserve biodiversity

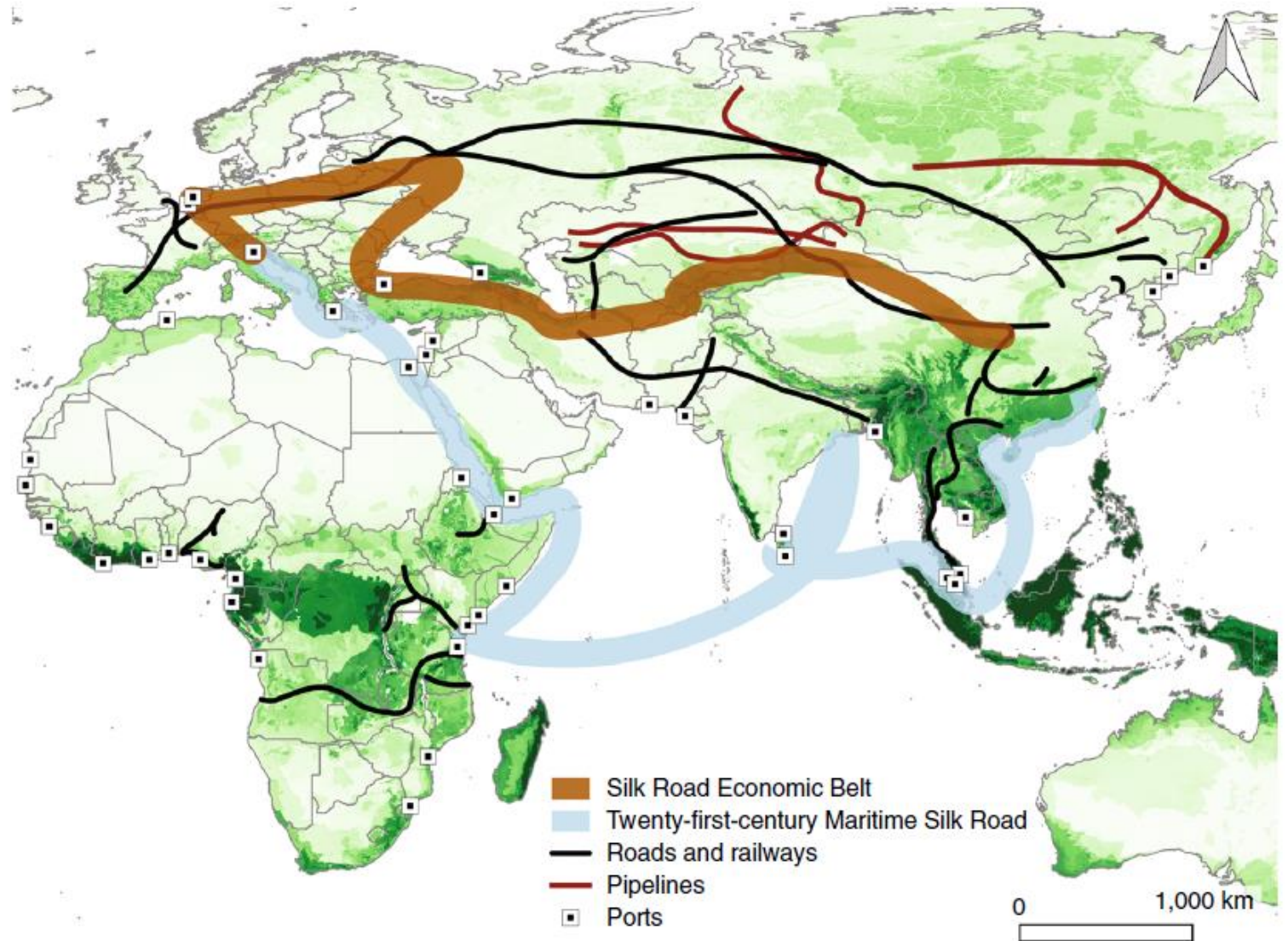
Discover Protected Areas





**Since...** there are plans of expansion of linear transportation infrastructures

# BELT and ROAD Initiative



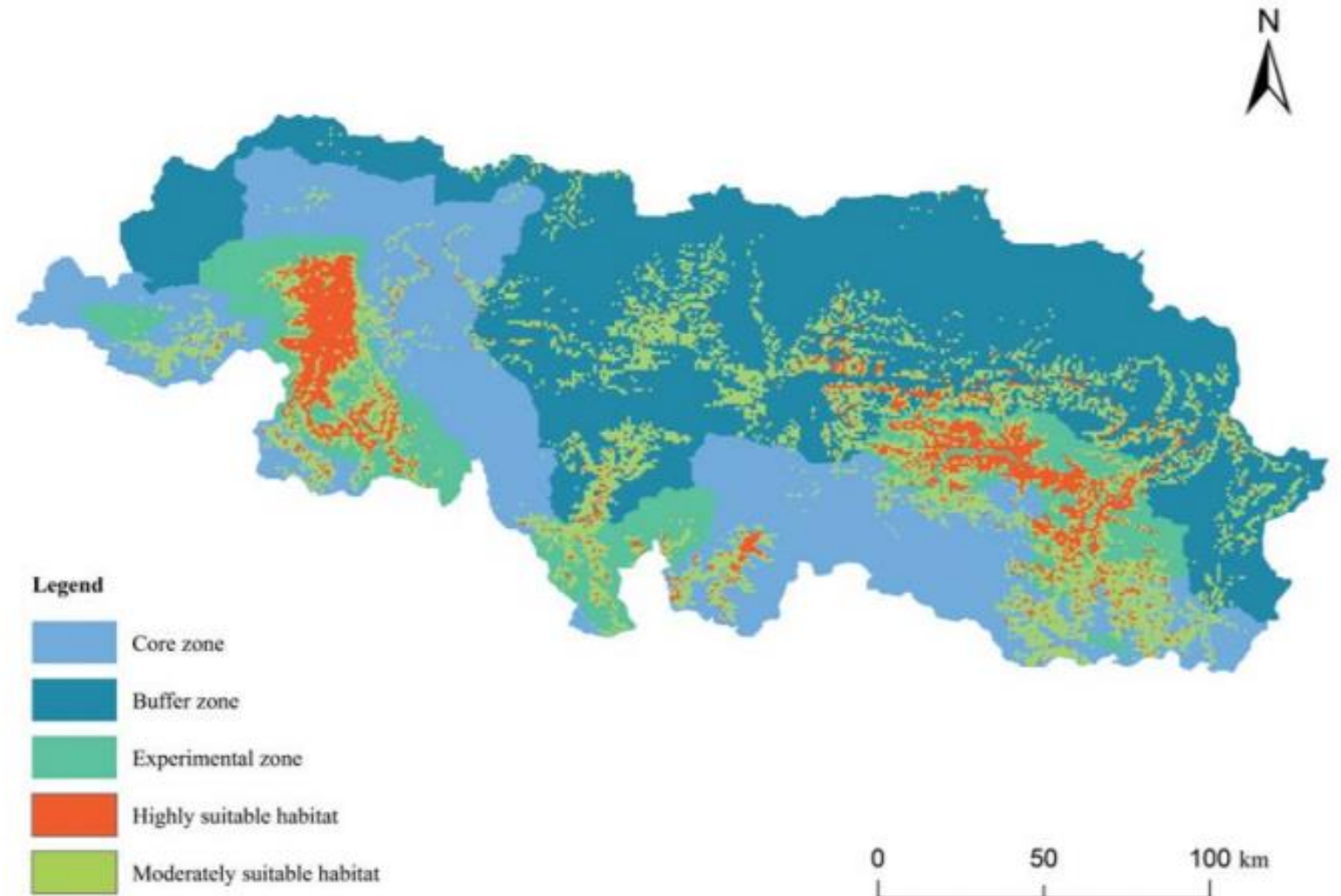
*Ascensão et al 2018. Environmental challenges for the Belt and Road Initiative. Nature*



**It is crucial to...** map species habitat suitability

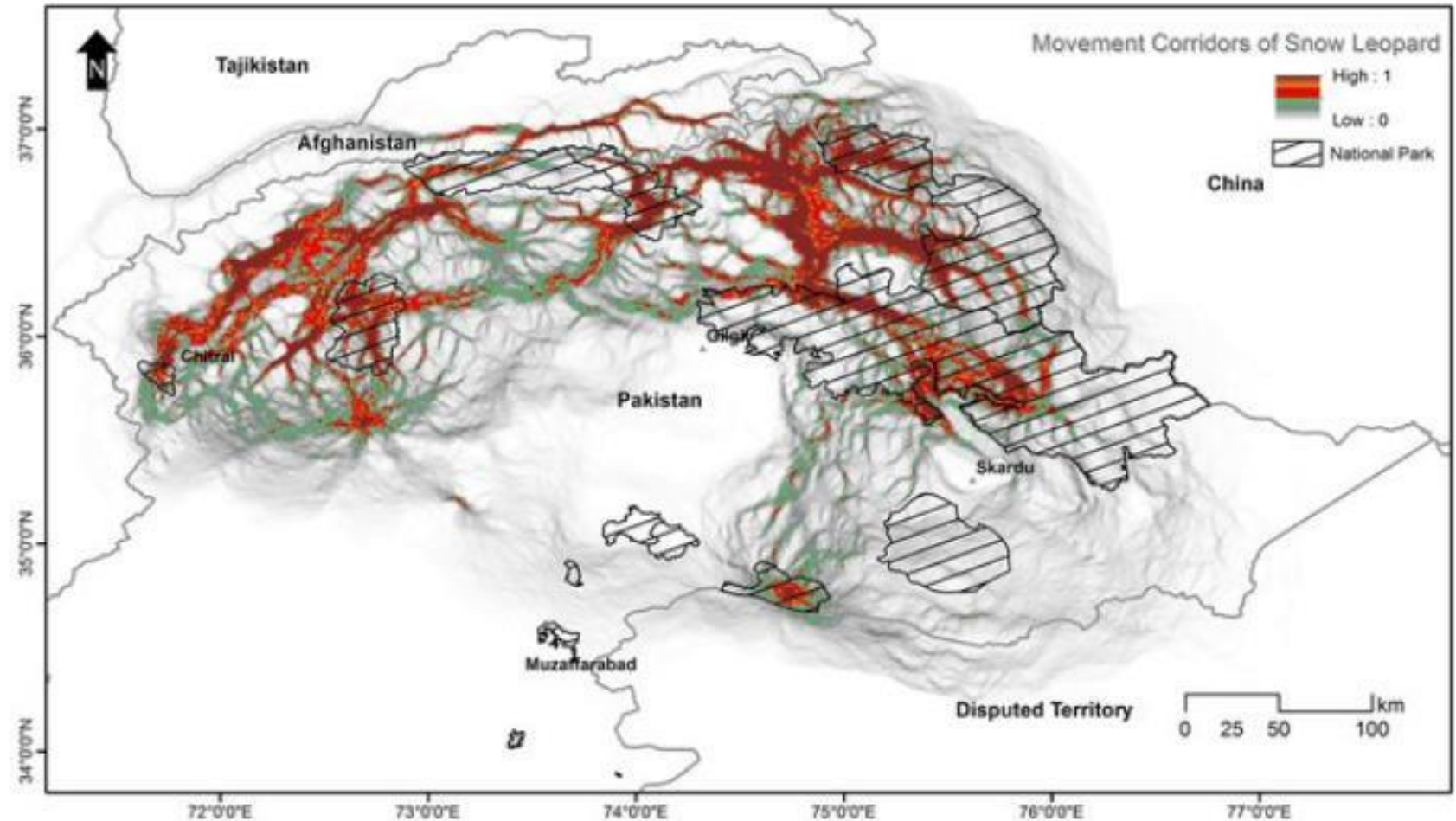
## Distribution of suitable snow leopard habitat in different functional zones in QNNR

*Bai et al.2018. Assessment of habitat suitability of the snow leopard (Panthera uncia) in Qomolangma National Nature Reserve based on MaxEnt modeling. Zoological Research.*



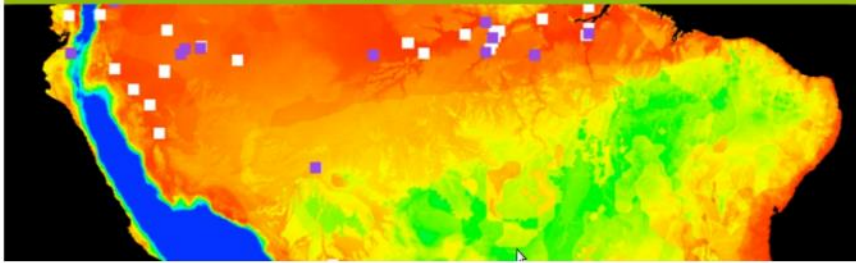


# It is crucial to...map species movement corridors



Hameed et al. 2020. Identifying priority landscapes for conservation of snow leopards in Pakistan. PLoS One.

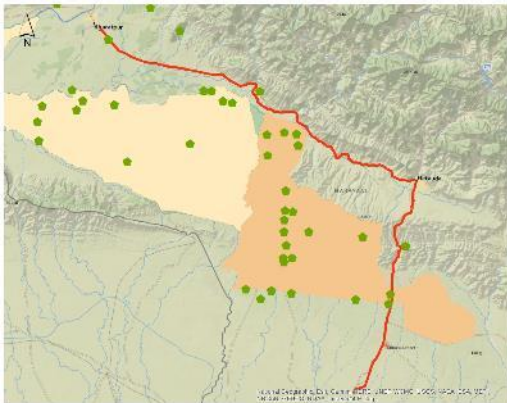
Maxent software for modeling species niches and distributions



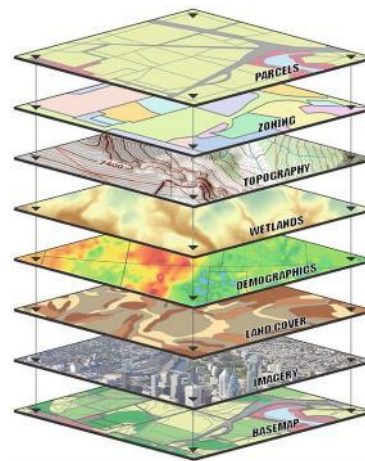
Maxent is now open source!

INPUT

Species occurrence



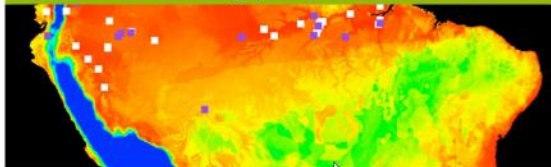
Spatial information



Habitat suitability

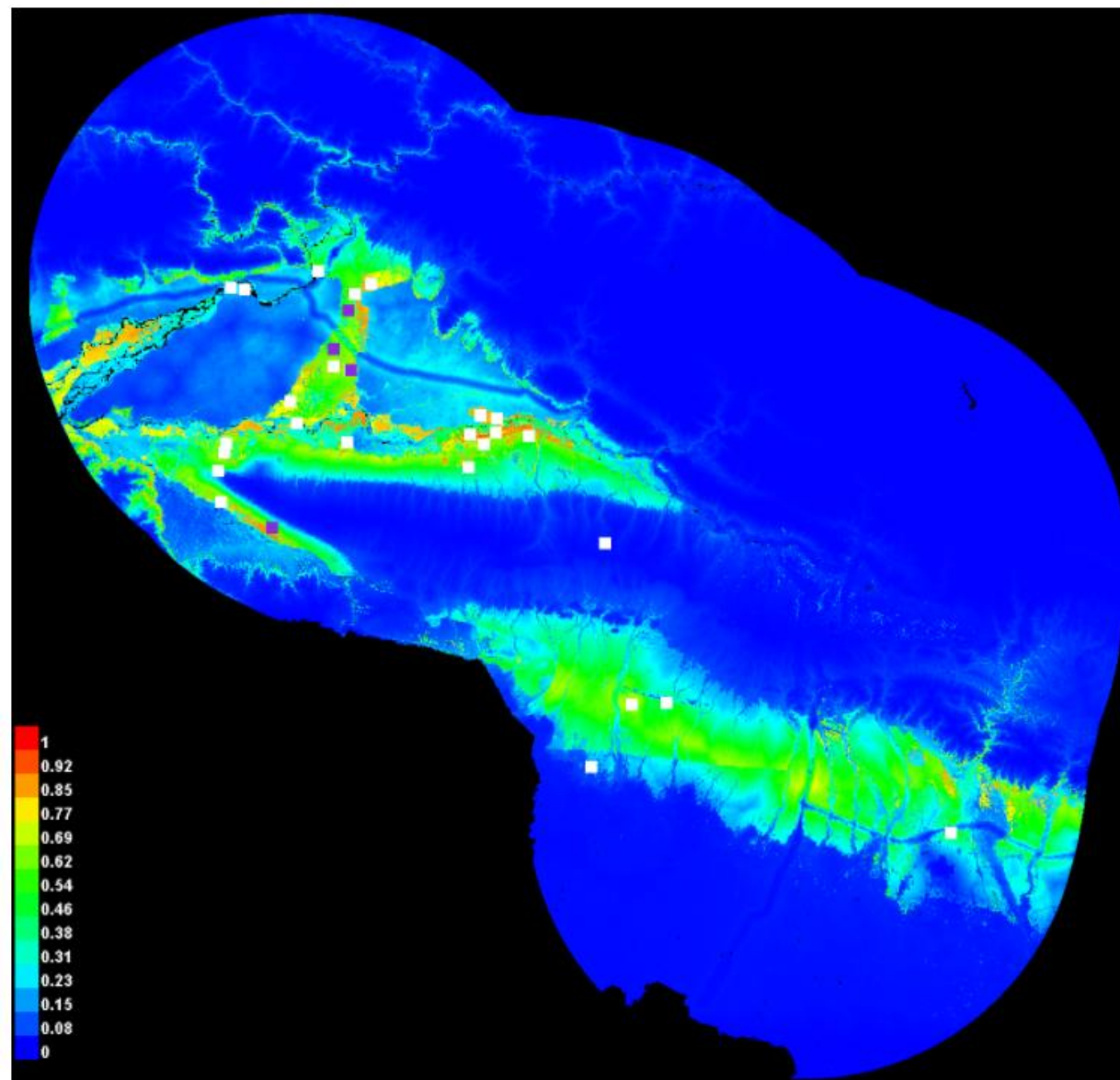


Maxent software for modeling species niches and distributions



Maxent is now open source!

## OUTPUT

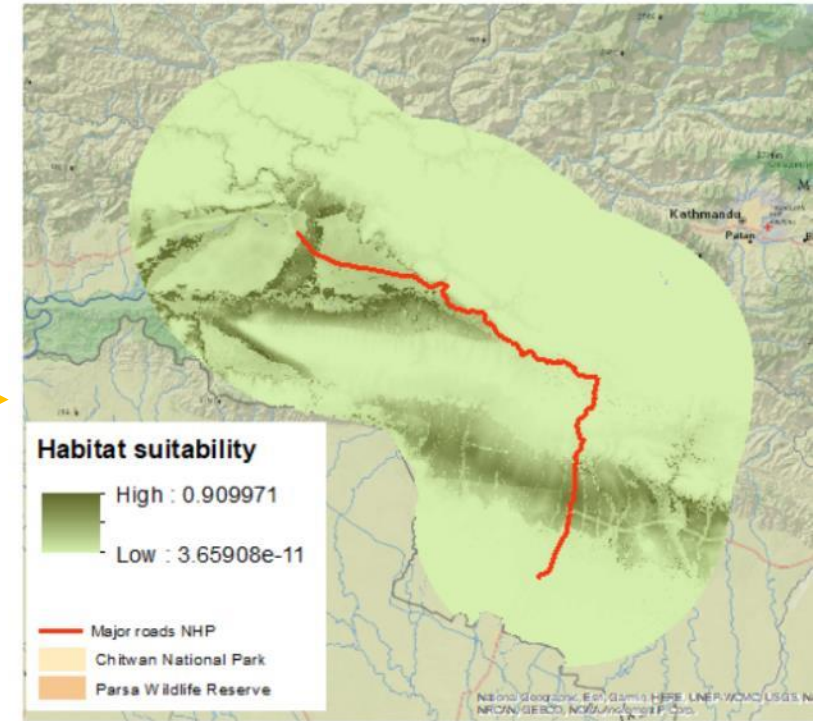
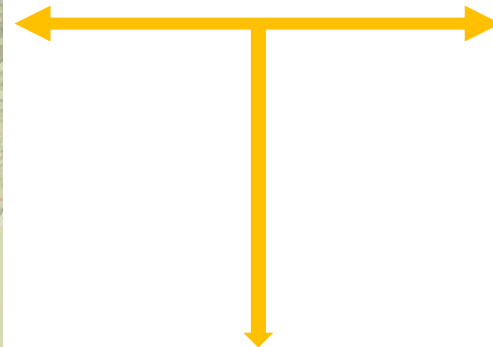
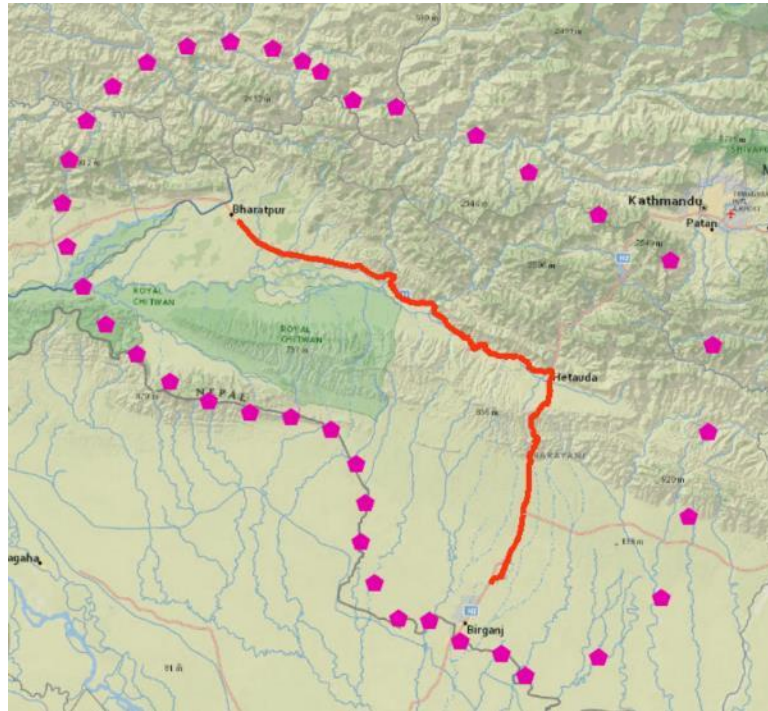






**CIRCUITSCAPE.ORG**

<https://circuitscape.org/>



**Potential movement corridors**





**CIRCUITSCAPE.ORG**

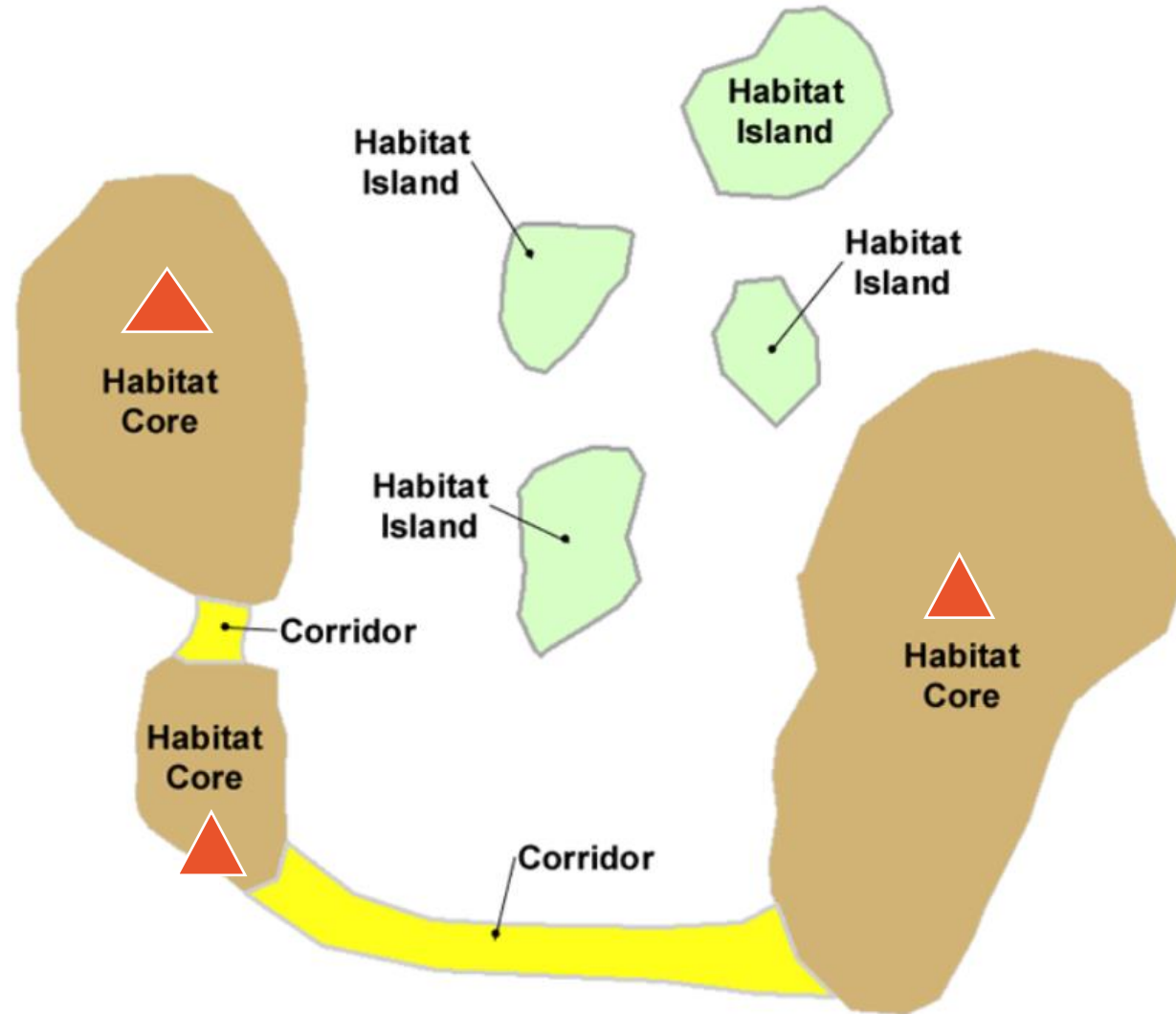
<https://circuitscape.org/>



**LEGEND**

 Potential corridor

 Focal nodes





**CIRCUITSCAPE.ORG**

<https://circuitscape.org/>

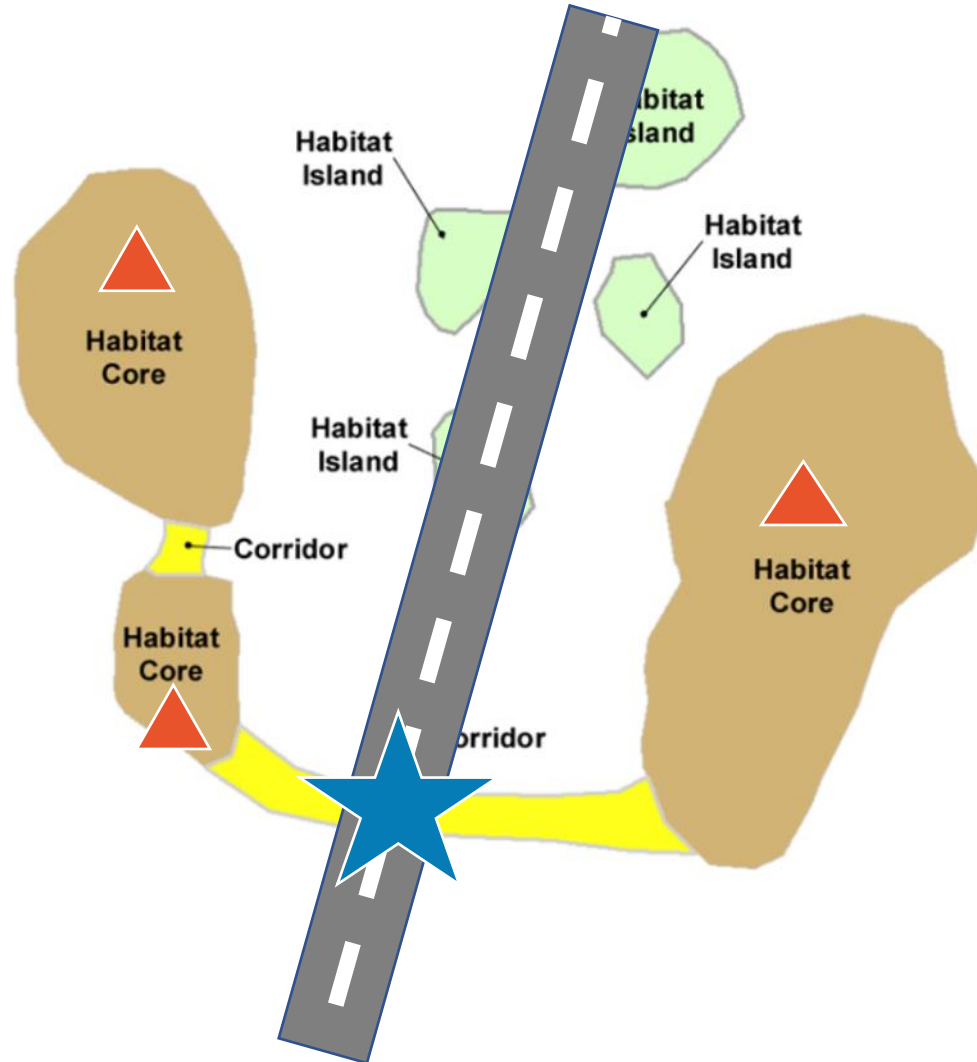


**LEGEND**

 Potential corridor

 Focal nodes

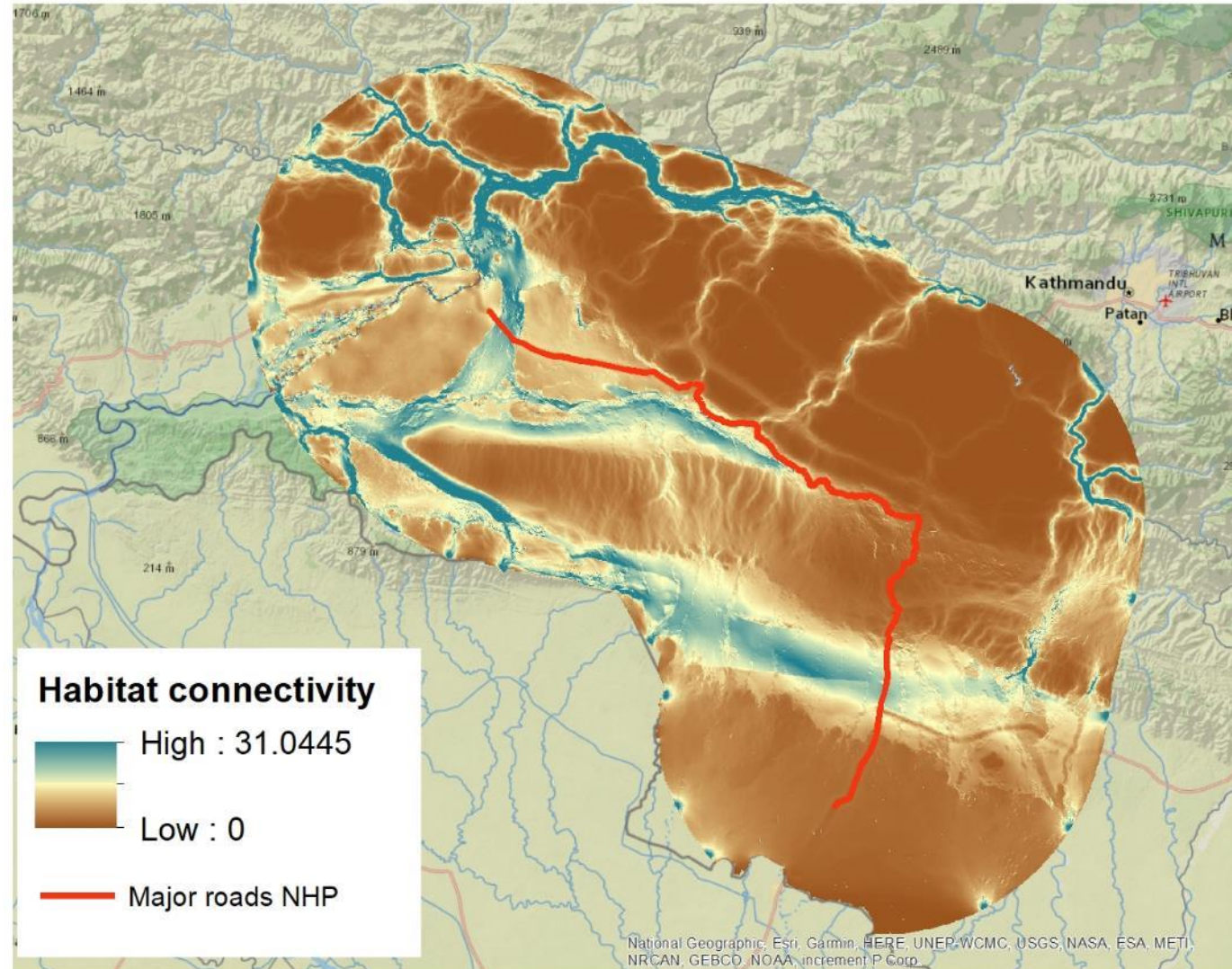
 Mitigation





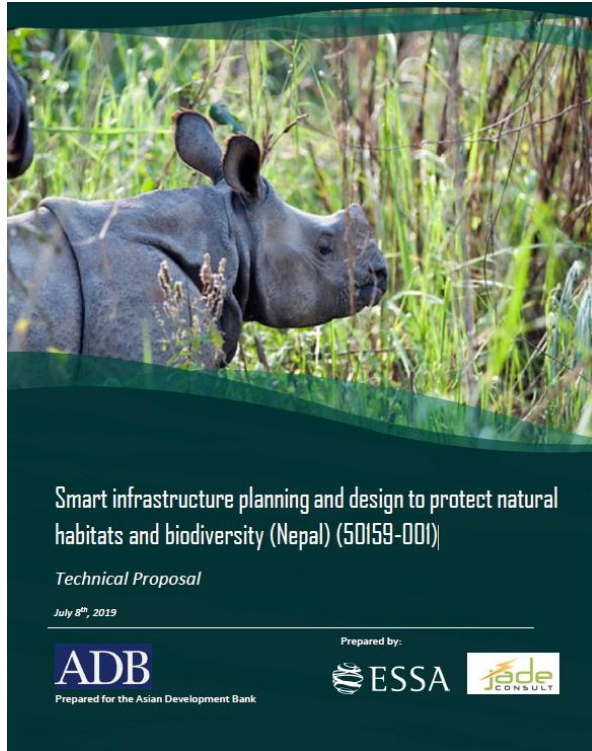
**CIRCUITSCAPE.ORG**

<https://circuitscape.org/>





# STUDY AREA




NHP: Narayanghat – Hetauda – Pathlaiya (NHP) - 108 km





# STUDY AREA






Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

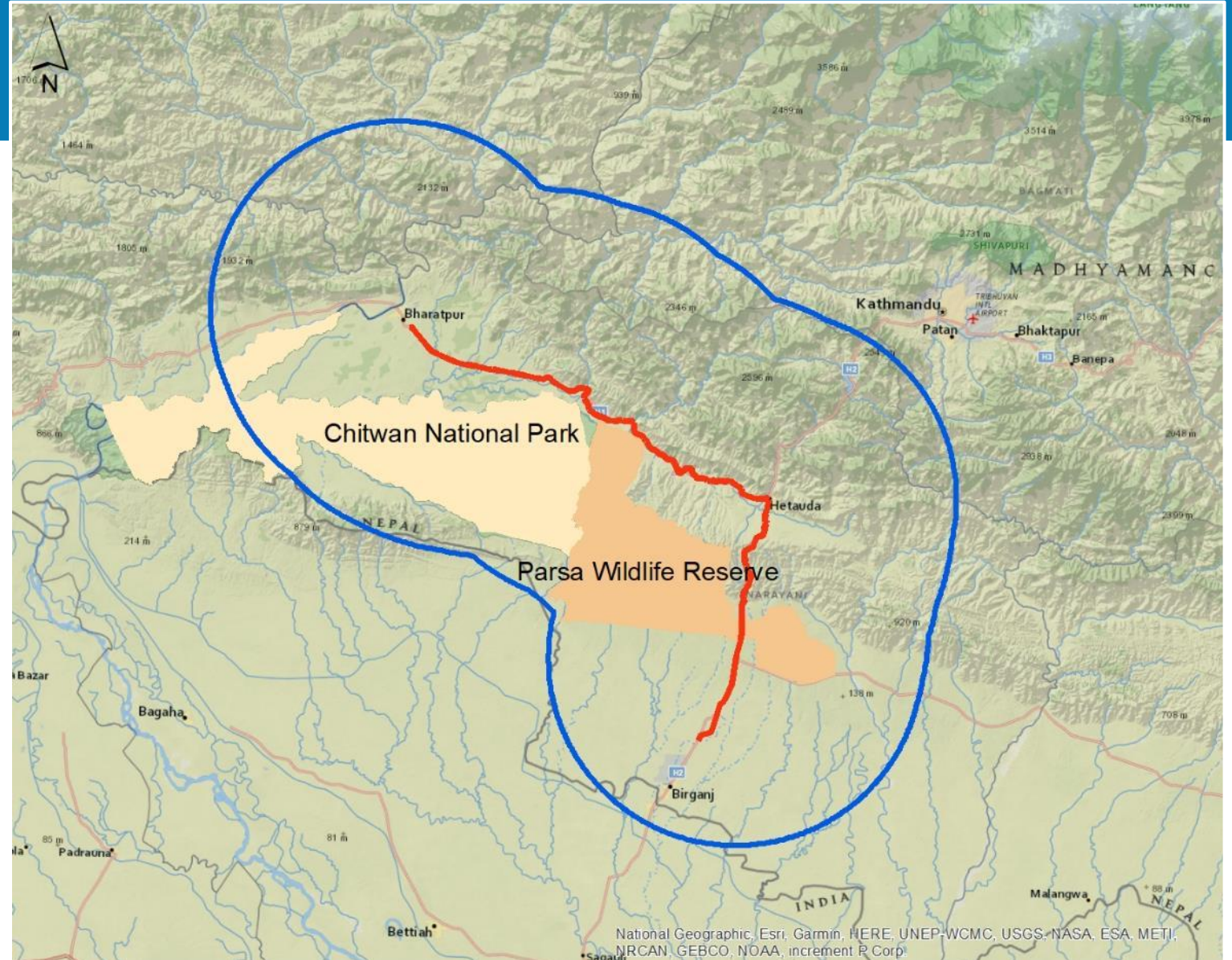
Technical Proposal

July 8<sup>th</sup>, 2019

Prepared by:



Prepared for the Asian Development Bank



NHP: Narayanghat – Hetauda – Pathlaiya (NHP) - 108 km



# SPECIES DATA



Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

Technical Proposal

July 8<sup>th</sup>, 2019



NHP: Narayanghat – Hetauda – Pathlaiya (NHP) - 108 km



Roadkill survey



Underpasses use



Bird watching

Sign survey



Camera trapping





NTNC data (National Tiger survey)  
Chitwan NP camera trapping



Image  
classification

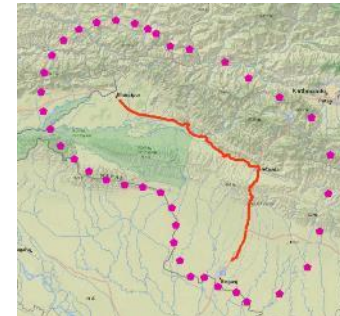
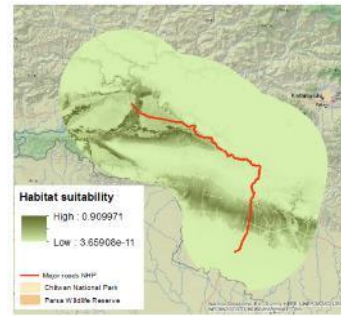
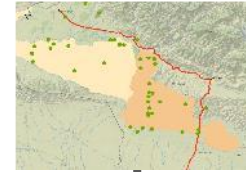
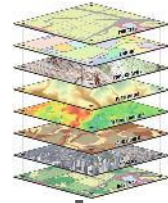


Underpass  
monitoring

Sign surveys

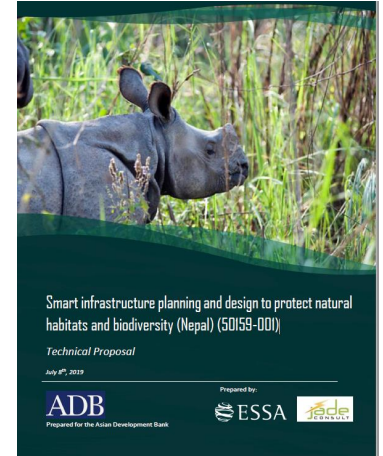
Bird surveys

Roadkill  
surveys



Validation

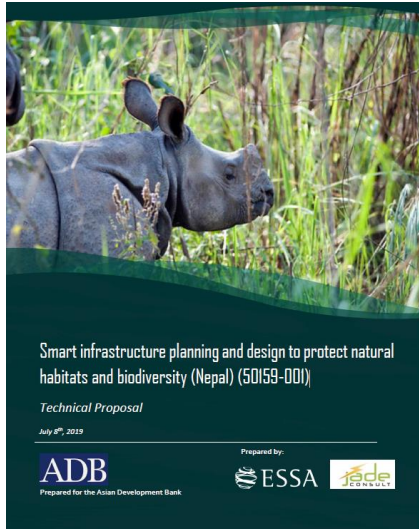
Potential  
movement  
corridor






# Image classification

TIMELAPSE - <http://saul.cpsc.ucalgary.ca/timelapse/>





View Edit History Print

## Timelapse: An Image Analyser for Camera Traps

**Field cameras** (also called camera traps) capture images (and sometimes videos) of strategic field locations at regular intervals or when any motion is detected. After retrieving the camera's images, scientists visually examine each image and video and count/describe the entities and conditions of interest (e.g., people, wildlife, weather).

**The problem** is that visually analyzing and encoding data from thousands of images and videos is a painful process.

**Timelapse Image Analyser** helps scientists do this last visual analysis and encoding step. In brief, the tool:

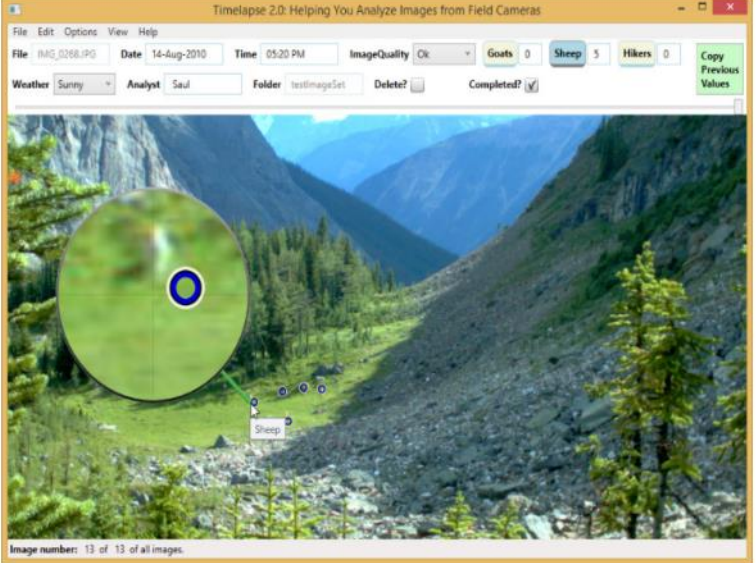
- reads and displays images and videos from any type of remote camera (as long as they are numbered);
- automatically extracts information from all images such as dates, times and location
- extracts metadata information of your choosing, if its available in the images
- categories unusual images including dark (night time) and corrupted ones;
- displays a custom interface for entering data specific to the scientist's project, where the biologist can enter data by typing, by selecting from a list of choices, and (for counting) by clicking on objects in the image;
- supports visual search through a magnifying glass, through pan and zooming (where switching images will keep the same pan/zoom levels), and through several image enhancement methods;
- saves all data to a file that can be opened in Excel and later imported into a database of your choice.
- allows you to examine subset of your images where you apply searches specific to your data.
- and much more...

### Contents

- Brief Overview
- Download and Installation (includes a tutorial user guide)
- Getting Started
- Frequently Asked Questions - FAQ
- Mailing list

### Further readings

- Greenberg, S. (2019) **Pity the analyst: Designing software for image inspection.** In Remote Cameras Workshop. (Held at Canmore Nordic Centre, Canmore, AB. Sponsored by Innovis, AB), Presentation: 35 slides with embedded video, March 25. *This slide deck includes videos of various Timelapse features*



Timelapse 2.0: Helping You Analyze Images from Field Cameras

File Edit Options View Help

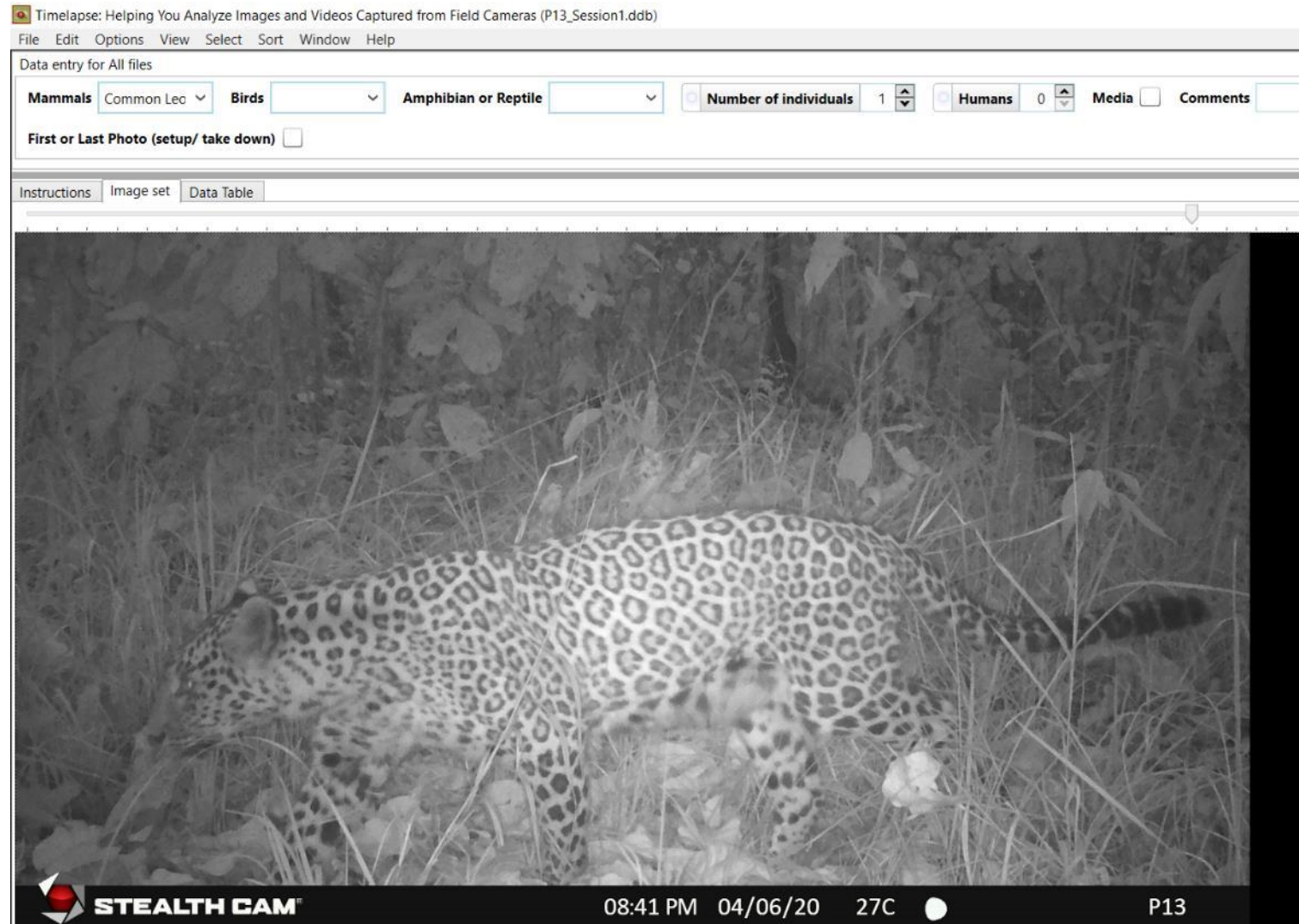
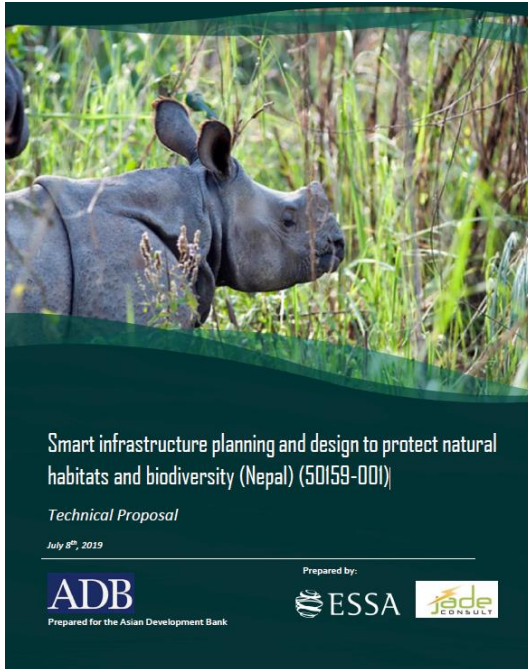
File IMG\_0268.JPG Date 14-Aug-2010 Time 05:20 PM ImageQuality Ok Goats 0 Sheep 5 Hikers 0 Copy Previous Values

Weather Sunny Analyst Saul Folder testImageSet Delete? Completed? [x]

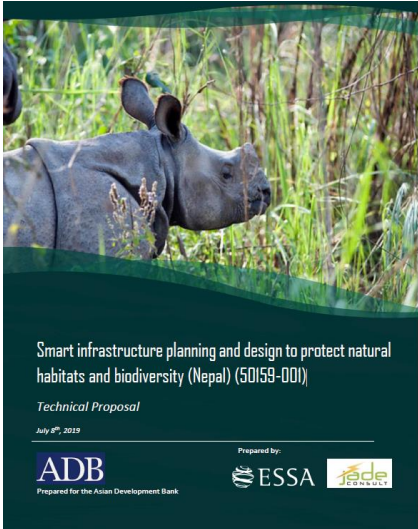
Image number: 13 of 13 of all images.



# Image classification



# Image classification



Timelapse: Helping You Analyze Images and Videos Captured from Field Cameras (P13\_Session1.ddb)

File Edit Options View Select Sort Window Help

Data entry for All files

Mammals Common Leo Birds Amphibian or Reptile Number of individuals 1 Humans 0 Media Comments Copy previous values

First or Last Photo (setup/ take down)

Instructions Image set Data Table

Displays the contents of the database, including changes as they occur.  
The highlight row indicates the currently viewed file

Id	Mammals	Birds	AmphibRept	Count	Sex	Humans	Analyst	PublictyShot	Comments	File	RelativePath	Folder	DateTime	UtcOffs	Date	Time	ImageQuality	DeleteFlag	FirstLastPhoto
387	Wild Pig			1		0		false		STC_0387.JPG	P13	P13	4/2/2020 6:23:19 PM	1	02-Apr-2020	19:23:19	Ok	false	false
388				1		0		false		STC_0388.JPG	P13	P13	4/2/2020 6:23:20 PM	1	02-Apr-2020	19:23:20	Ok	false	false
389				1		0		false		STC_0389.JPG	P13	P13	4/2/2020 6:23:21 PM	1	02-Apr-2020	19:23:21	Ok	false	false
390				1		0		false		STC_0390.JPG	P13	P13	4/2/2020 6:23:22 PM	1	02-Apr-2020	19:23:22	Ok	false	false
391				1		0		false		STC_0391.JPG	P13	P13	4/3/2020 8:16:48 PM	1	03-Apr-2020	21:16:48	Ok	false	false
392				1		0		false		STC_0392.JPG	P13	P13	4/3/2020 8:16:49 PM	1	03-Apr-2020	21:16:49	Ok	false	false
393	Gaur			1		0		false	doubt in iD Gaur?	STC_0393.JPG	P13	P13	4/3/2020 8:16:50 PM	1	03-Apr-2020	21:16:50	Ok	false	false
394				1		0		false		STC_0394.JPG	P13	P13	4/3/2020 8:16:51 PM	1	03-Apr-2020	21:16:51	Ok	false	false
395				1		0		false		STC_0395.JPG	P13	P13	4/3/2020 8:16:52 PM	1	03-Apr-2020	21:16:52	Ok	false	false
396				1		0		false		STC_0396.JPG	P13	P13	4/3/2020 8:16:53 PM	1	03-Apr-2020	21:16:53	Ok	false	false
397				1		0		false		STC_0397.JPG	P13	P13	4/4/2020 9:10:19 PM	1	04-Apr-2020	22:10:19	Ok	false	false
398				1		0		false		STC_0398.JPG	P13	P13	4/4/2020 9:10:20 PM	1	04-Apr-2020	22:10:20	Ok	false	false
399	other			1		0		false	doubt in iD	STC_0399.JPG	P13	P13	4/4/2020 9:10:21 PM	1	04-Apr-2020	22:10:21	Ok	false	false
400				1		0		false		STC_0400.JPG	P13	P13	4/4/2020 9:10:22 PM	1	04-Apr-2020	22:10:22	Ok	false	false
401				1		0		false		STC_0401.JPG	P13	P13	4/4/2020 9:10:23 PM	1	04-Apr-2020	22:10:23	Ok	false	false
402				1		0		false		STC_0402.JPG	P13	P13	4/4/2020 9:10:24 PM	1	04-Apr-2020	22:10:24	Ok	false	false
403				1		0		false		STC_0403.JPG	P13	P13	4/5/2020 2:03:23 PM	1	05-Apr-2020	15:03:23	Ok	false	false
404				1		0		false		STC_0404.JPG	P13	P13	4/5/2020 2:03:24 PM	1	05-Apr-2020	15:03:24	Ok	false	false
405				1		0		false		STC_0405.JPG	P13	P13	4/5/2020 2:03:25 PM	1	05-Apr-2020	15:03:25	Ok	false	false
406				1		0		false		STC_0406.JPG	P13	P13	4/5/2020 2:03:26 PM	1	05-Apr-2020	15:03:26	Ok	false	false
407				1		0		false		STC_0407.JPG	P13	P13	4/5/2020 2:03:27 PM	1	05-Apr-2020	15:03:27	Ok	false	false
408				0		1		false	walking	STC_0408.JPG	P13	P13	4/5/2020 2:03:28 PM	1	05-Apr-2020	15:03:28	Ok	false	false
409				1		0		false		STC_0409.JPG	P13	P13	4/6/2020 7:41:09 PM	1	06-Apr-2020	20:41:09	Ok	false	false
410	Common Leopard			1		0		false		STC_0410.JPG	P13	P13	4/6/2020 7:41:10 PM	1	06-Apr-2020	20:41:10	Ok	false	false
411				1		0		false		STC_0411.JPG	P13	P13	4/6/2020 7:41:12 PM	1	06-Apr-2020	20:41:12	Ok	false	false
412	Common Leopard			1		0		false		STC_0412.JPG	P13	P13	4/6/2020 7:41:13 PM	1	06-Apr-2020	20:41:13	Ok	false	false
413				1		0		false		STC_0413.JPG	P13	P13	4/6/2020 7:41:14 PM	1	06-Apr-2020	20:41:14	Ok	false	false
414				1		0		false		STC_0414.JPG	P13	P13	4/6/2020 7:41:15 PM	1	06-Apr-2020	20:41:15	Ok	false	false
415				1		0		false		STC_0415.JPG	P13	P13	4/6/2020 8:24:32 PM	1	06-Apr-2020	21:24:32	Ok	false	false

File: 412 of 529 Select: All files Sorted by: Id1 (the order files were added to Timelapse)

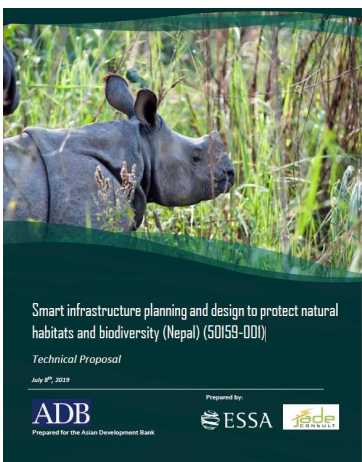


@ Benjamin Dorsey - how to organize the timelapse table for image classification



# Image classification

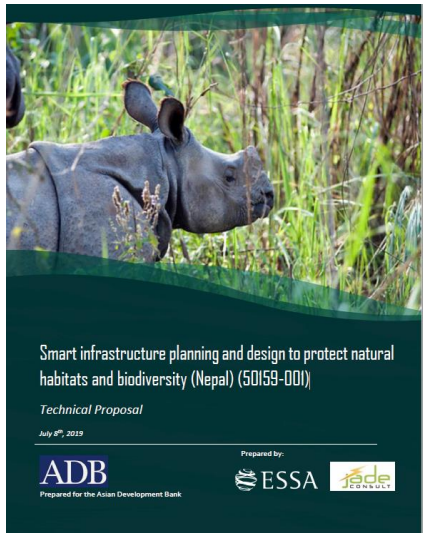
## Final data table



- ✓ Delete humans and domestic species;
- ✓ Add the latitude and longitude
- ✓ Add the Class, Order, Family and scientific name

	A	B	C	D	E	F	G	H	I	J
1	ID	Camera#	Latitude	Longitude	Order	Family	Species	Date	Month	Season
1796	9039	P14	301152	3016400	Cetartiodactyla	Cervidae	<i>Muntiacus muntjak</i>	2020-03-30	3	Dry
1797	9040	P14	301152	3016400	Cetartiodactyla	Cervidae	<i>Axis axis</i>	2020-03-30	3	Dry
1798	9041	P14	301152	3016400	Carnivora	Felidae	<i>Panthera tigris tigris</i>	2020-04-01	4	Dry
1799	9042	P14	301152	3016400	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-04-01	4	Dry
1800	9048	P14	301152	3016400	Carnivora	Felidae	<i>Felis chaus</i>	2020-04-03	4	Dry
1801	9049	P14	301152	3016400	Carnivora	Canidae	<i>Canis aureus</i>	2020-04-03	4	Dry
1802	9067	P14	301152	3016400	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-04-04	4	Dry
1803	9068	P14	301152	3016400	Carnivora	Felidae	<i>Panthera tigris tigris</i>	2020-04-04	4	Dry
1804	9069	P14	301152	3016400	Primates	Cercopithecidae	<i>Macaca mulatta</i>	2020-04-05	4	Dry
1805	9070	P14	301152	3016400	Primates	Cercopithecidae	<i>Macaca mulatta</i>	2020-04-05	4	Dry
1806	9071	P14	301152	3016400	Primates	Cercopithecidae	<i>Macaca mulatta</i>	2020-04-05	4	Dry
1807	9072	P14	301152	3016400	Carnivora	Felidae	<i>Panthera pardus</i>	2020-04-06	4	Dry
1808	9073	P14	301152	3016400	Cetartiodactyla	Bovidae	<i>Tetracerus quadricornis</i>	2020-04-06	4	Dry
1809	9102	P14a	301759	3016307	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-03-16	3	Dry
1810	9103	P14a	301759	3016307	Carnivora	Felidae	<i>Felis chaus</i>	2020-03-17	3	Dry
1811	9104	P14a	301759	3016307	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-03-18	3	Dry
1812	9105	P14a	301759	3016307	Cetartiodactyla	Cervidae	<i>Axis axis</i>	2020-03-18	3	Dry
1813	9106	P14a	301759	3016307	Cetartiodactyla	Cervidae	<i>Axis axis</i>	2020-03-18	3	Dry
1814	9107	P14a	301759	3016307	Cetartiodactyla	Cervidae	<i>Axis axis</i>	2020-03-18	3	Dry
1815	9108	P14a	301759	3016307	Cetartiodactyla	Cervidae	<i>Axis axis</i>	2020-03-18	3	Dry
1816	9109	P14a	301759	3016307	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-03-19	3	Dry
1817	9110	P14a	301759	3016307	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-03-19	3	Dry
1818	9111	P14a	301759	3016307	Cetartiodactyla	Cervidae	<i>Axis axis</i>	2020-03-20	3	Dry
1819	9112	P14a	301759	3016307	Carnivora	Felidae	<i>Panthera pardus</i>	2020-03-20	3	Dry
1820	9121	P14a	301759	3016307	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-03-21	3	Dry
1821	9130	P14a	301759	3016307	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	2020-03-21	3	Dry





## GIS layers



Altitude

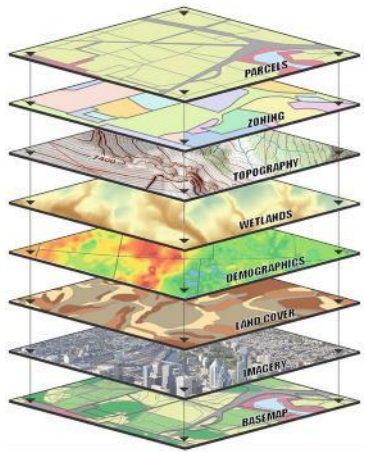
Hydrology

Land use

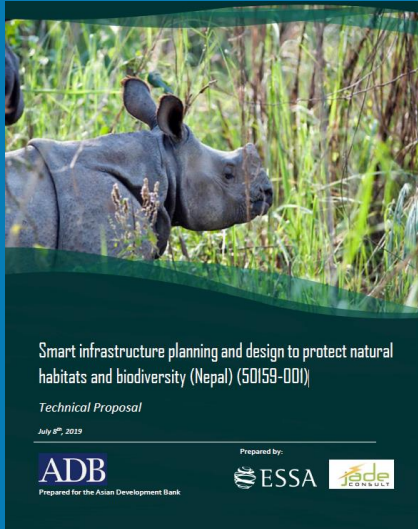
Buildings

Human  
population

Roads



# ALTITUDE



## SOURCE:

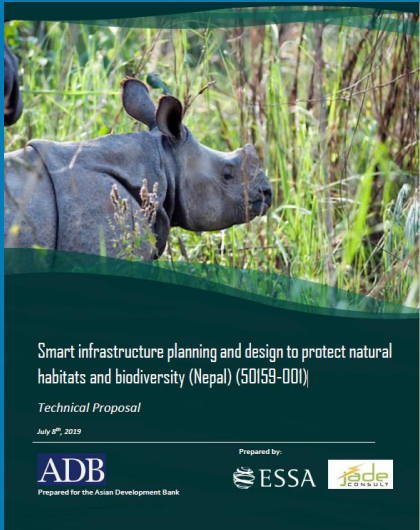
<https://search.asf.alaska.edu/#/>

## FORMAT: raster

## YEAR: 2011

## RESOLUTION: 12.5m

The screenshot shows the ASF Data Search Vertex web application. The search filters are set to Geographic, Sentinel-1, and Area of Interest. The search results show 250 of 13,350,962 files. The map displays a region in Nepal with various village names such as Siddhantnagar, Sunauli, Pasauli, Thuthiban, Susta, Jharharwa, Nichaul, Gorbadhana, Gaunaha, Bairiya Madhopur, Ramnagar, Narkatlaganj, Mainatani, Pokhariya, Birgunj, Kalaiya, and Auniya. The interface includes a search bar, navigation tools, and a NASA logo.



# Median altitude

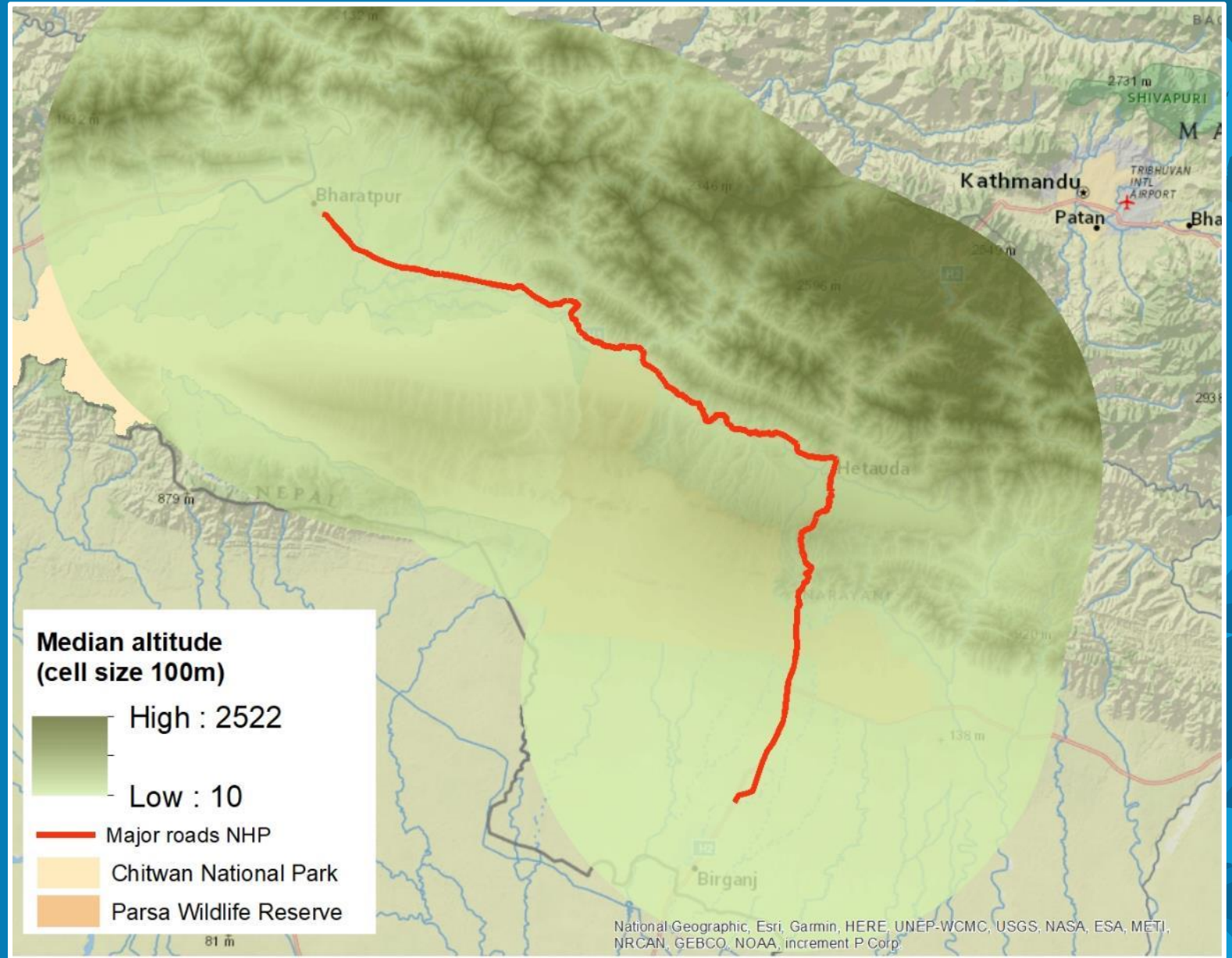


**Arc Toolbox – Data Management**

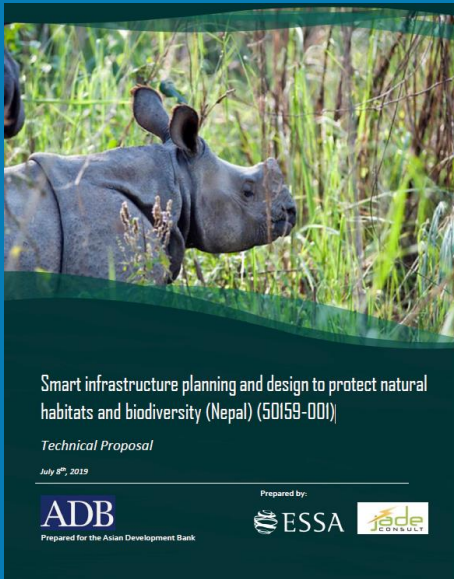
**RESAMPLE to 100m (median altitude)**

**Arc Toolbox – Conversion**

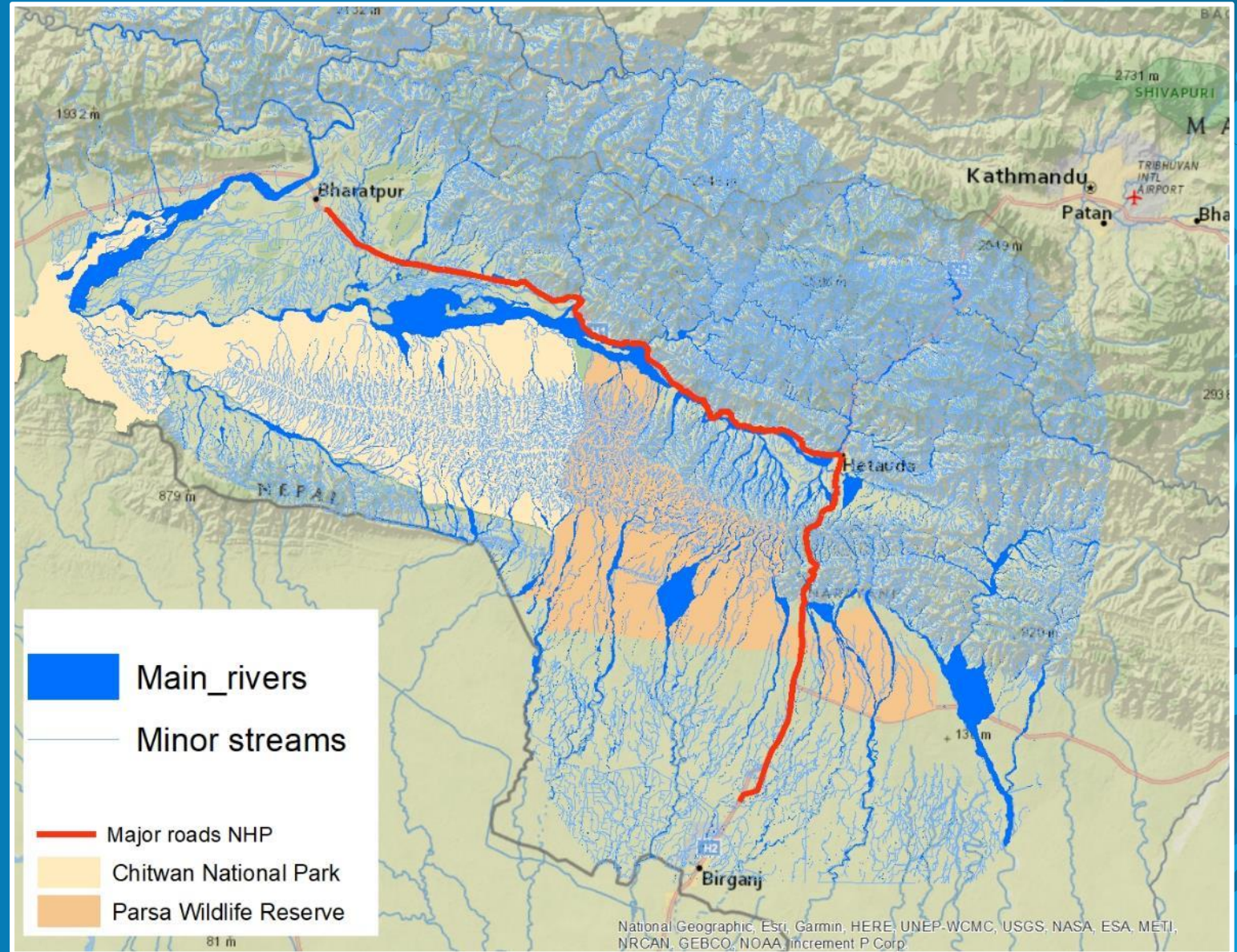
**Raster to ASCII (.asc)**







# HYDROLOGY

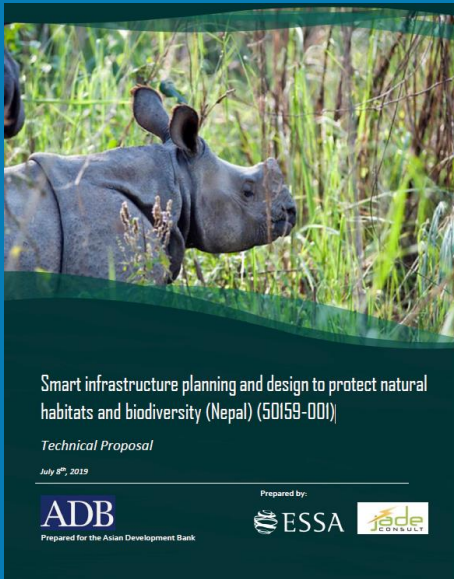


**SOURCE:**  
Department of Survey

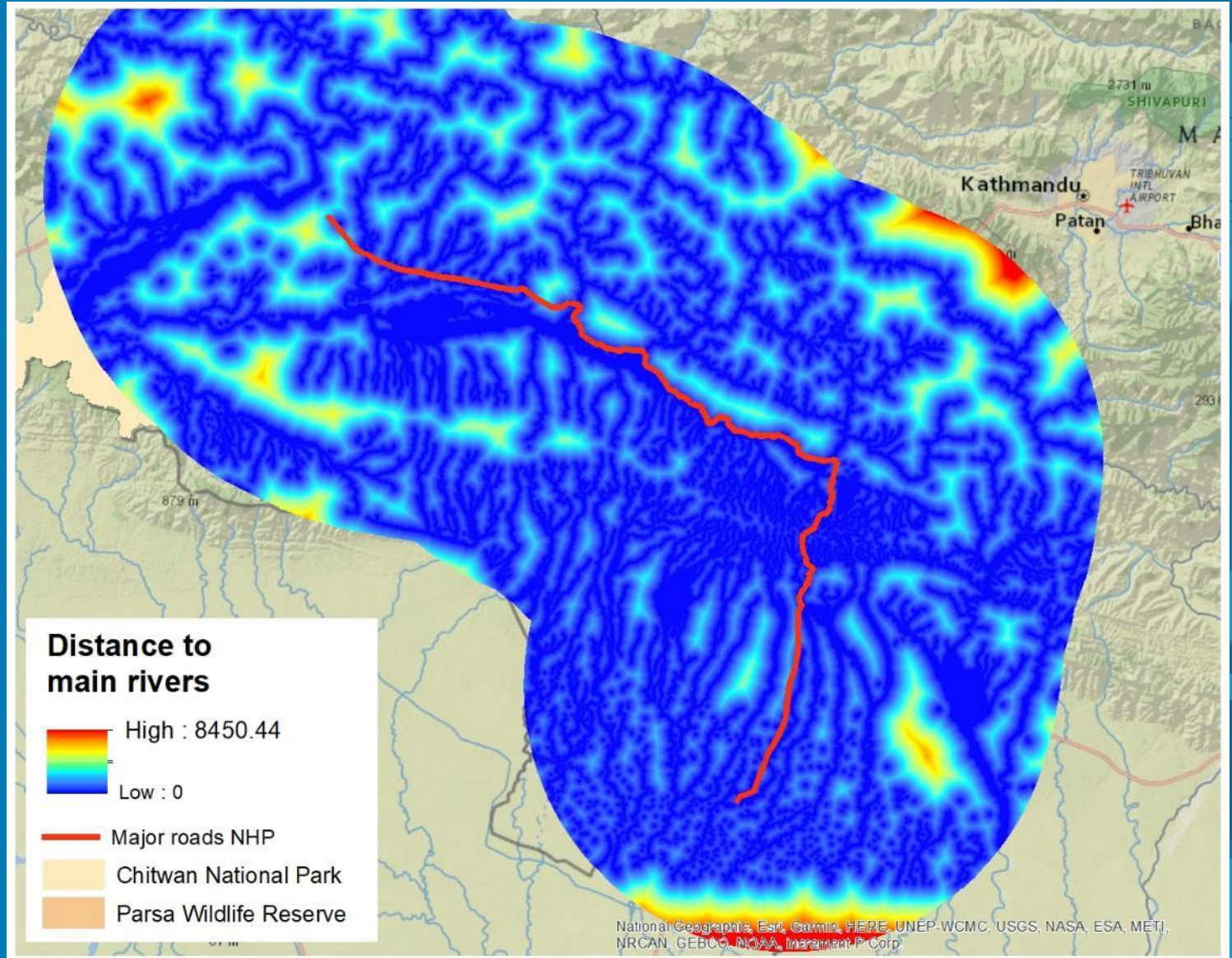
**FORMAT:** polygon/polylines

**YEAR:** 2002

**SCALE:** 1: 25 000



# Distance to main rivers (m)



Arc Toolbox – Spatial analyst

ESTIMATE Euclidean distance

Arc Toolbox – Conversion

Raster to ASCII (.asc)



Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

Technical Proposal

July 8<sup>th</sup>, 2019

Prepared by:

ADB

Prepared for the Asian Development Bank

ESSA

EDGE CONSULT

# LAND USE (dry season)

The screenshot shows the Earth Explorer website (earthexplorer.usgs.gov) with the following elements:

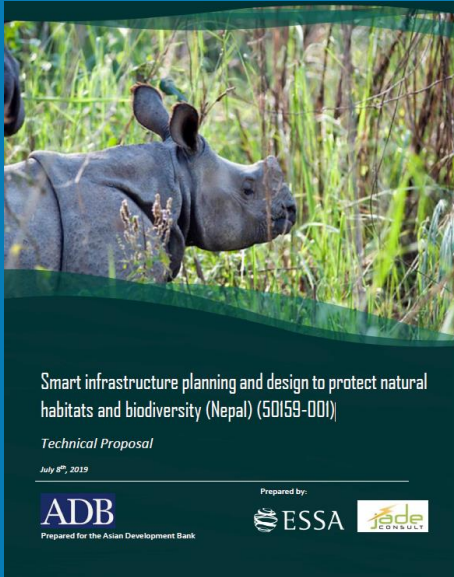
- Search Criteria Section:**
  - Geocoder:** Includes a "KML/Shapfile Upload" option and a dropdown menu for "Select a Geocoding Method" set to "Feature (GNIS)".
  - Search Limits:** A note stating "The search result limit is 100 records; select a Country, Feature Class, and/or Feature Type to reduce your chances of exceeding this limit." Below this are tabs for "US Features" and "World Features".
  - Feature Name:** A text input field with the instruction "(use % as wildcard)".
  - State:** A dropdown menu set to "All".
  - Feature Type:** A dropdown menu set to "All".
  - Show/Clear:** Two buttons at the bottom of the search criteria section.
- Polygon Section:** Includes tabs for "Polygon", "Circle", and "Predefined Area". Below these are tabs for "Degree/Minute/Second" and "Decimal". A message states "No coordinates selected." with buttons for "Use Map", "Add Coordinate", and "Clear Coordinates".
- Date Range Section:** Includes tabs for "Date Range", "Cloud Cover", and "Result Options".
- Map:** A satellite map of Nepal showing geographical features like the Gandaki, Narayani, and Bagmati rivers, and cities like Kathmandu, Bharatpur, and Birganj. The map includes a coordinate display at the top right: (27° 23' 45" N, 84° 43' 15" E).

**SOURCE:**  
Sentinel-2A satellite -  
<https://earthexplorer.usgs.gov/>

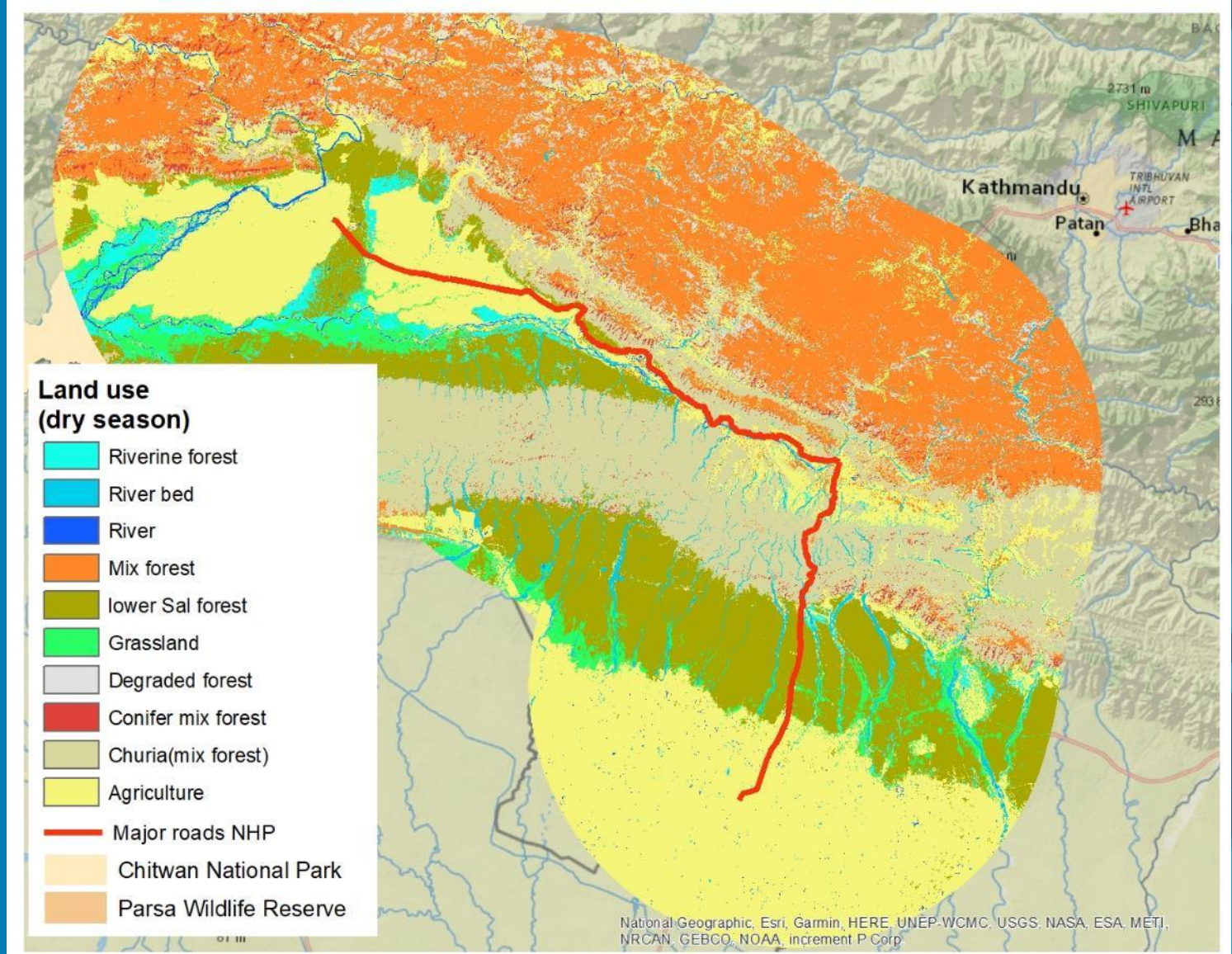
**FORMAT:** image

**YEAR:** 2020

**RESOLUTION:** 10m



# LAND USE (dry season)

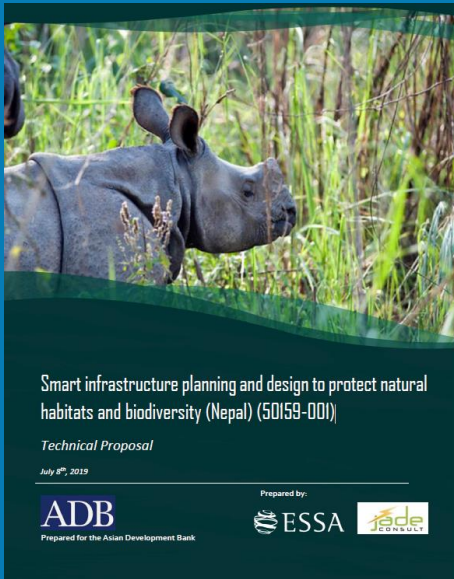


**Arc Toolbox – Data Management**

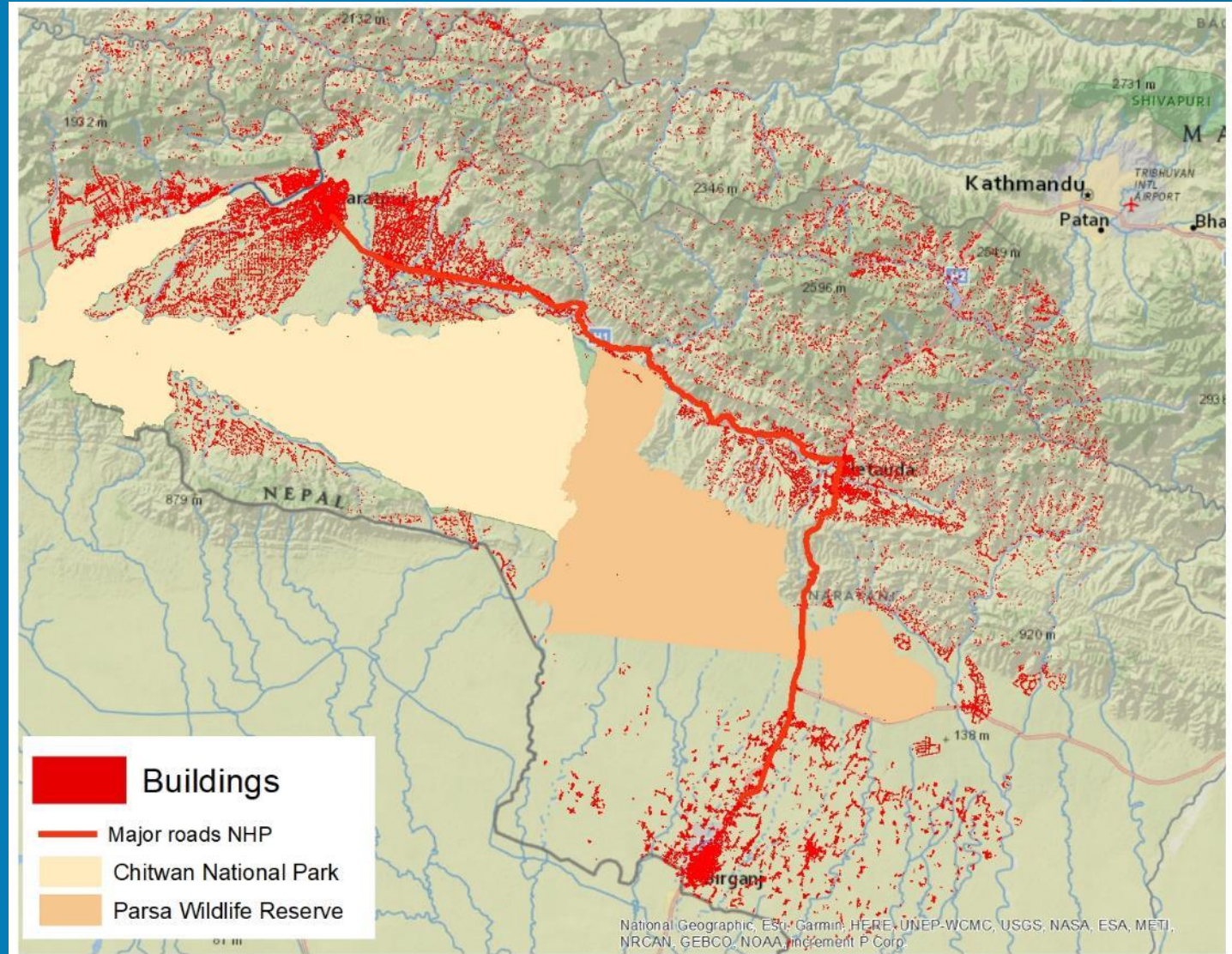
**RESAMPLE to 100m**

**Arc Toolbox – Conversion**

**Raster to ASCII (.asc)**



# BUILDINGS



**SOURCE:**  
OpenStreetMap

**FORMAT:** polygon

**YEAR:** 2021



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Prepared by:

ESSA

Jade CONSULT



ArcGIS<sup>®</sup>

**Arc Toolbox – Spatial analyst**

**Data Management – Features to points**

**Estimate the centroids of buildings**

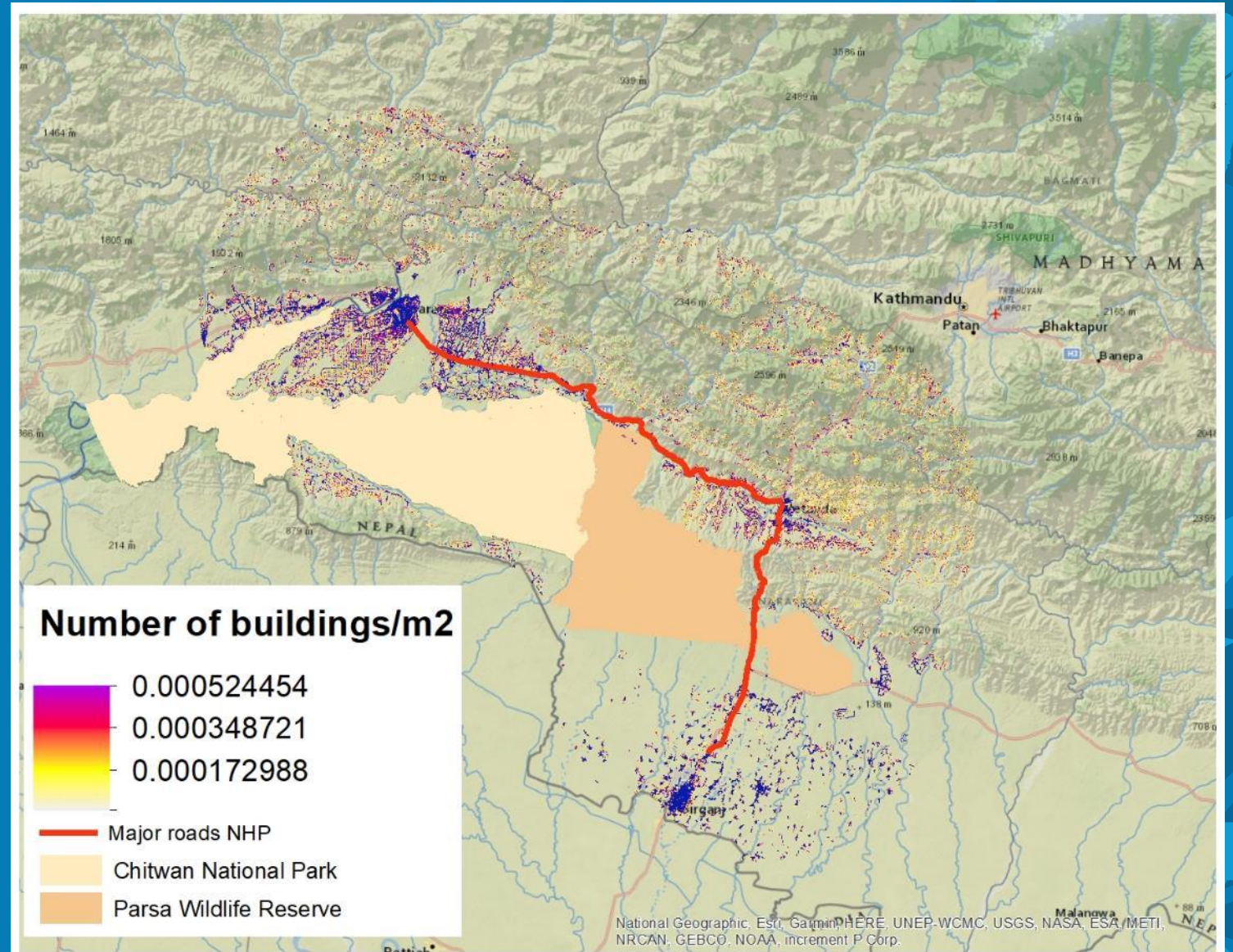
**Arc Toolbox – Spatial Analyst**

**Density – Point density**

**Arc Toolbox – Conversion**

**Raster to ASCII (.asc)**

# Density of buildings





Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

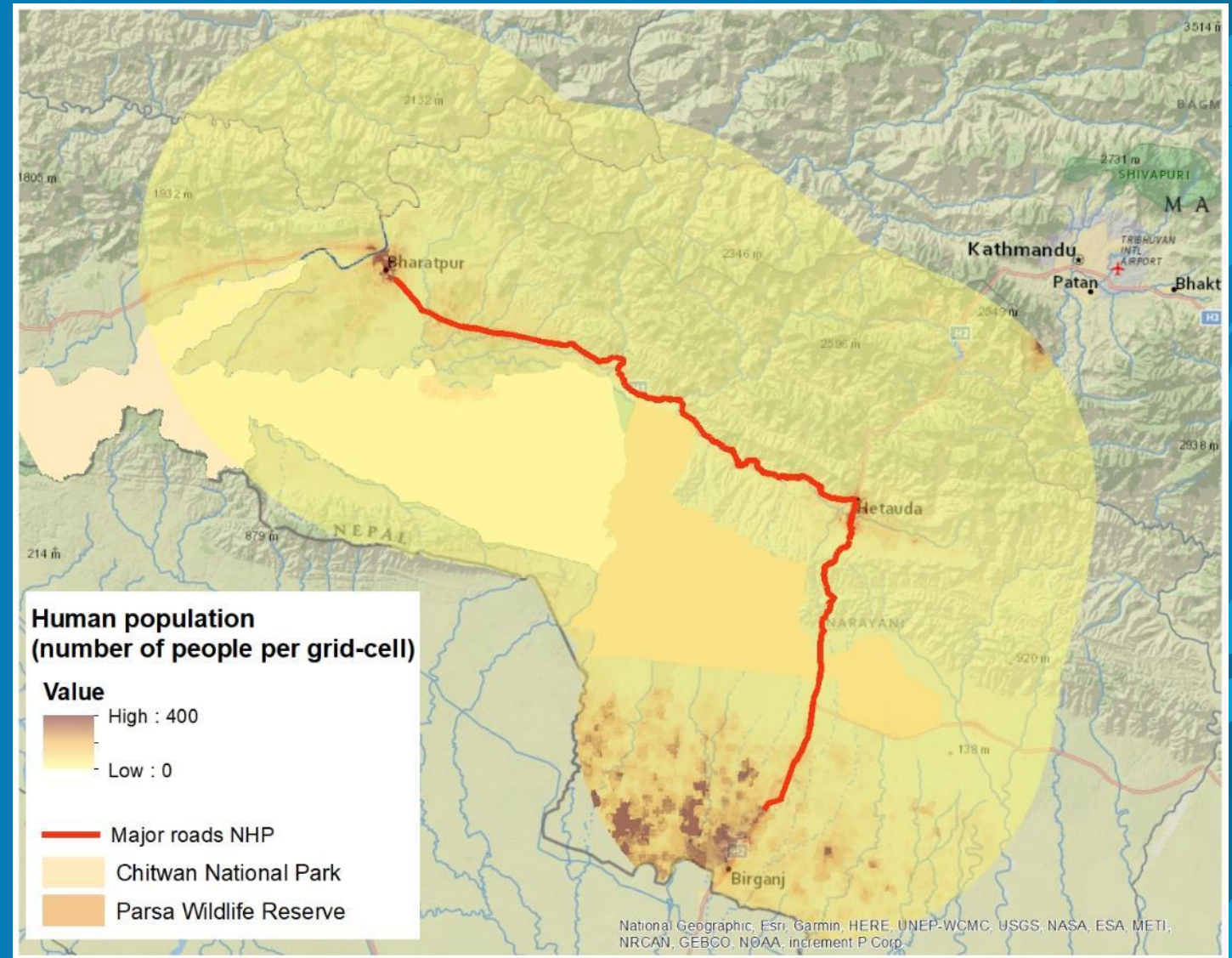
Technical Proposal

July 8<sup>th</sup>, 2019

ADB  
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jade  
JODUC

# HUMAN POPULATION



## SOURCE:

<https://www.worldpop.org/geodata/summary?id=27800>

## FORMAT: tiff

## YEAR: 2020

## RESOLUTION: 100m



Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

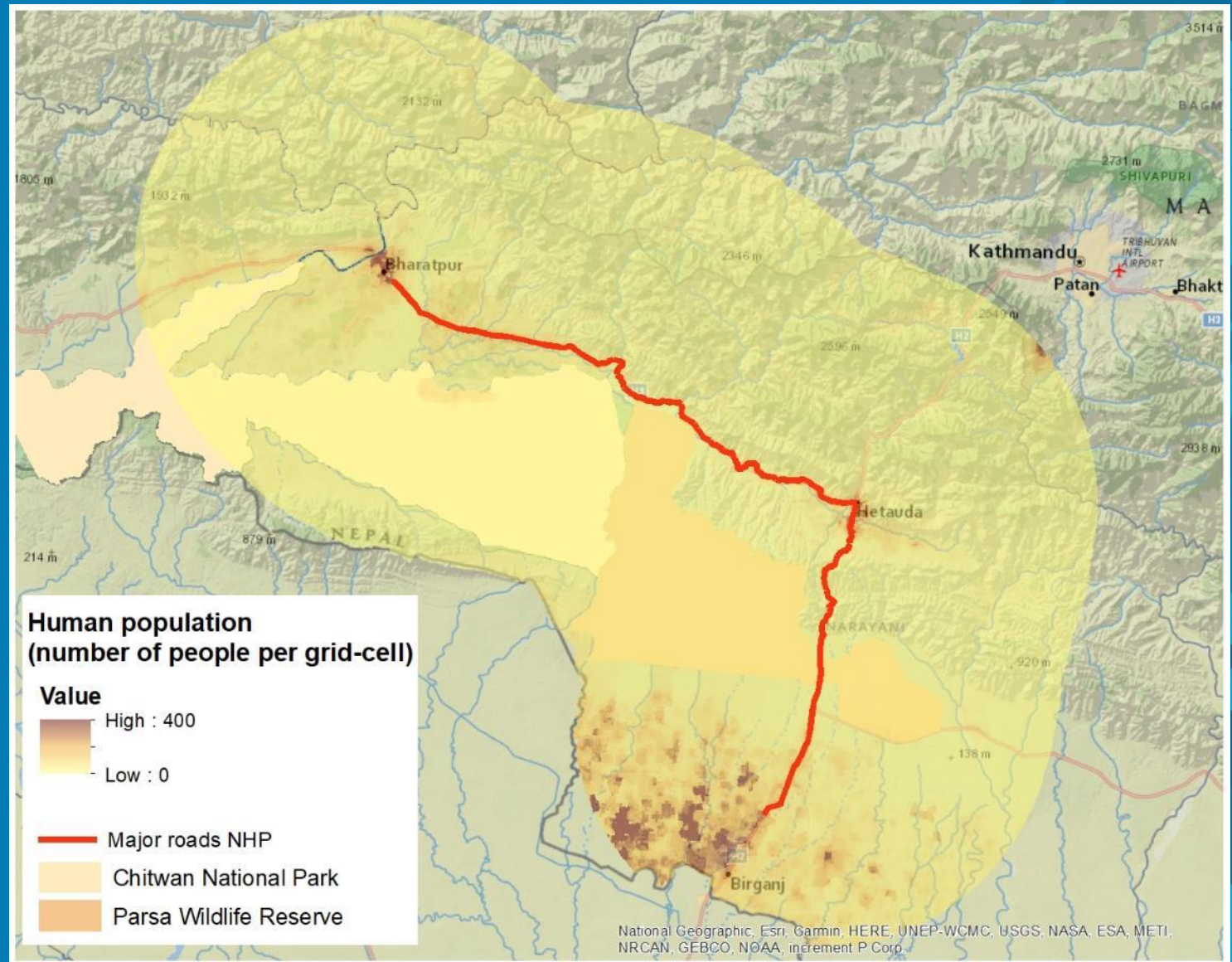
Technical Proposal

July 8<sup>th</sup>, 2019

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ESSA ESSE

# Number of people/100x100m



**Arc Toolbox – Conversion**

**Raster to ASCII (.asc)**





Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

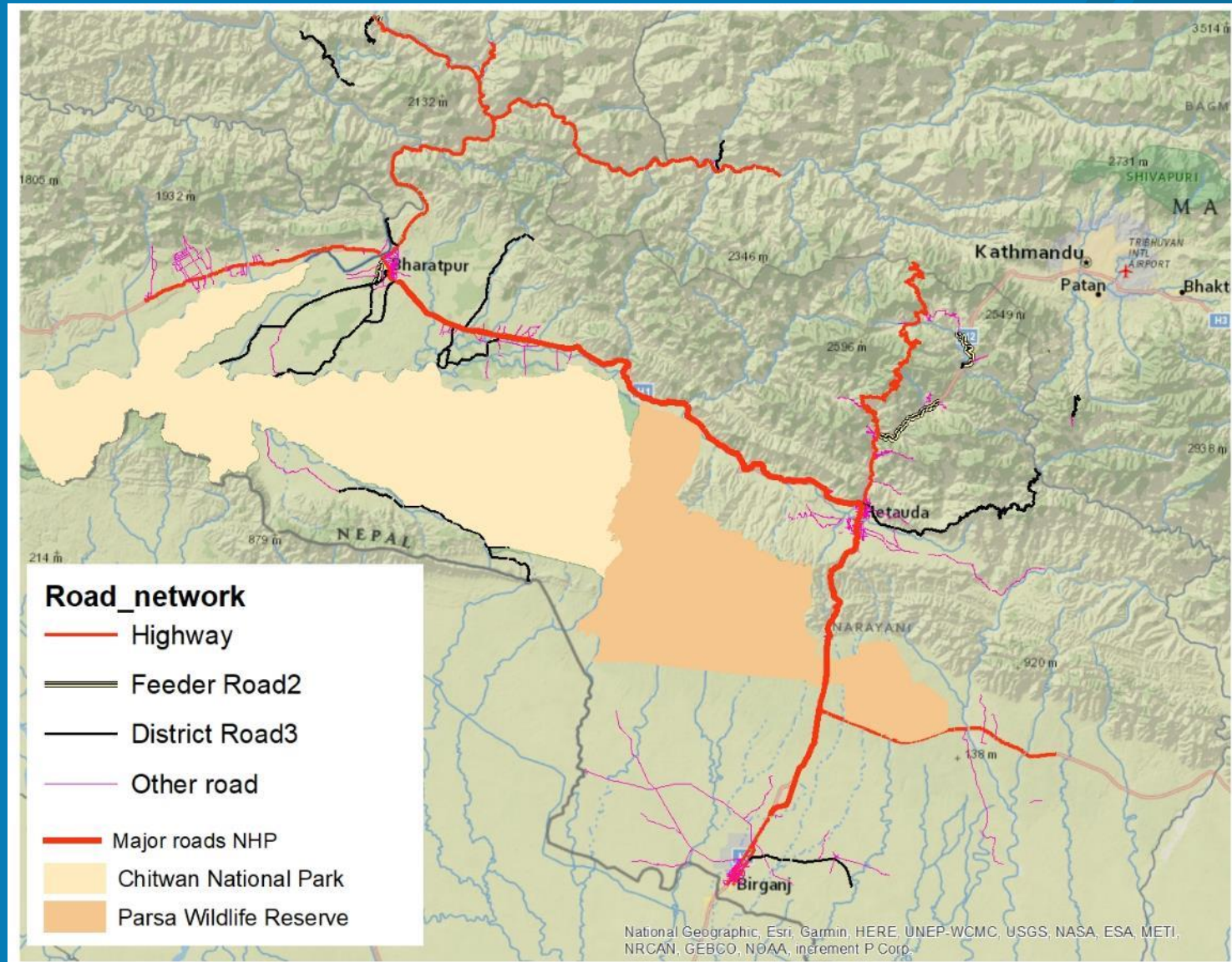
Technical Proposal

July 8<sup>th</sup>, 2019

ADB  
Prepared for the Asian Development Bank

Prepared by:  
ESSA  
Jade Consult

# ROAD NETWORK



## SOURCE:

Department of Survey  
(Nepal)

**FORMAT:** vectorial (polylines)

**Year:** 2002

**SCALE:** 1:25 000m



Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

Technical Proposal

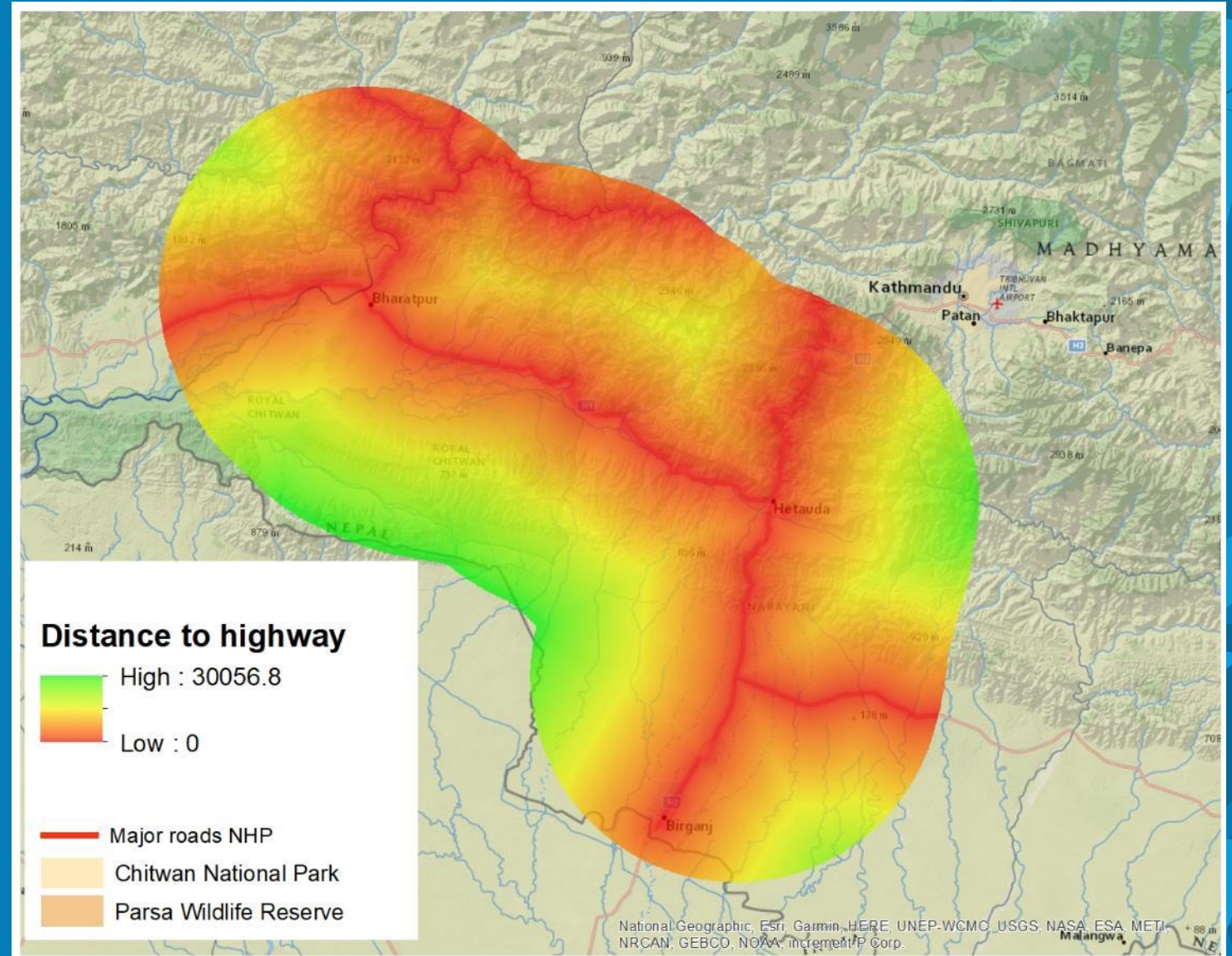
July 8<sup>th</sup>, 2019



Prepared by:



# Distance to highways (m)



Arc Toolbox – Spatial analyst


Estimate Euclidean distance

Arc Toolbox – Conversion

Raster to ASCII (.asc)



# Habitat suitability



Smart infrastructure planning and design to protect natural habitats and biodiversity (Nepal) (50159-001)

Technical Proposal

July 8<sup>th</sup>, 2019

Prepared by:

**ADB**  
Prepared for the Asian Development Bank

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 AMERICAN MUSEUM  
OF NATURAL HISTORY

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[Exhibitions](#)

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[Explore](#)

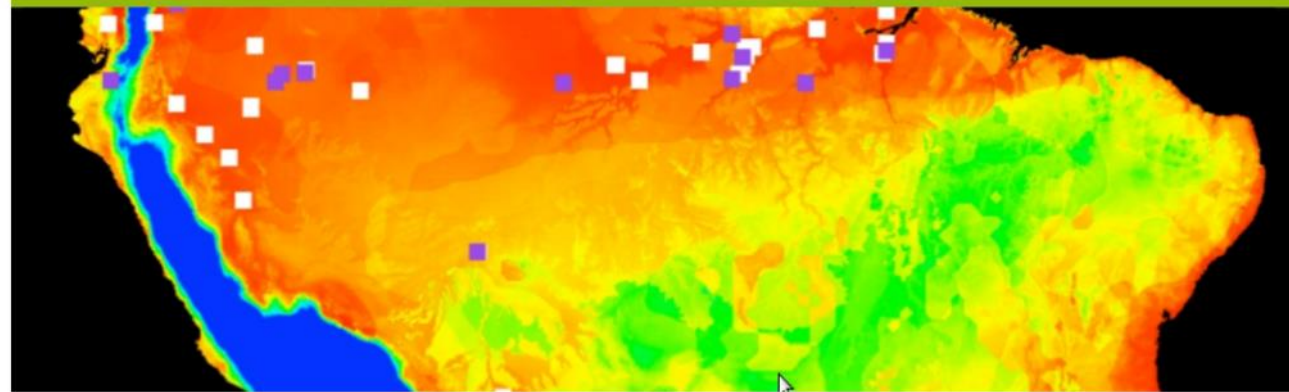
[Our Research](#)

[Calendar](#)

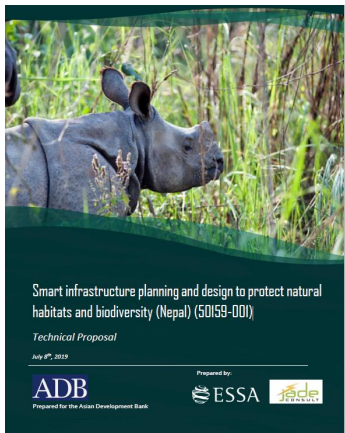
[Join & Support](#)

[Shop](#)

Maxent software for modeling species niches and distributions



Maxent is now open source!



## 3 folders

- Output
- Samples
- Variables

### Samples – SP.csv

	species	y	x
1	species		
2	SP	248836	3059762
3	SP	248836	3059762
4	SP	248836	3059762
5	SP	248836	3059762
6	SP	248836	3059762
7	SP	248836	3059762
8	SP	248836	3059762
9	SP	248836	3059762
10	SP	248836	3059762
11	SP	248890	3057906
12	SP	248890	3057906
13	SP	248890	3057906
14	SP	248890	3057906

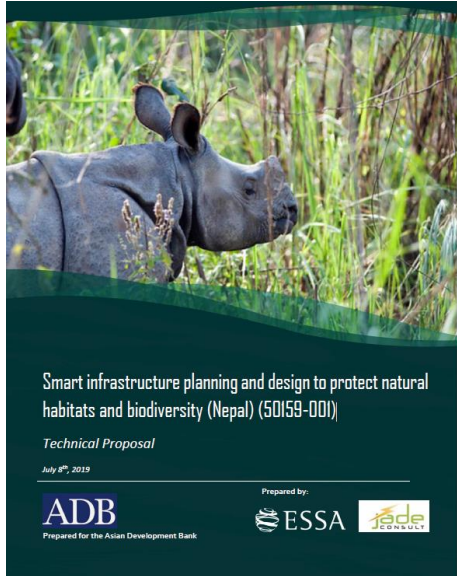
### Variables

- Altitude.asc
- Dens buildings.asc
- Dist highway.asc
- Dist main rivers.asc
- Human population.asc
- Land use dry.asc

**Training data - 85%**  
**Test data - 15%**



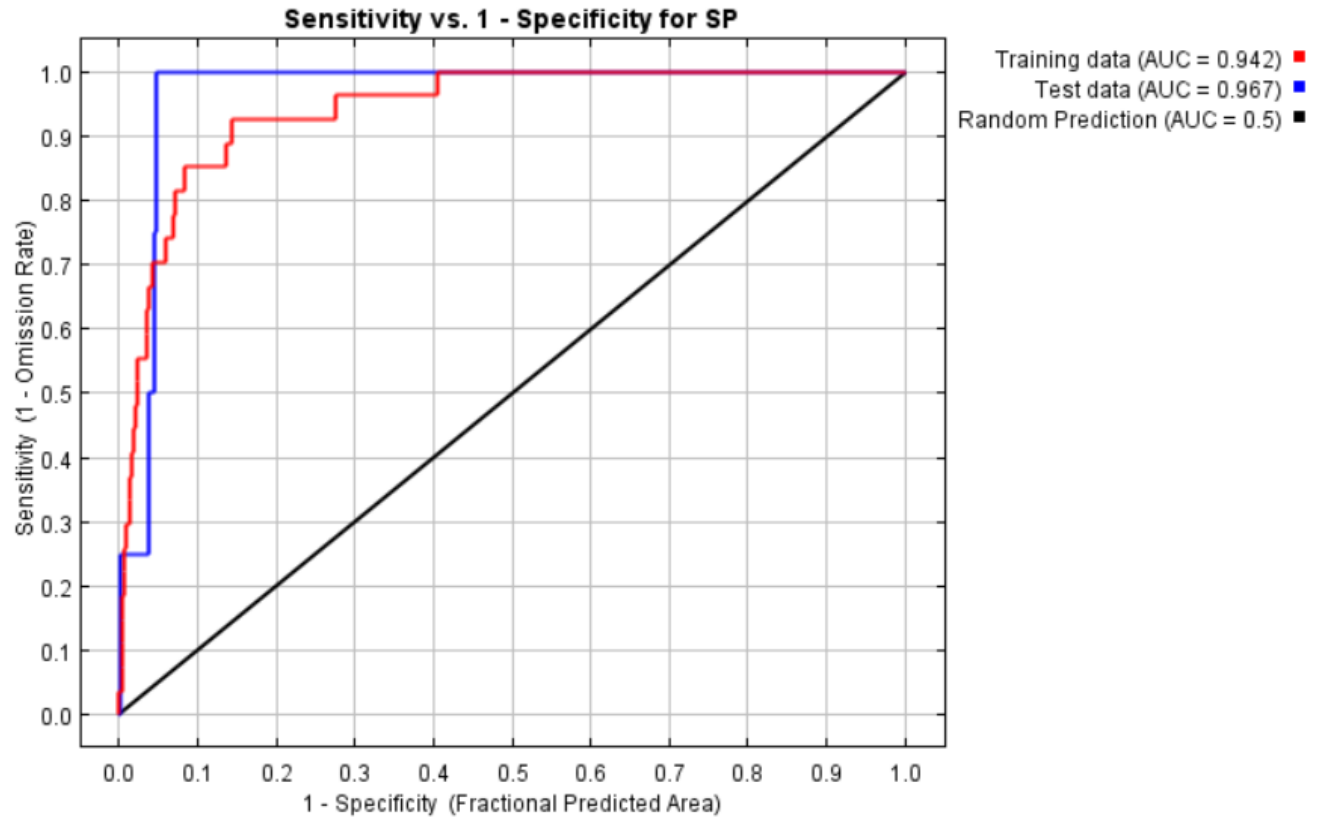
# Habitat suitability



## Output

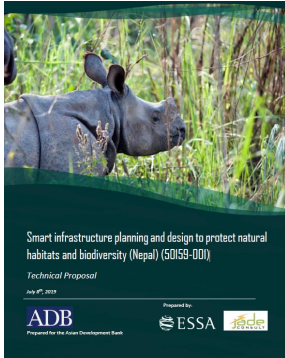
- plots
- maxent
- maxentResults
- SP.asc
- SP
- SP.lambdas
- SP\_explain
- SP\_omission
- SP\_sampleAverages
- SP\_samplePredictions

## MODEL PERFORMANCE - AUC AUC > 0.8 GOOD MODEL





# Habitat suitability



## Output

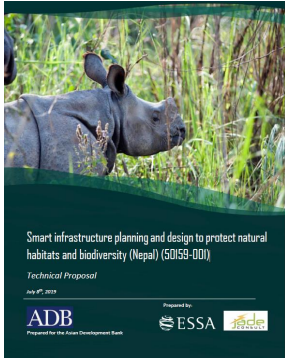
- plots
- maxent
- maxentResults
- SP.asc
- SP
- SP.lambdas
- SP\_explain
- SP\_omission
- SP\_sampleAverages
- SP\_samplePredictions

## ANALYSIS OF VARIABLE CONTRIBUTIONS

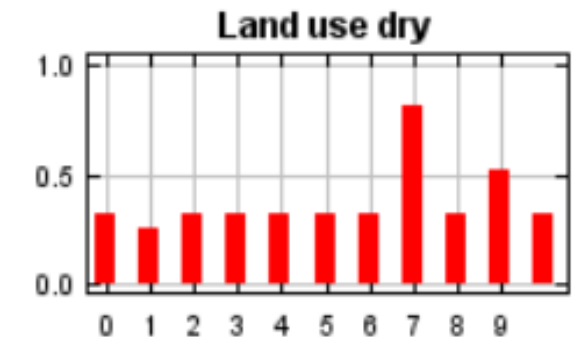
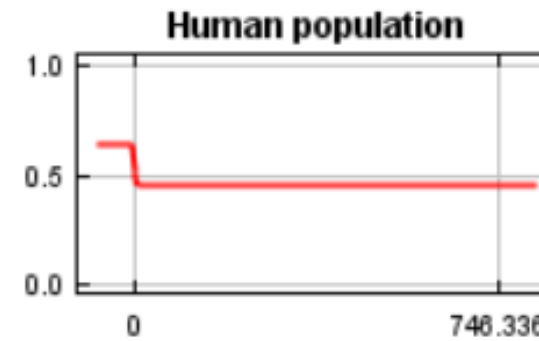
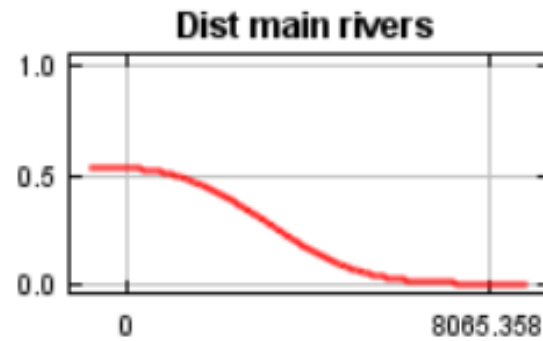
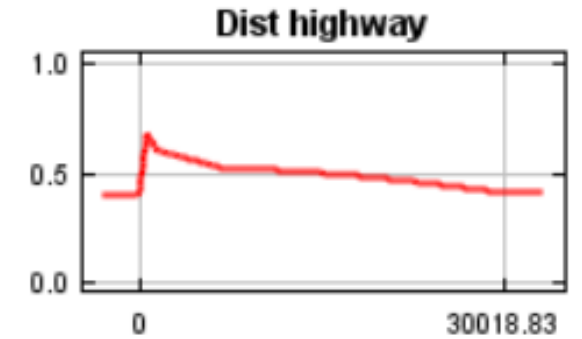
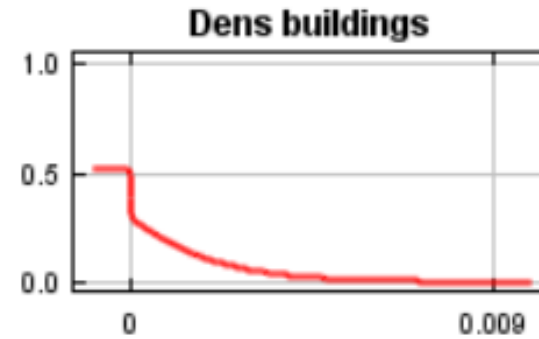
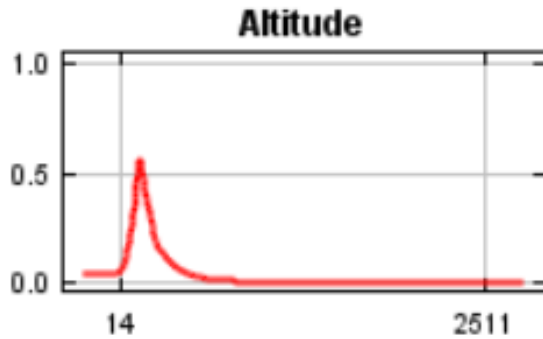
Variable	Percent contribution	Permutation importance
Land use dry	69.8	10
Altitude	21.6	83.8
Human population	5.4	4.1
Dist highway	1.3	1.3
Dens buildings	1.2	0
Dist main rivers	0.7	0.8



# Habitat suitability



## RESPONSE CURVES



## Output

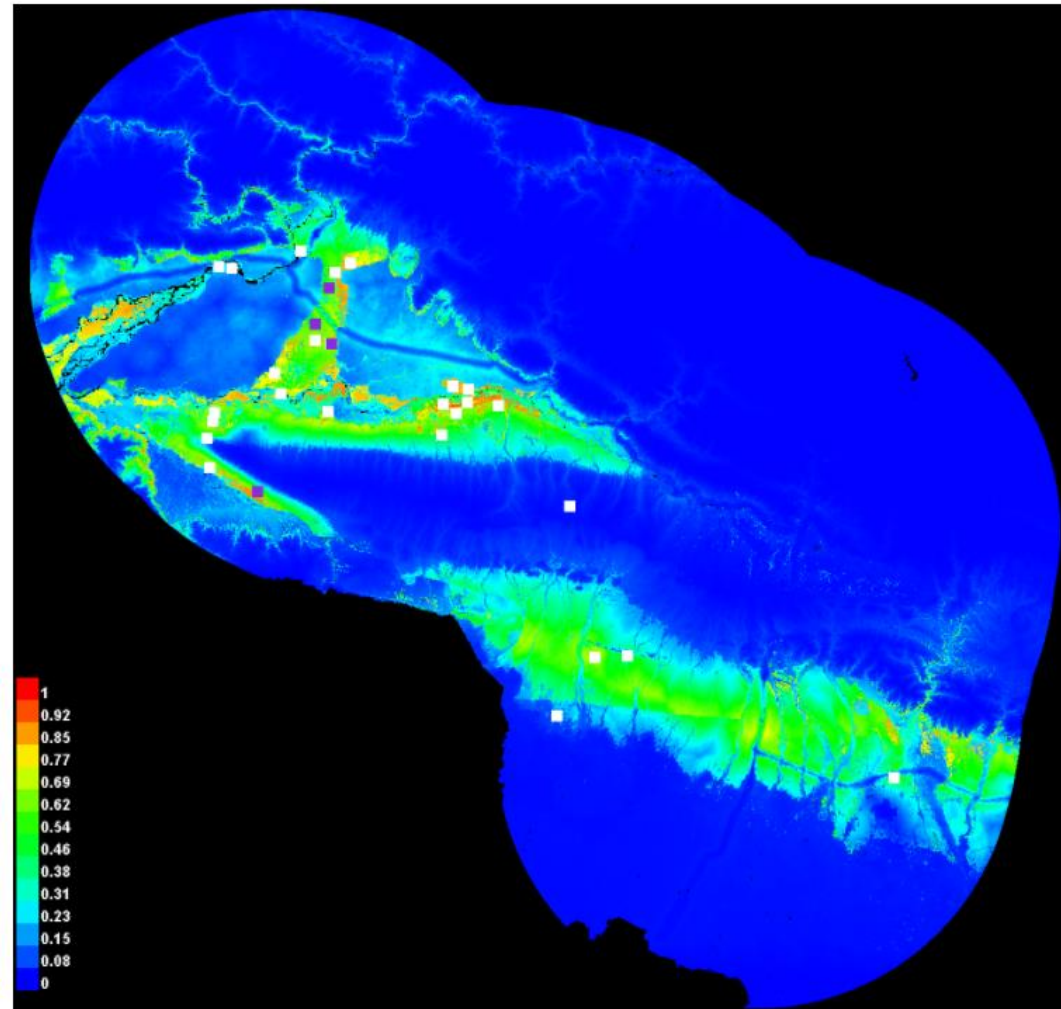
- plots
- maxent
- maxentResults
- SP.asc
- SP
- SP.lambdas
- SP\_explain
- SP\_omission
- SP\_sampleAverages
- SP\_samplePredictions



# Habitat suitability



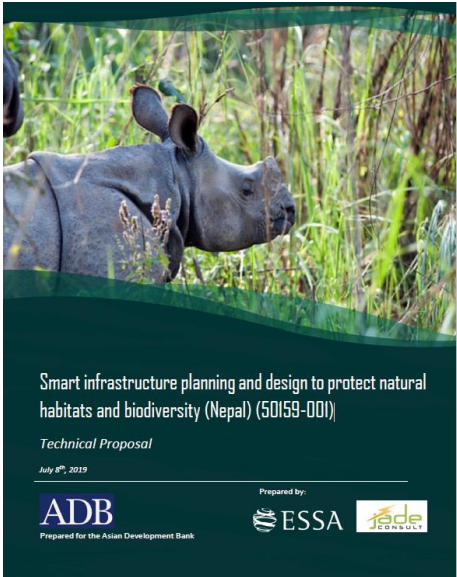
## OUTPUT MAP OF HABITAT SUITABILITY







# Habitat connectivity

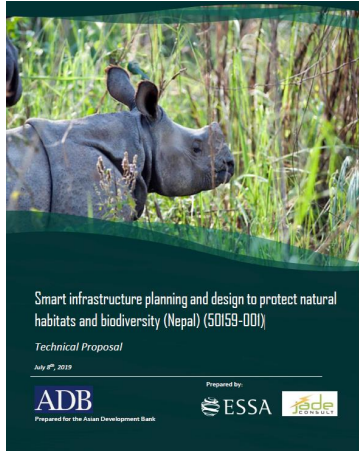


**CIRCUITSCAPE.ORG**

<https://circuitscape.org/>



# Habitat connectivity



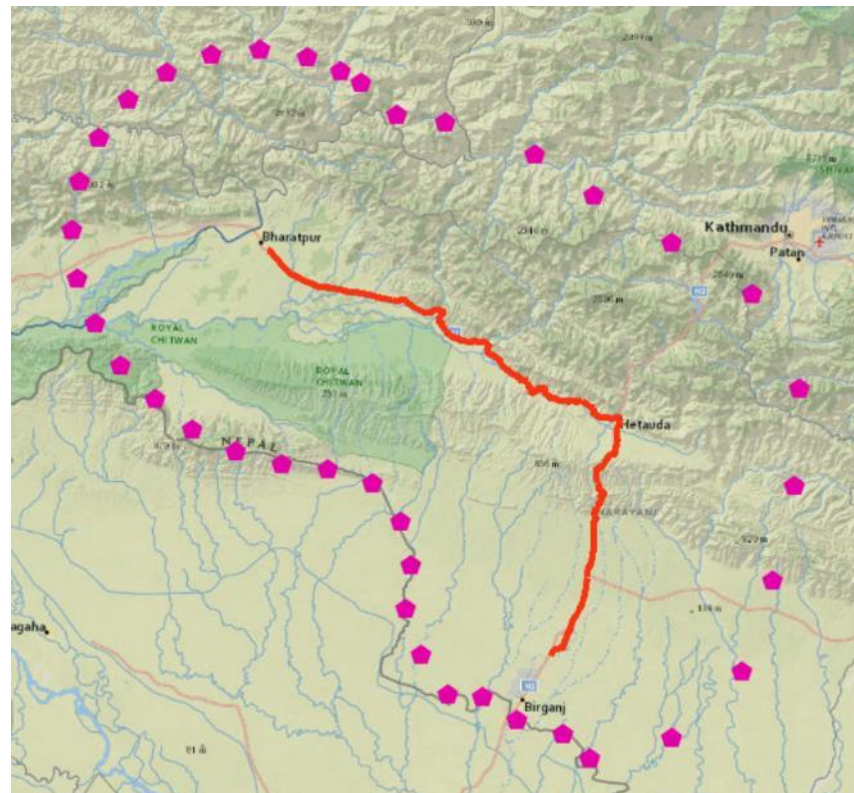
## INPUTS



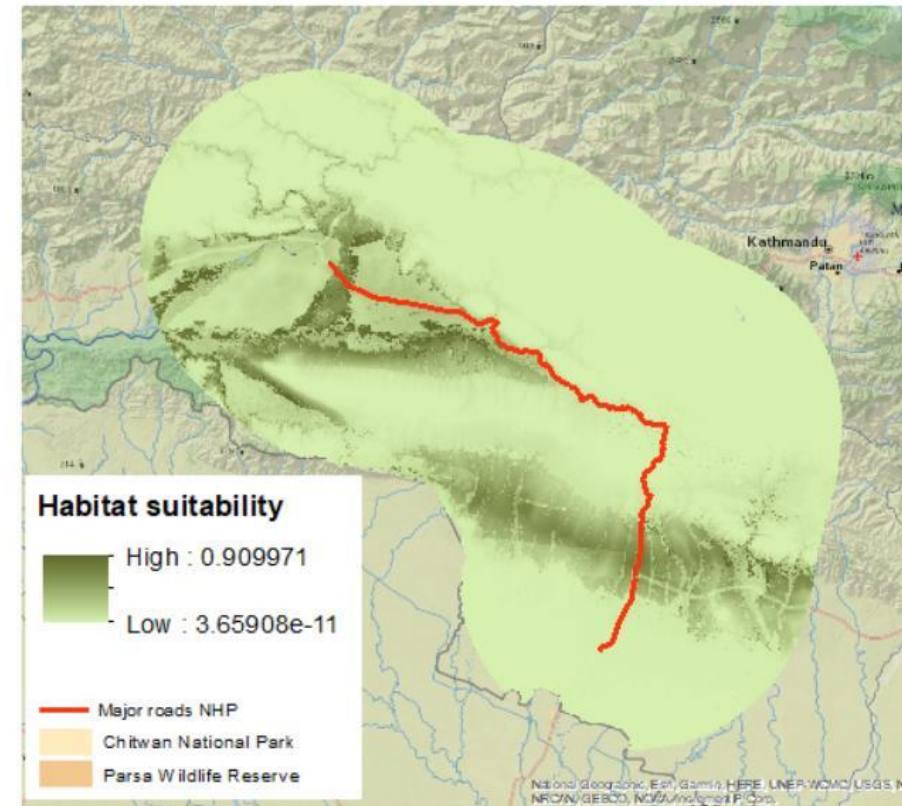
CIRCUITSCAPE.ORG

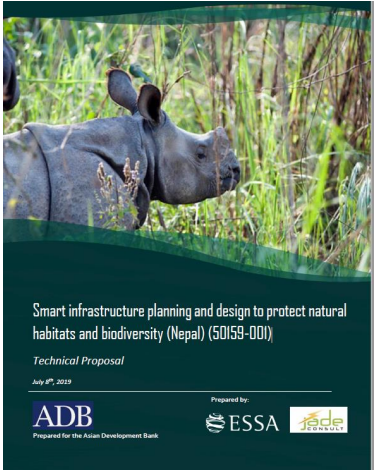
<https://circuitscape.org/>

## FOCAL NODES



## HABITAT SUITABILITY= CONDUCTANCE SURFACE

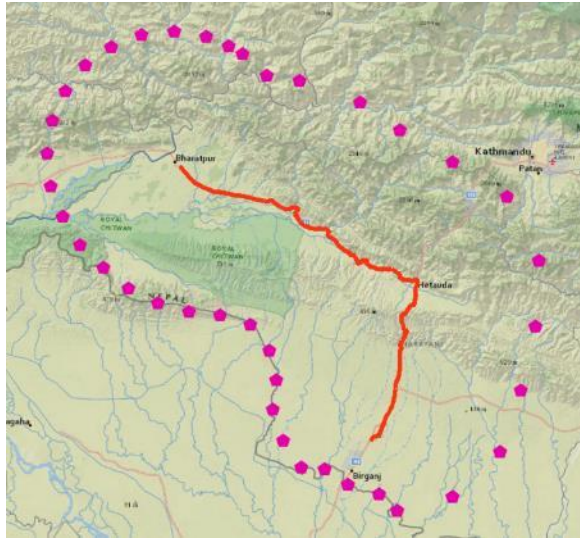




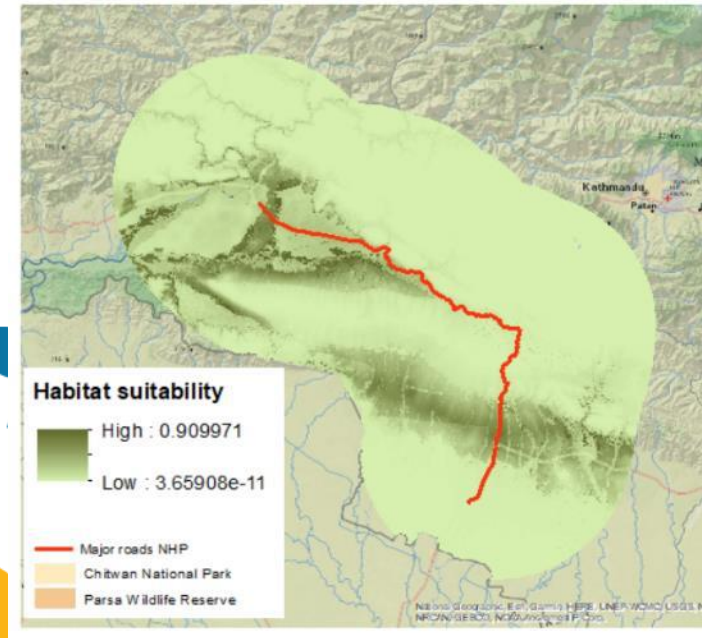
## INPUTS



## FOCAL NODES

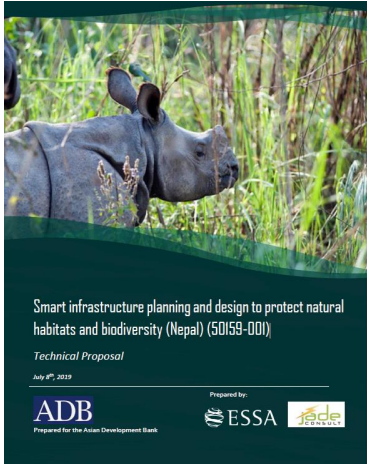


## HABITAT SUITABILITY= CONDUCTANCE SURFACE



**Arc Toolbox – Convert from points to RASTER**

**– Convert from RASTER to ASCII (.asc)**



**RUN**

Circuitscape

File Options Help

### Data type and modeling mode

**Step 1: Choose your input data type**  
Raster

**Step 2: Choose a modeling mode**  
Pairwise: iterate across all pairs in focal node file

### Input resistance data

**Raster resistance map or network/graph**  
D:\Conferences\Webinar ADB\Module 3\Circuitscap Browse  
 Data represent conductances instead of resistances

### Pairwise mode options

**Focal node location file**  
D:\Conferences\Webinar ADB\Module 3\Circuitscape\lr Browse  
Number of parallel processors to use: 1

### Advanced mode options

Current source file  
(Browse for a current source file) Browse

Ground point file  
(Browse for a ground point file) Browse  
 Data represent conductances instead of resistances to ground

### Output options

**Base output file name**  
D:\Conferences\Webinar ADB\Module 3\Circuitscap Browse

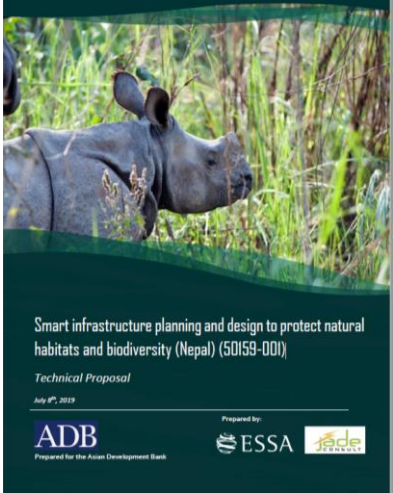
**Output maps to create:**  
 Current maps  
 Voltage maps

**RUN**

Log window Level INFO  Log completion times  Log resource usage info Clear log

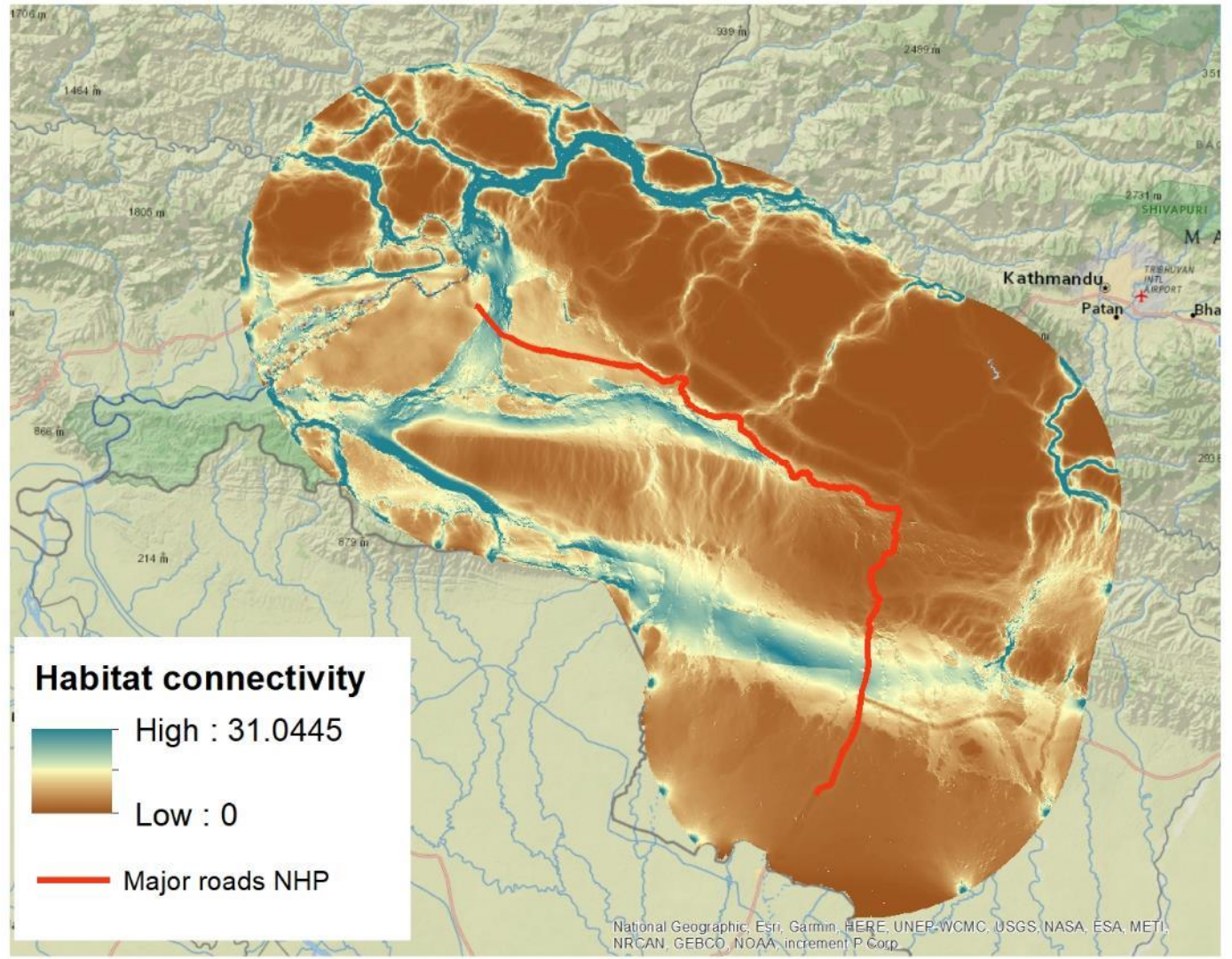
```
Solving focal pair 2 of 406
Solving focal pair 3 of 406
Solving focal pair 4 of 406
Solving focal pair 5 of 406
Solving focal pair 6 of 406
Solving focal pair 7 of 406
Solving focal pair 8 of 406
Solving focal pair 9 of 406
Solving focal pair 10 of 406
Solving focal pair 11 of 406
```

Job started 12:43:33 Solving focal pair 11 of 406



# OUTPUT

- SP6I\_cum\_curmap.asc
  - SP6I\_curmap\_35\_36.asc
  - SP6I\_resistances.out
  - SP6I\_resistances\_3columns.out
  - SP6I\_voltmap\_35\_36.asc
  - SP6I
  - SP6I\_curmap\_34\_36.asc
  - SP6I\_voltmap\_34\_36.asc
  - SP6I\_curmap\_34\_35.asc
  - SP6I\_voltmap\_34\_35.asc
  - SP6I\_curmap\_33\_36.asc
  - SP6I\_voltmap\_33\_36.asc
  - SP6I\_curmap\_33\_35.asc
  - SP6I\_voltmap\_33\_35.asc
  - SP6I\_curmap\_33\_34.asc
  - SP6I\_voltmap\_33\_34.asc
  - SP6I\_curmap\_32\_36.asc
  - SP6I\_voltmap\_32\_36.asc
  - SP6I\_curmap\_32\_35.asc
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  - SP6I\_curmap\_32\_34.asc
  - SP6I\_voltmap\_32\_34.asc
  - SP6I\_curmap\_32\_33.asc
  - SP6I\_voltmap\_32\_33.asc
  - SP6I\_curmap\_31\_36.asc
  - SP6I\_voltmap\_31\_36.asc
  - SP6I\_curmap\_31\_35.asc
- 1.5 MB



Further information at:  
<https://docs.circuitscape.org/Circuitscape.jl/latest/options/>

@Benjamin Dorsey - how to add the final map of connectivity to the dashboard

