Engineering Faculty
Urban Planning Engineering

An-Najah National University

كلية الهندسة و تكنولوجيا المعلومات
قسم التخطيط العمراني

Urban Planning Engineering
Graduation Project

DESIGNING & PLANNING A SOLAR NEIGHBORHOOD

Fida' Hamdan ahmad 11106835
June. 2016

Outline:

Chapter 1: introduction:

Chapter 2: Project location **:**

- Project location
- Justifications
- Analysis
- Solar analysis
- SOWT analysis
- New boundary

Chapter 4 :Project Definition

Chapter 3: Solar Planning:

- Conceptual Plan
- Shadow analysis
- Solar Buildings Regulation
- Solar Urban Elements

Chapter4: Solar Design stage :

Chapter5 : Solar Energy Production , economic study:

Chapter6: Final Master plans and Results:

Conclusion and Recommendations:

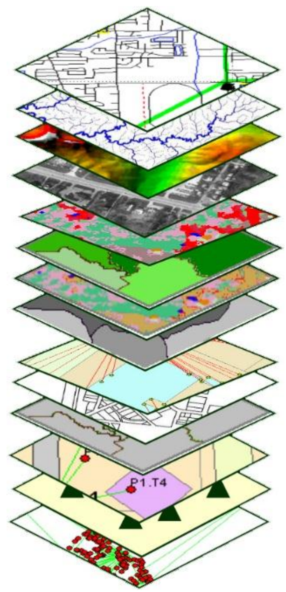
LAR

NEIGHBORHOOD

Chapter1. Introduction :

The necessity of using solar energy in urban scale :

- The acceleration of urban population growth around the world .
- The global prediction results showing the exhausting of none-renewable energy resources.
- The increase of public concerns about environmental pollution .



Energy
Waste
Transport
Materials
Food
Water
Social
Livability
Health

Minimum fuel consumption
Maximum energy production
Maximum Solar Access
More livable city
More Clean city
Healthy city

Chapter1. Introduction :

SOLAR URBAN DESIGN – CONCEPT

According to the legal documents supporting the strategy Europe 2020, the nearly zero-energy building is defined as:

(…) a building that has a very high energy performance.

Cities, buildings and their various elements must be interpreted as a complex system of material and energy flows . Thomas Herzog

An essential basis for designing solar architecture and solar urbanism is the direct use of solar energy based on the solar access principle.

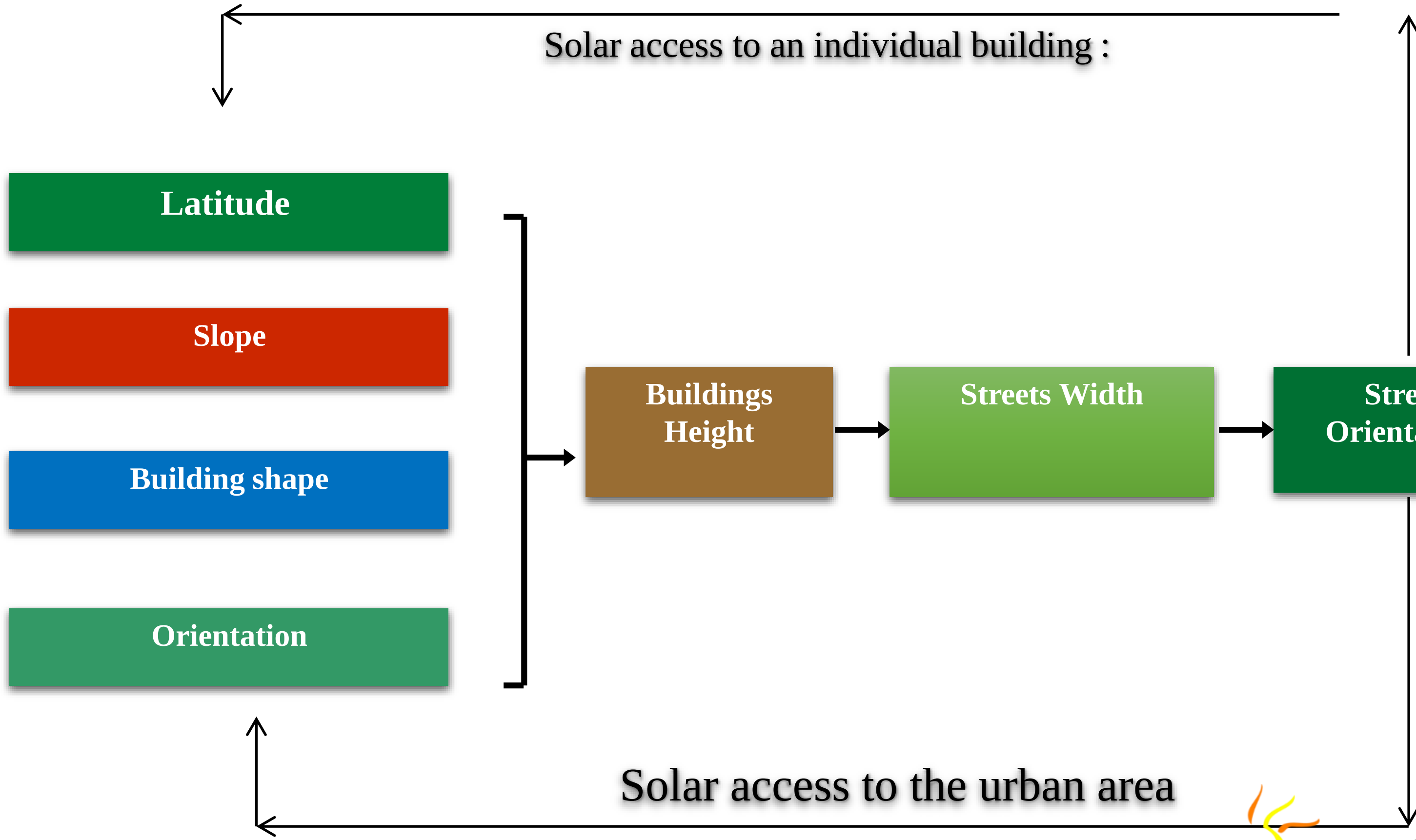
converting solar energy into thermal, chemical or electrical energy

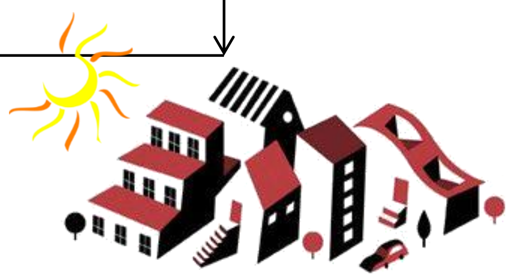
By :

- photovoltaic panels
- solar collectors
- & solar town planning

Chapter1. Introduction :

Solar access factors :





Chapter1. Introduction :

Palestinian Condition :

- High consumption of fossil fuel – limited resources.

Attempts :

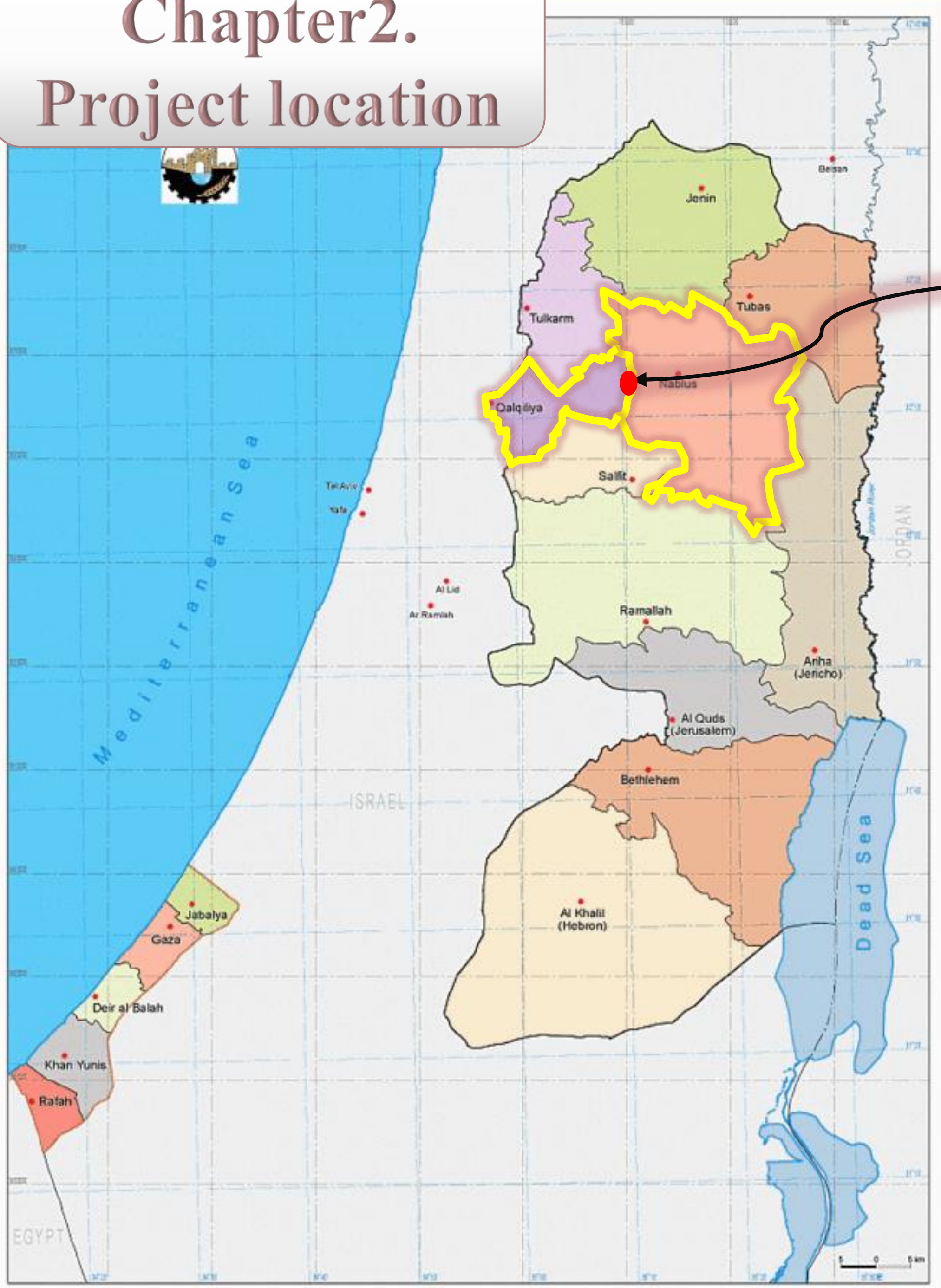
- Electricity production & Lighting isolated areas (small villages)
- Street lightening (ex. wadi anar street)
- Small house solar Panels

Positive points Palestine distinguish from the rest of the countries, including:

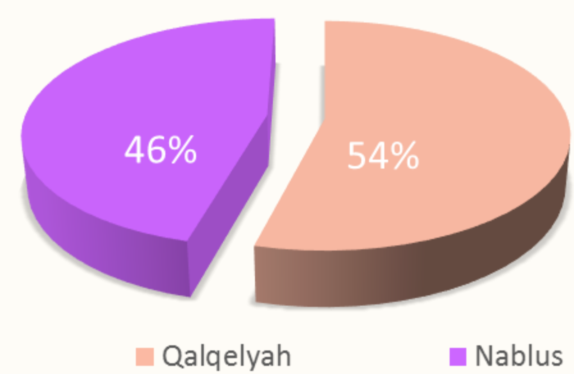
- The high number of sunny days
- The presence of strong winds in more than one location.
- The high level of environmental awareness .
- population is relatively small;

Chapter2. Project location

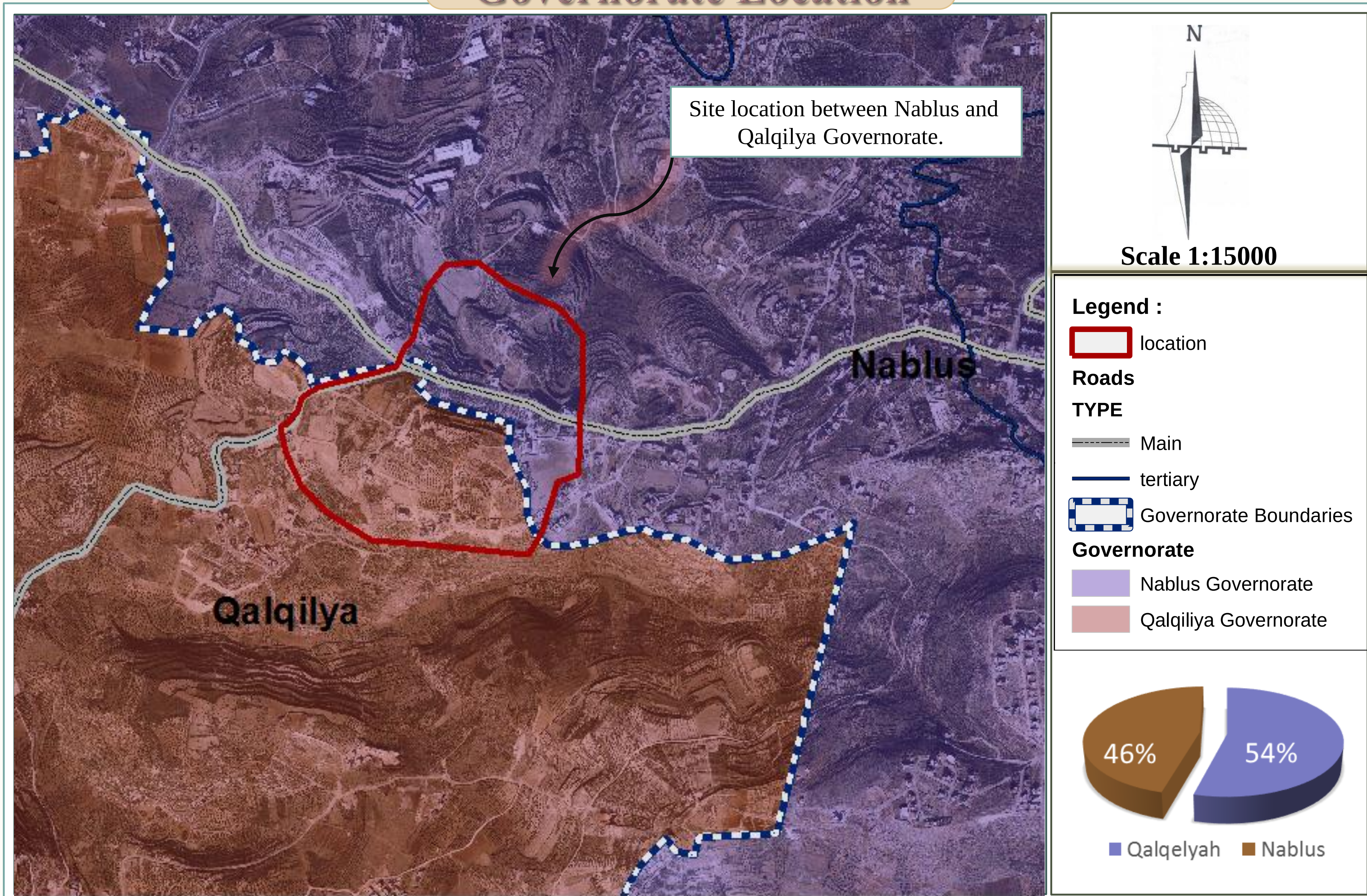
Project Location Governorate Location



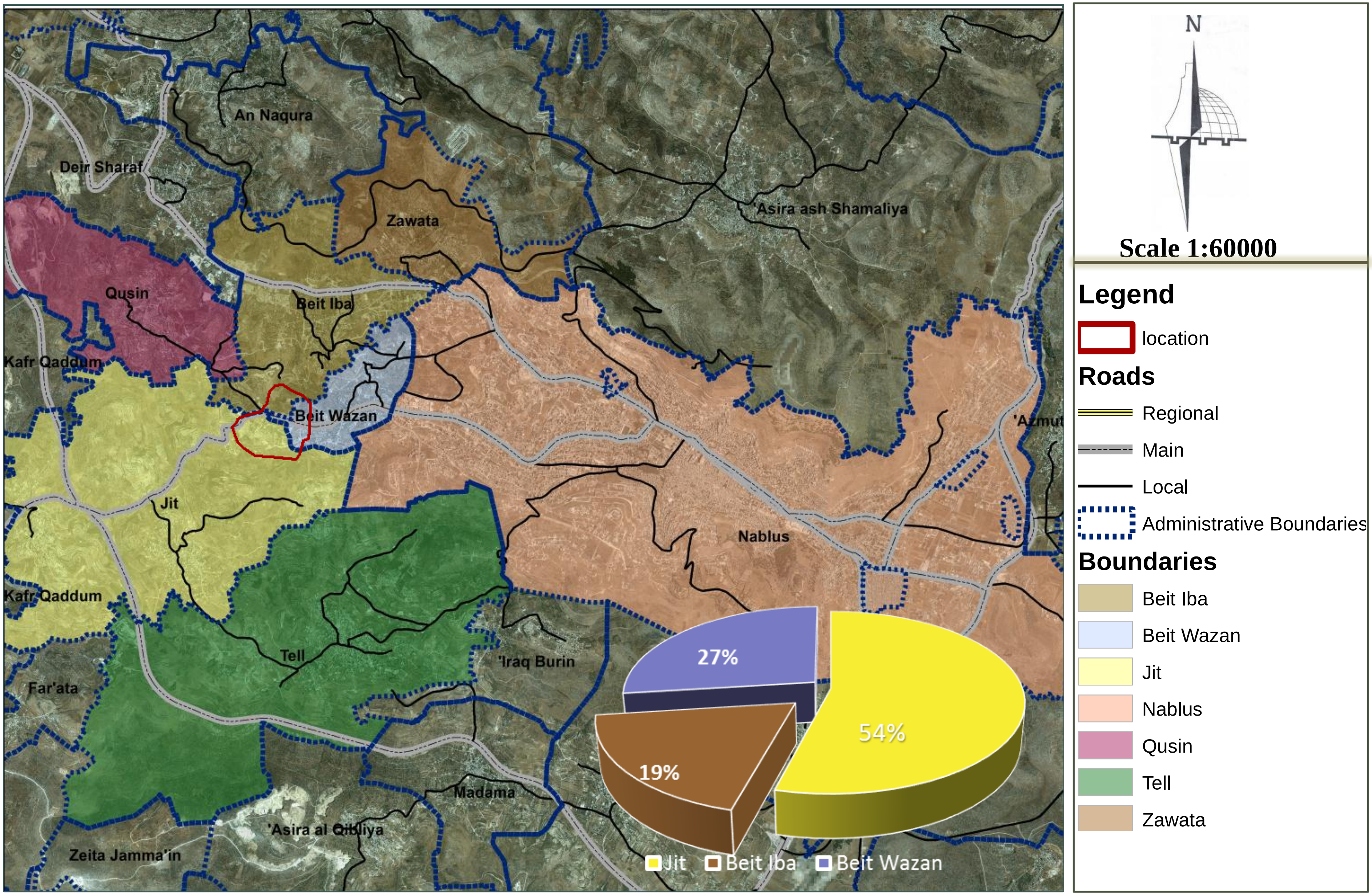
Percentage of the project site al governorates



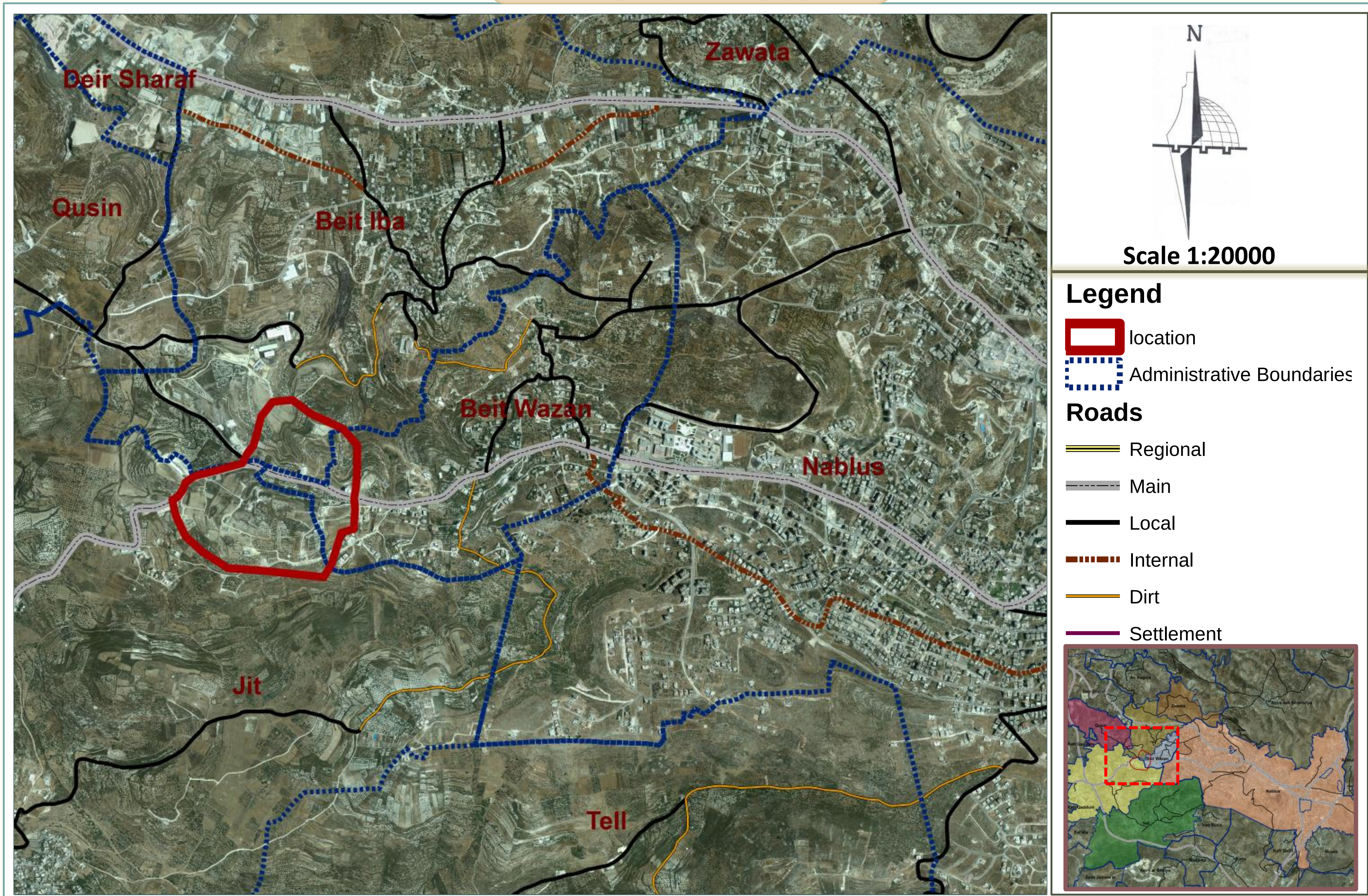
Project Location
Governorate Location



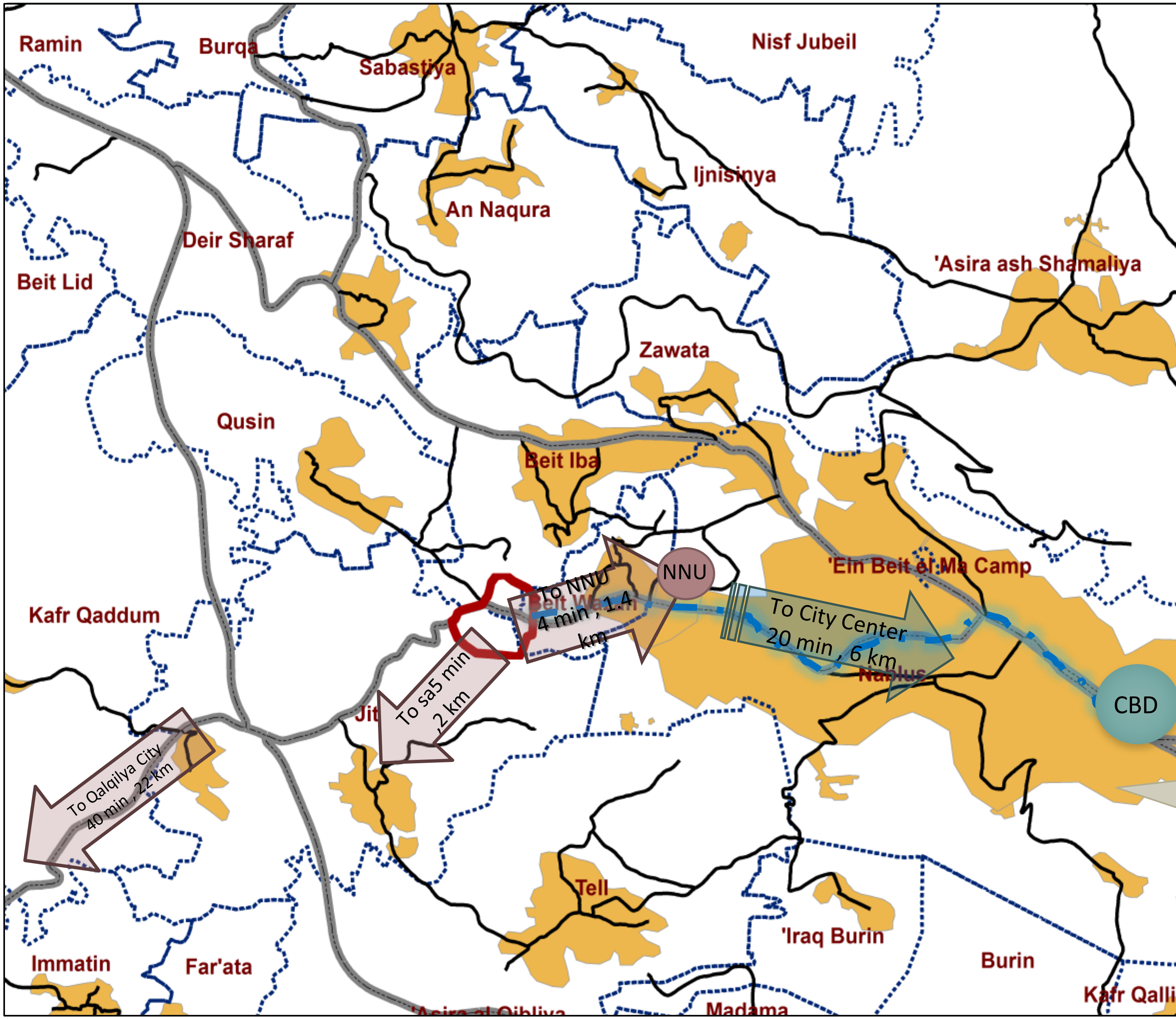
Project Location
Administrative Boundaries



Site Location
Aerial Photo



Project Location - Locational Plan



Legend

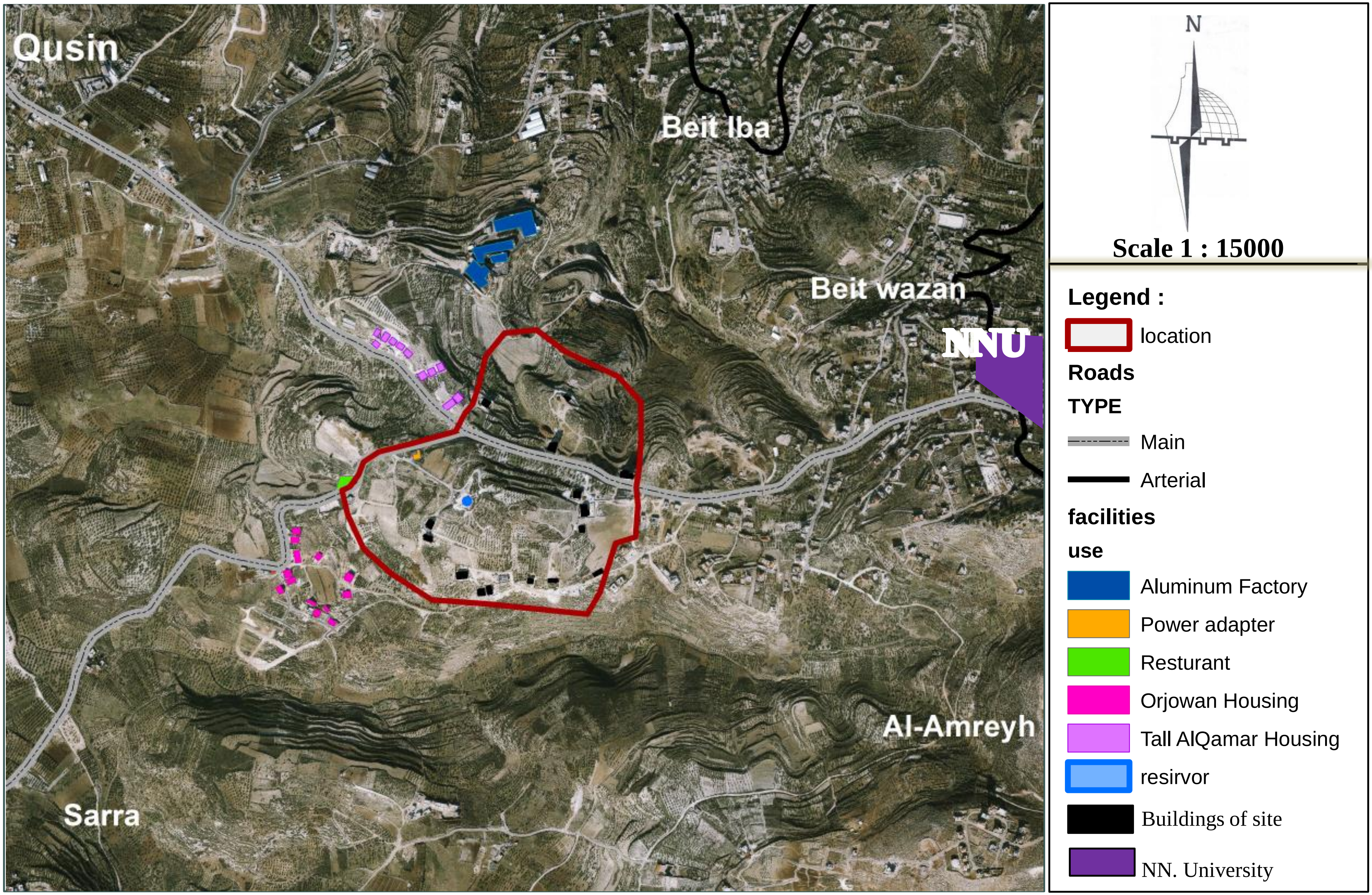
- location
- Administrative Boundaries

Roads

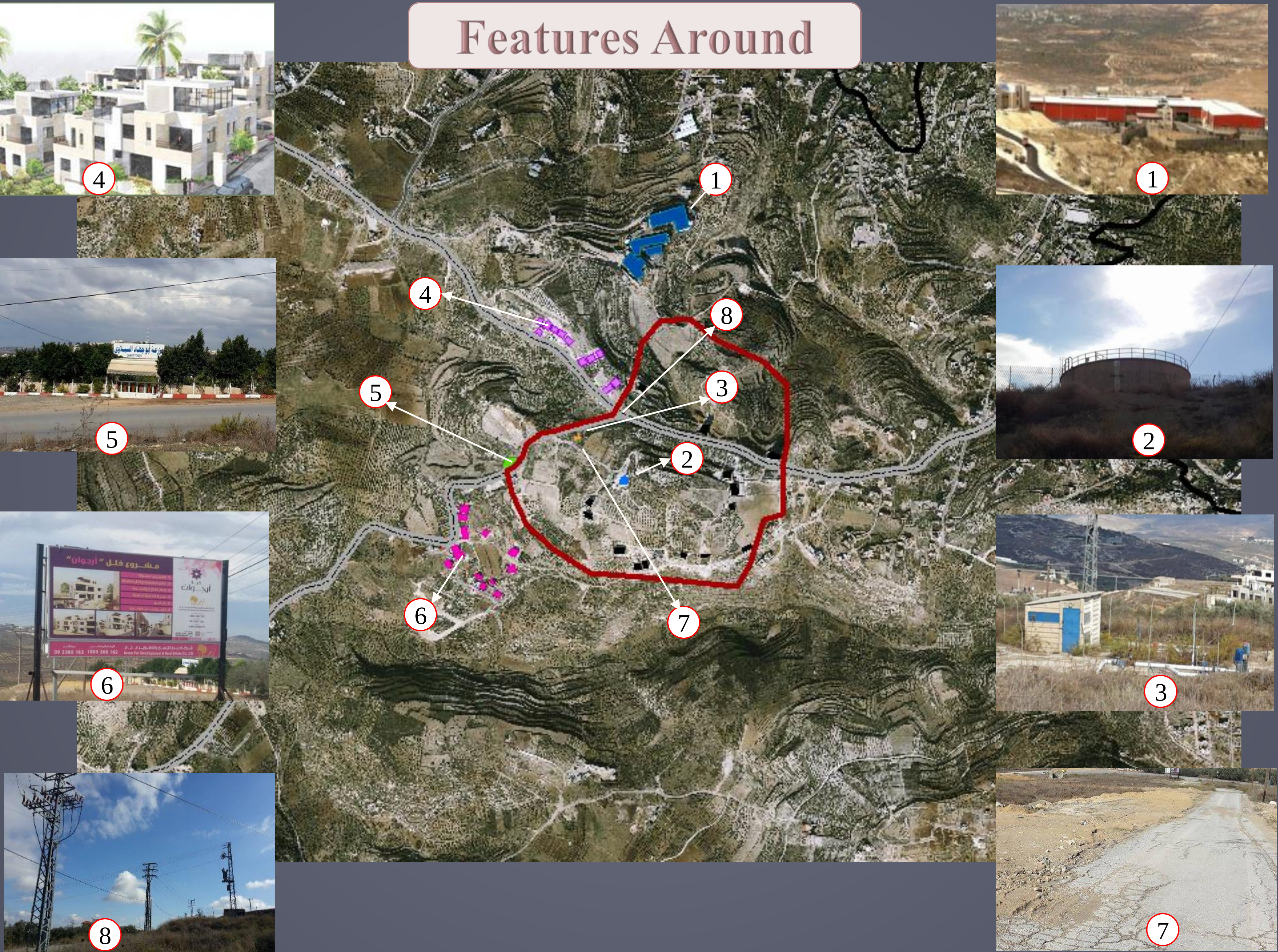
- Regional
- Main
- Local
- Builtup_Areas

Proposed site : 45 acre
Nablus , Qalqilya Governirate
Jit , sarra , Bit Iba & Biet wazan Boundary

Features In & Around the site



Features Around

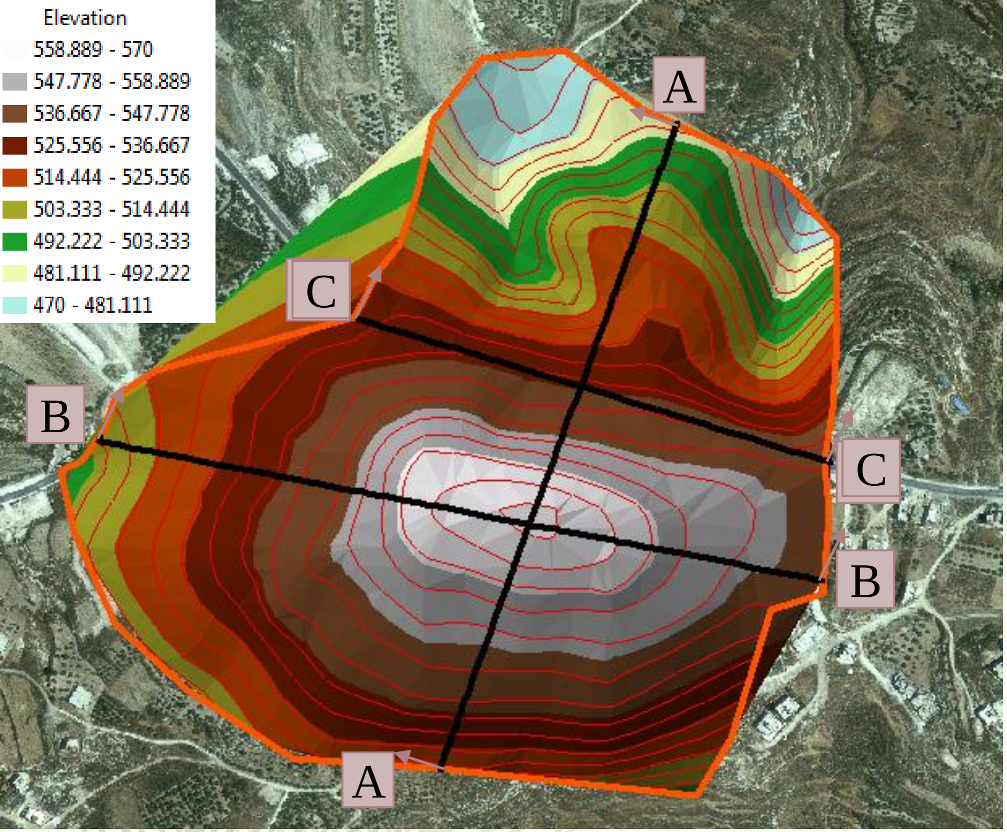


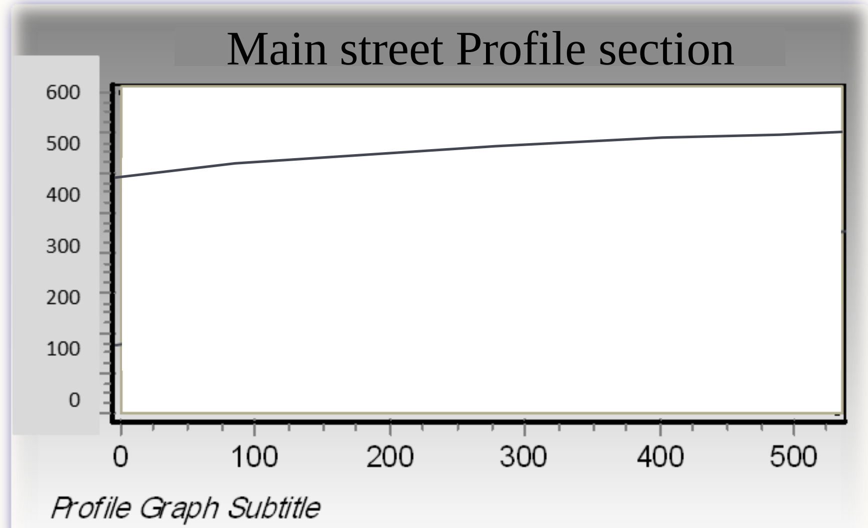
Justifications for site selection

- The general trend of population expansion in the city is towards the west of the Nablus.
- New development at this area. :
- The existence of residential projects and investment in the Western Region.
- Slopes in the region is suitable for use in receiving the sun's rays.
- The climate can be exploited well.

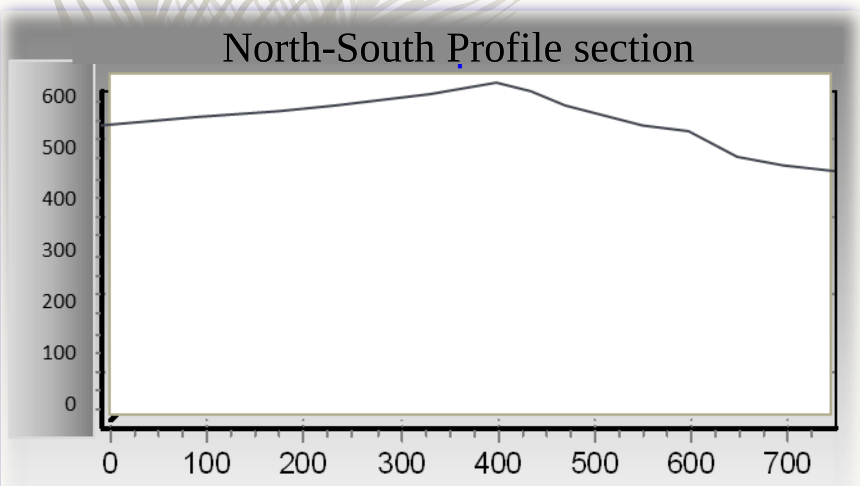
Site Analysis

Profile Sections

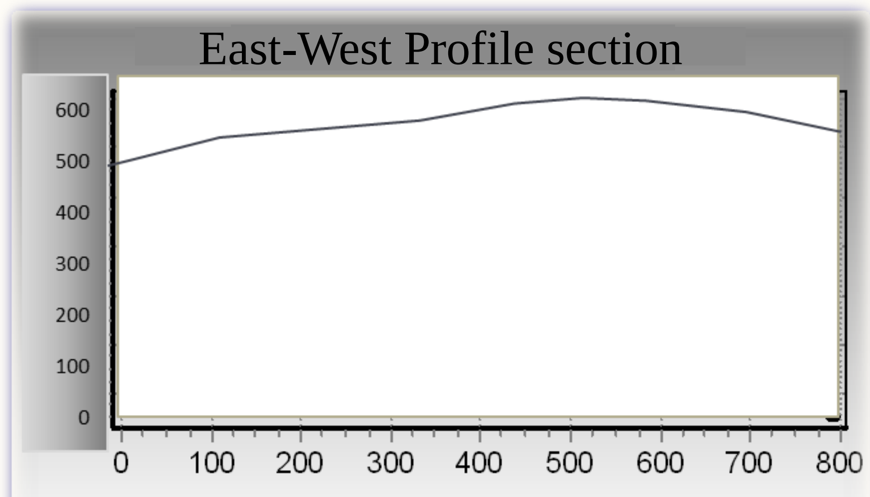




C-C

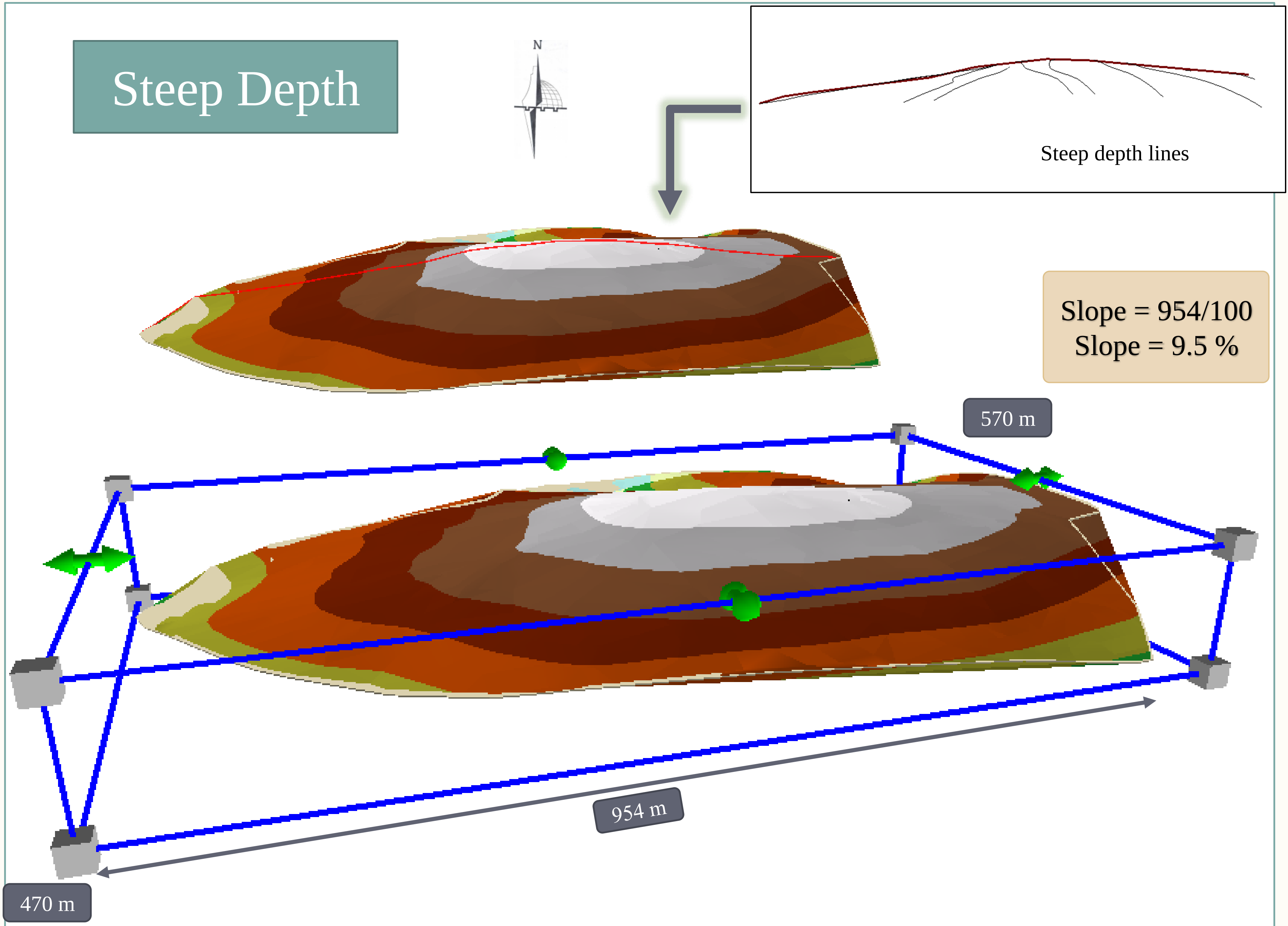


A-A

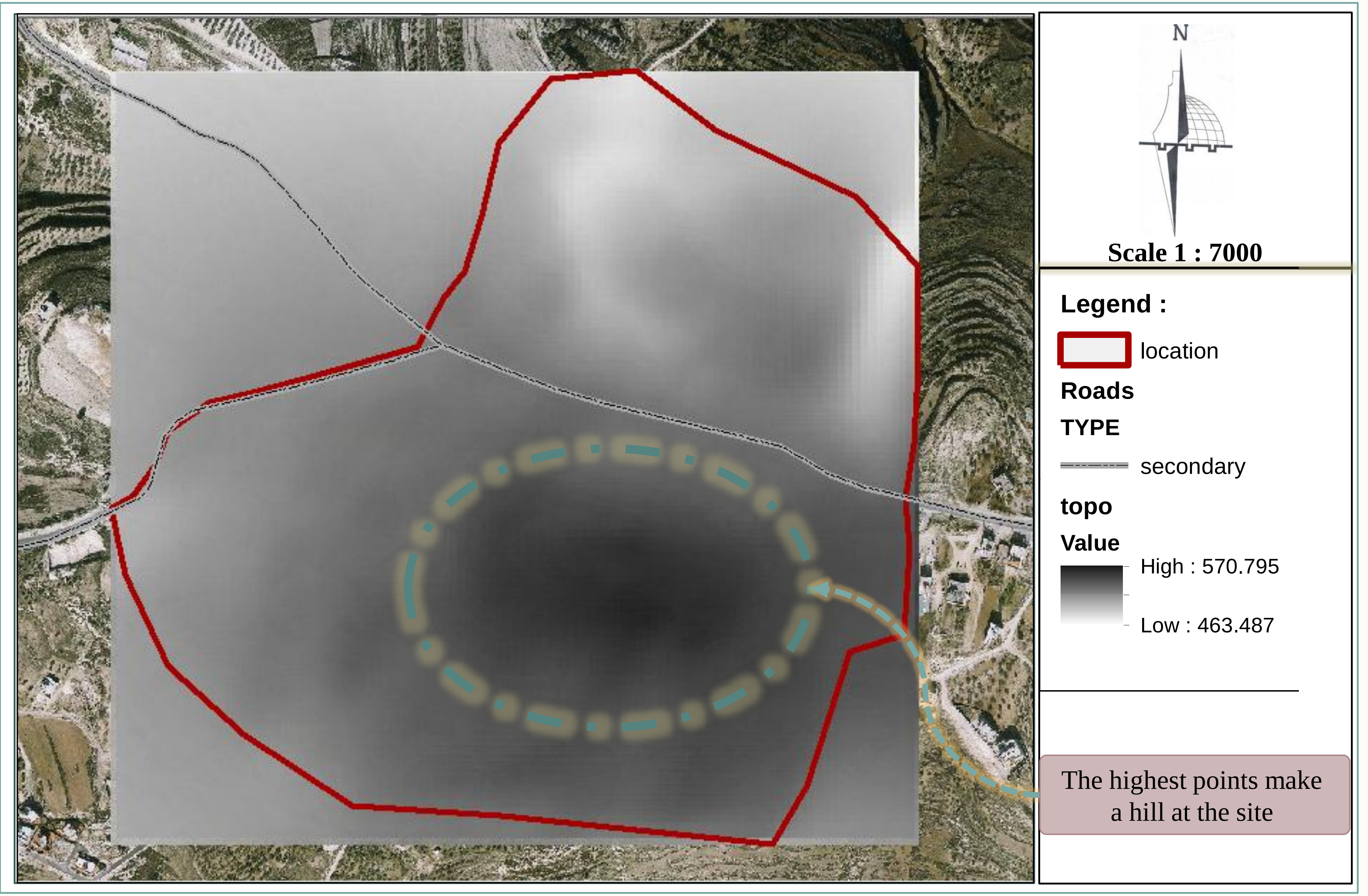


B-B

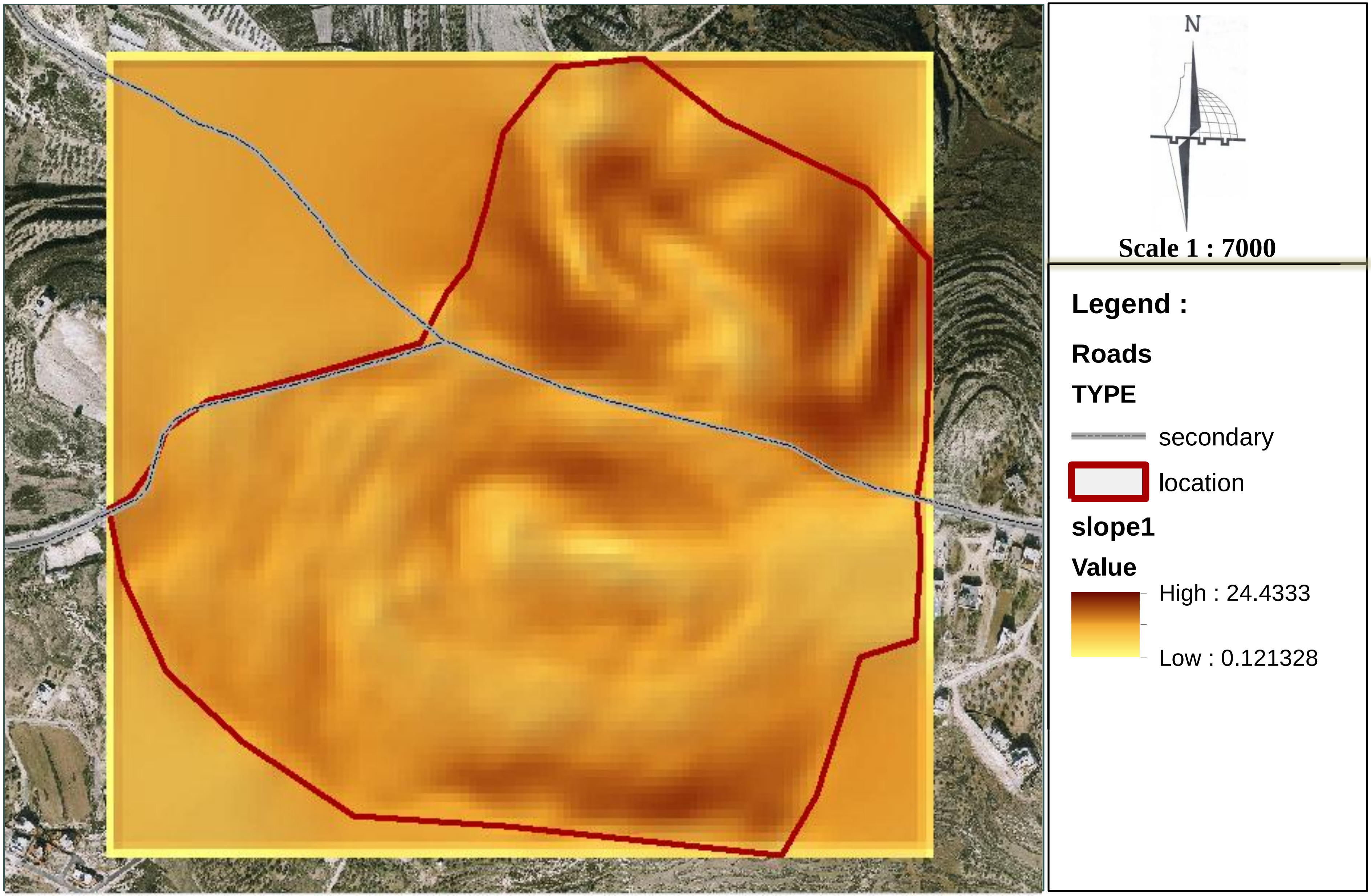
Steep Depth



Site Rates of Elevation



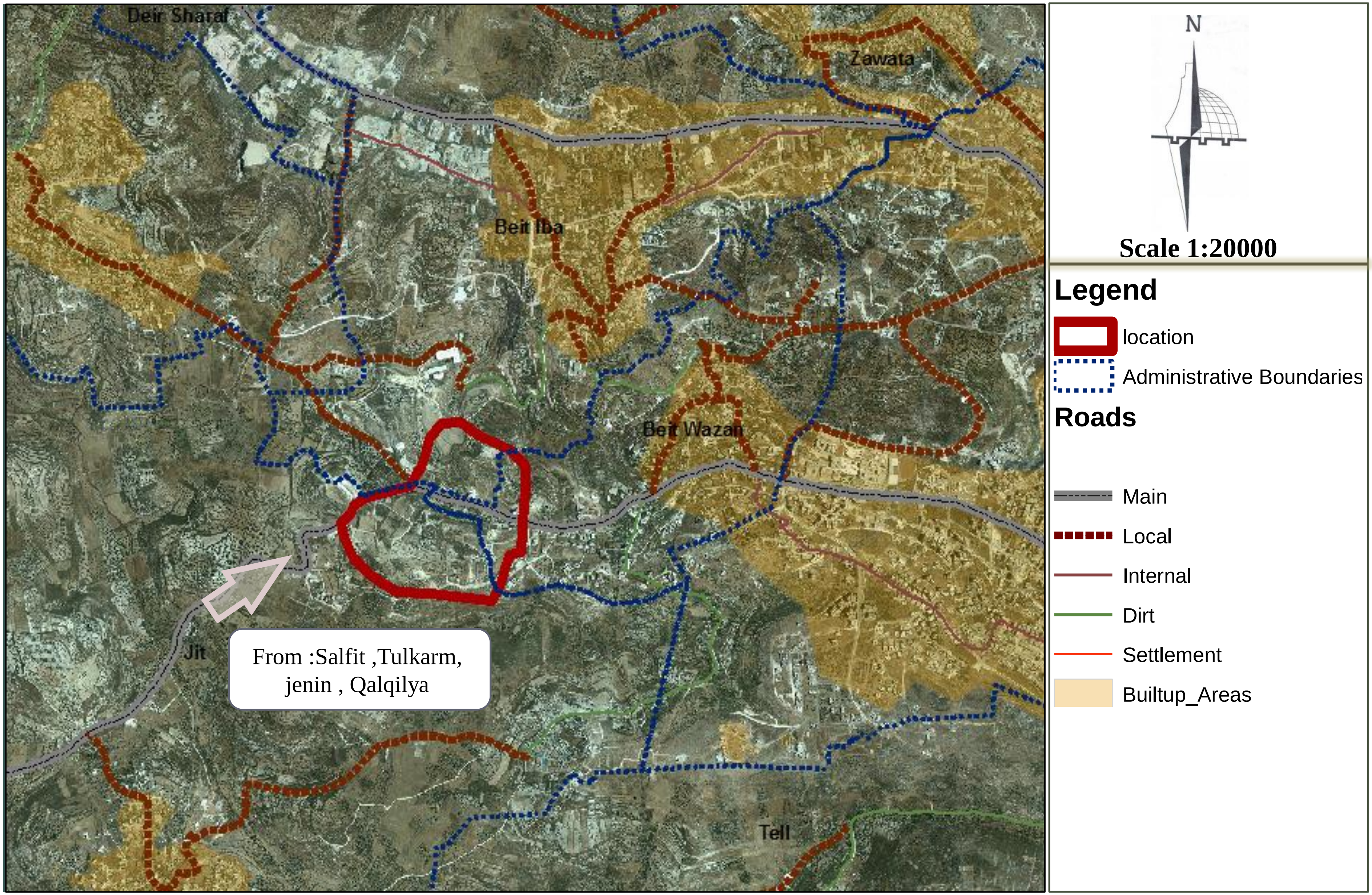
Slopes & Topography

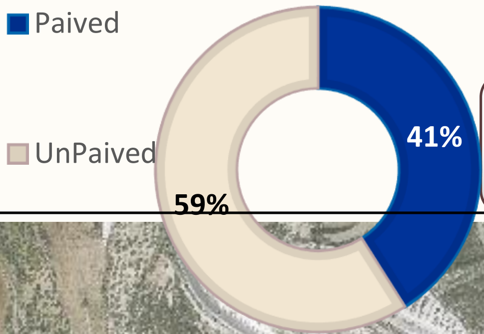


Site Land Classification

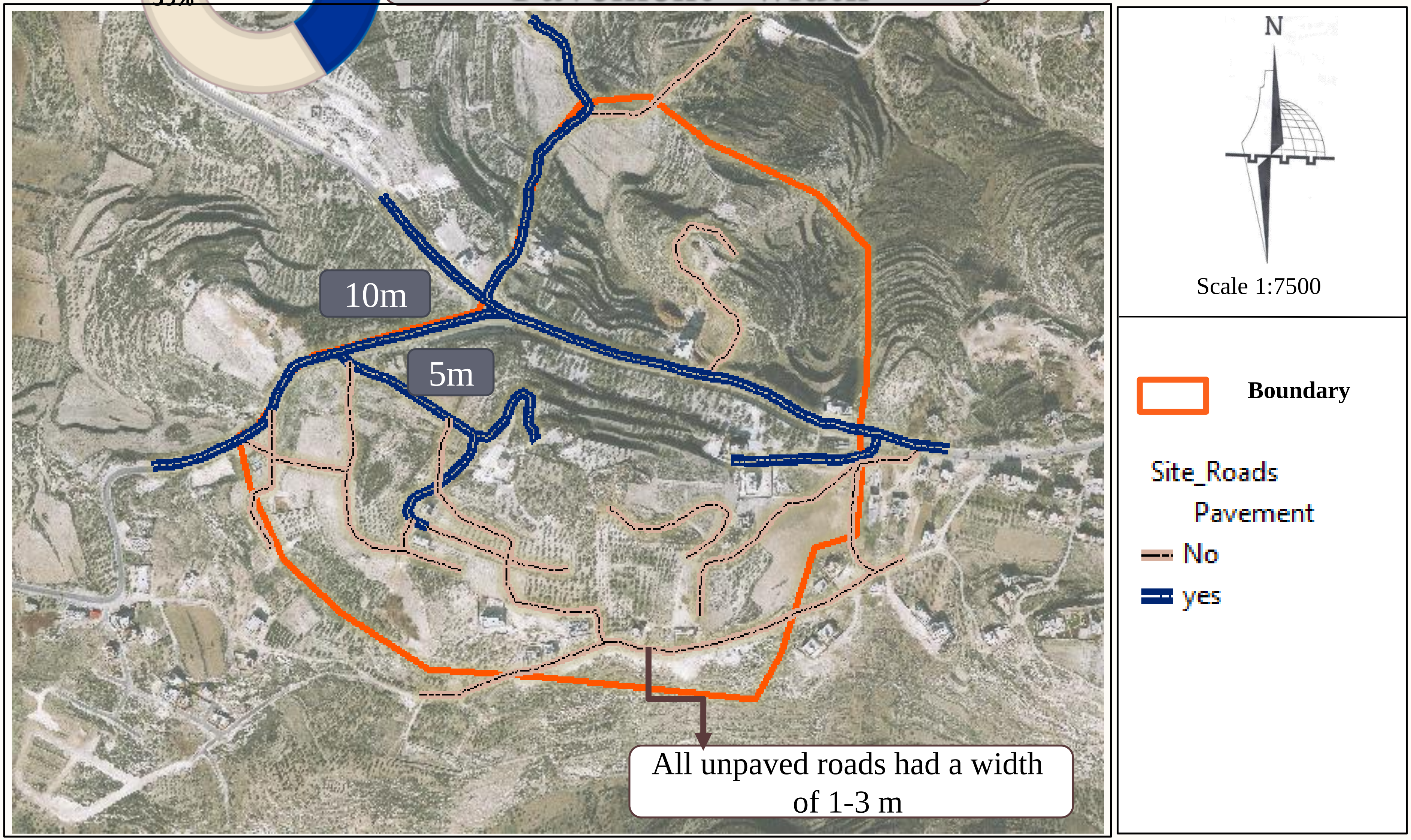
- **Seismic Zones :** at Zone 2B, is a dangerous zone for building and construction
- **Soil Classification:** Clay loam :rock with gravel , also good for development.
- **Water Sensitivity:** The site has no sensitivity to water
- **Agricultural Classification :** at medium and low Agricultural value
- **Geopolitical Classification:** The site was located at Area B

Road specification - local scale



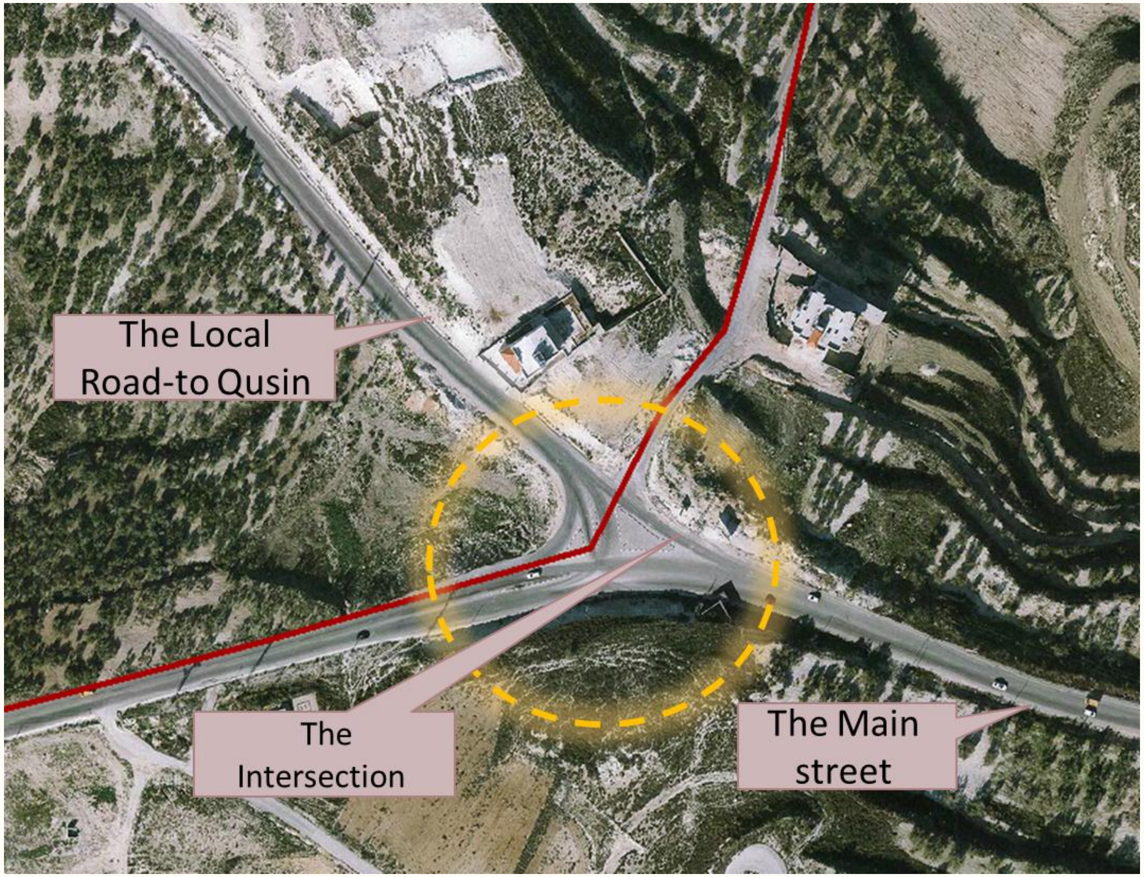


Site Road Classification Pavement - width



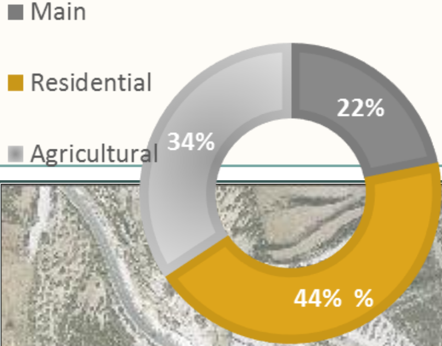
Site Road Classification

The Paved street at the site

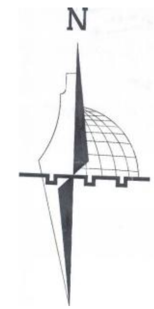


The Intersection of Main and Local street at the site.

The Main street at the site



Site Morphology



Scale 1 : 7000

Legend :

location

Site_Roads

Type

Main Road

Residential

Agricultural Road

Main Intrances

Buildings

Electricity poles

Road sign

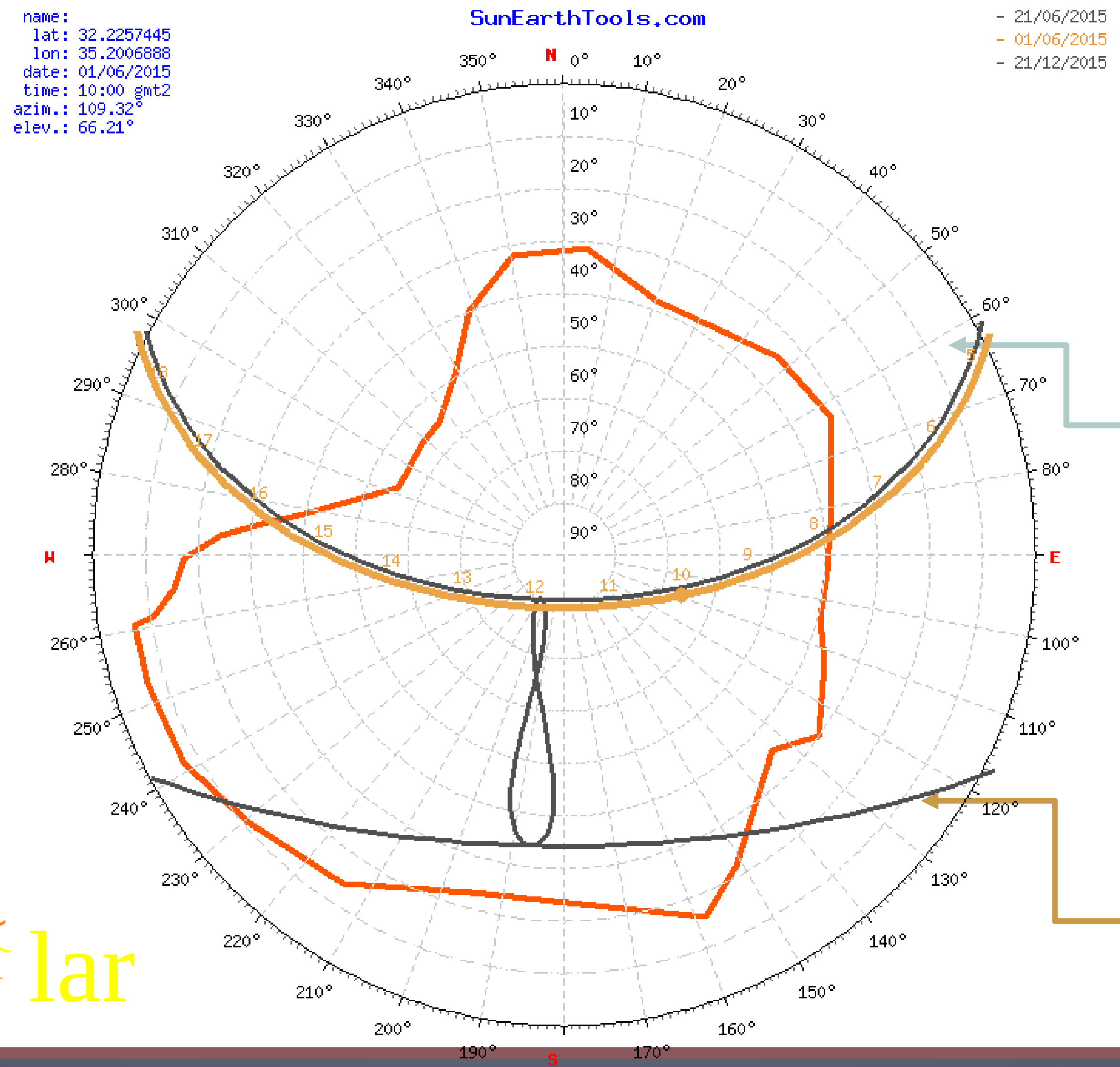
Houses Nu. at site= 15

Built up area =3440 m2

Services Used by the site

SOLAR ANALYSIS

Sun Path Analysis



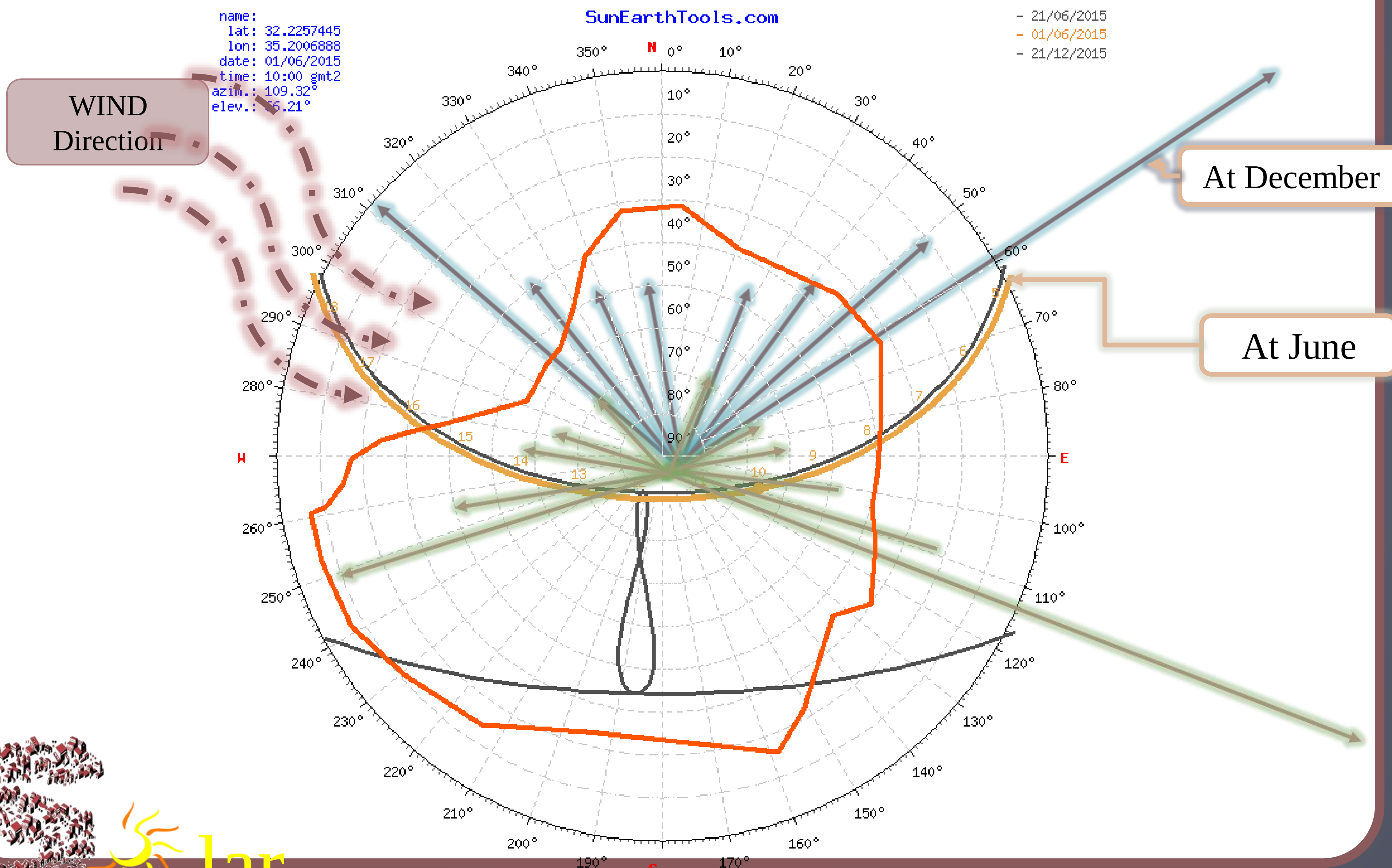
Sun Path

At June

At December

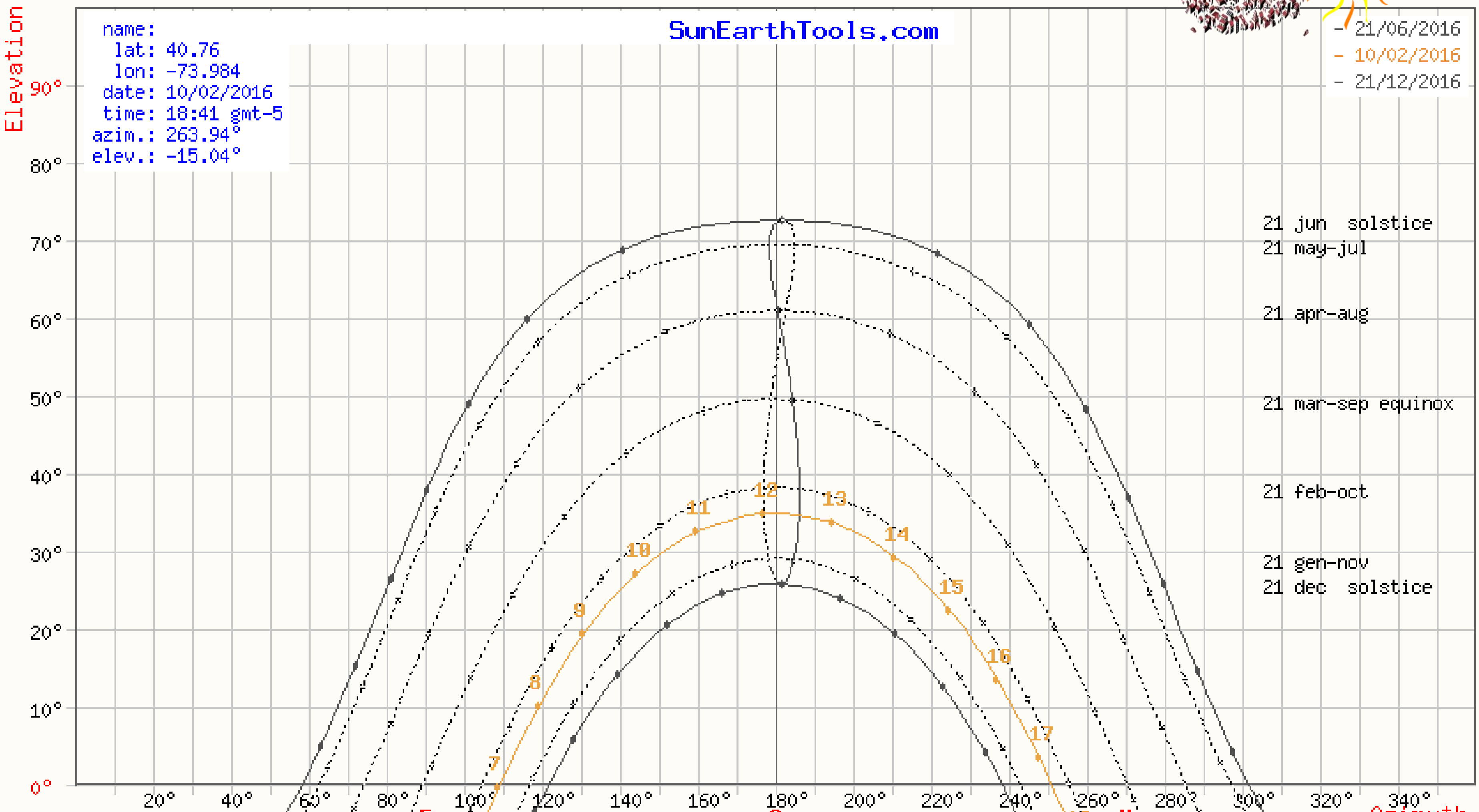
S lar

Shadows and Winds



lar

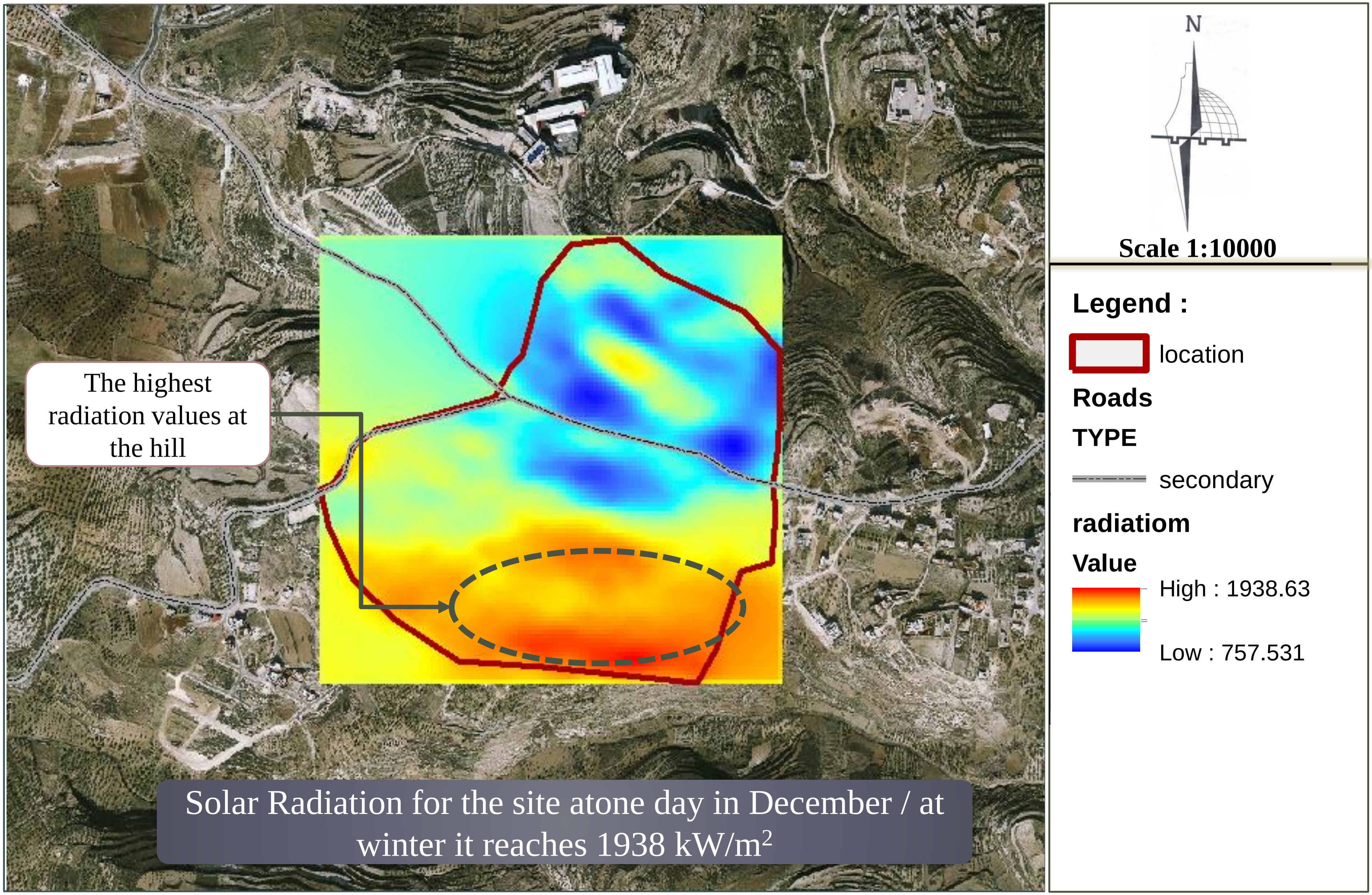
Azimuth - Elevation



Azimuth – Elevation :

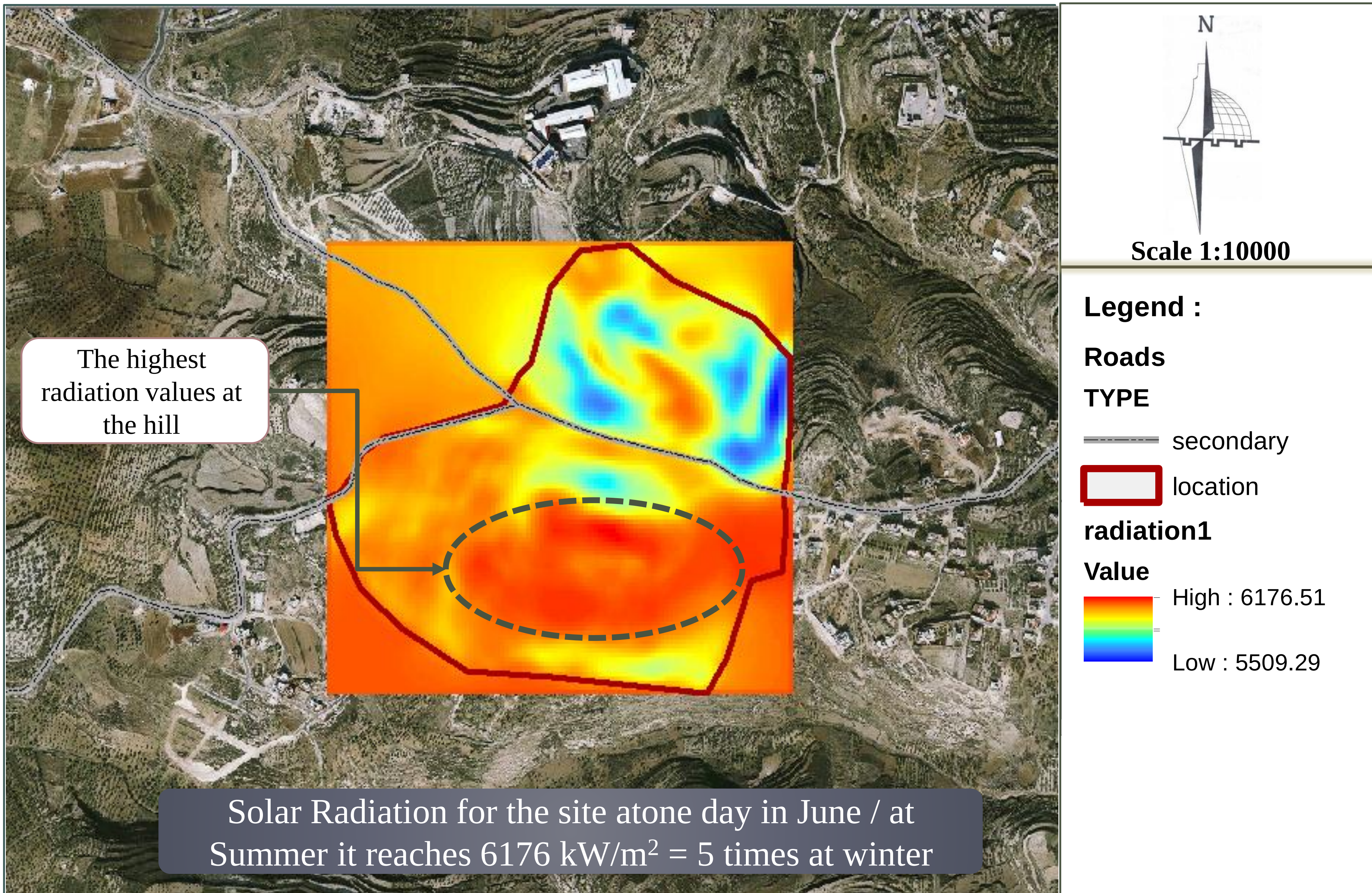
The azimuth angels of the sun at the site at all months of the year ,and it shows the highest azimuth angle reaches 75 degree at summer and the lowest at winter .

Solar Radiation-Winter



Solar Radiation for the site atone day in December / at winter it reaches 1938 kW/m^2

Solar Radiation-Summer



Solar Radiation for the site atone day in June / at Summer it reaches 6176 kW/m^2 = 5 times at winter

Azimuth Angels and Elevation

At Summer

Date:		1/6/2016
coordinates:		32.2260168, 35.2015686
location:		
hour	Azimuth	Elevation
04:33:19	63	-0.833
05:00:00	66.49	4.27
06:00:00	73.73	16.2
07:00:00	80.59	28.56
08:00:00	87.71	41.18
09:00:00	96.21	53.85
10:00:00	109.07	66.24
11:00:00	138.5	76.98
12:00:00	208.14	78.71
13:00:00	246.41	69.05
14:00:00	261.37	56.85
15:00:00	270.51	44.2
16:00:00	277.82	31.56
17:00:00	284.68	19.13
18:00:00	291.79	7.08
18:41:08	297.09	-0.833

At Winter

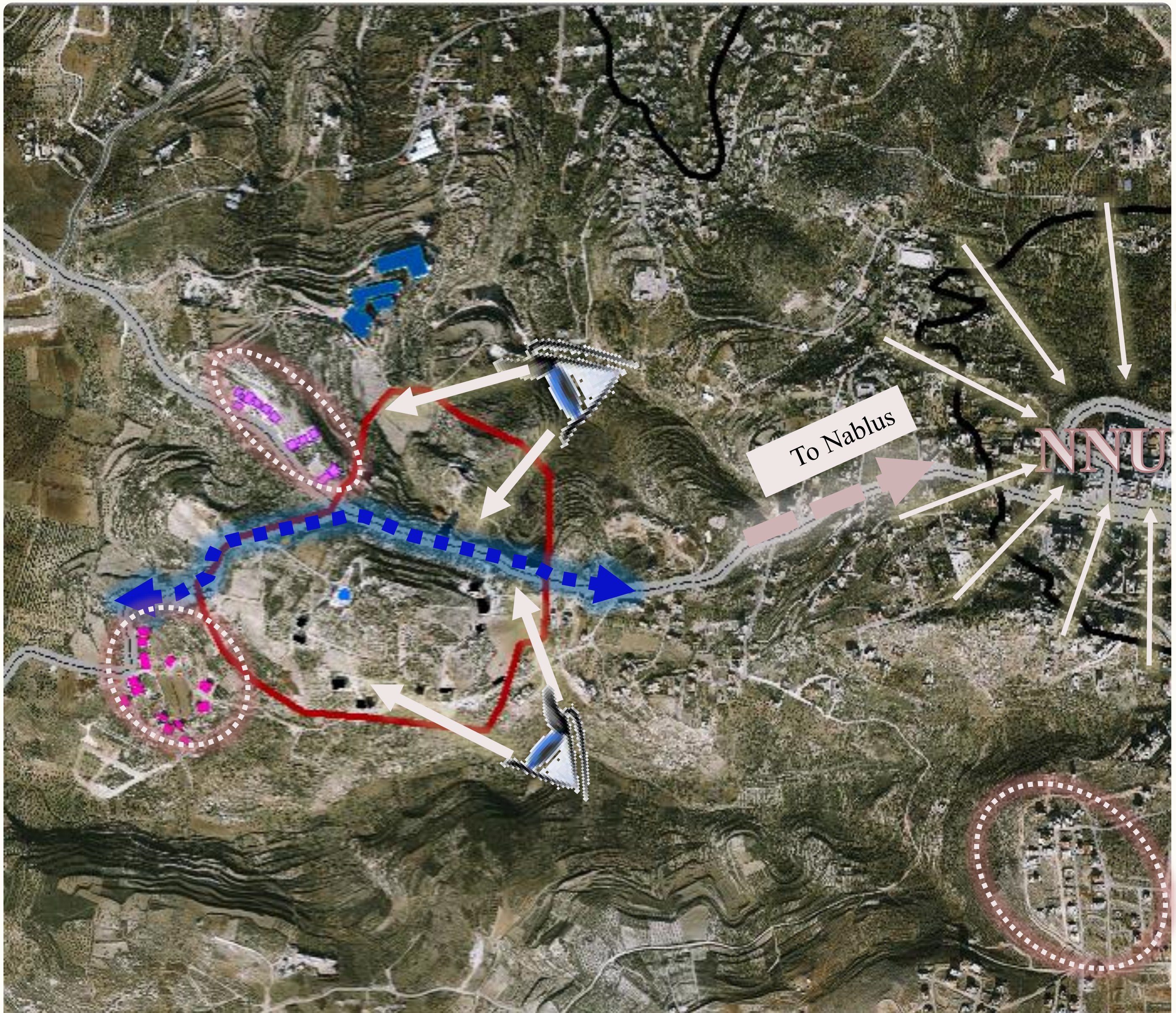
Date:		1/12/2016
coordinates:		32.2263073, 35.2017403
location:		Nablus
hour	Azimuth	Elevation
06:22:30	115.53	-0.833
07:00:00	120.71	6.15
08:00:00	130.23	16.49
09:00:00	141.76	25.31
10:00:00	155.73	31.91
11:00:00	171.92	35.46
12:00:00	189	35.35
13:00:00	205.08	31.61
14:00:00	218.91	24.86
15:00:00	230.3	15.93
16:00:00	239.71	5.53
16:34:02	244.39	-0.833

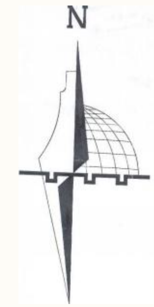
SWOT Analysis

SWOT Analysis :

Element	Strength	Weakness	Opportunity	Threat
Accessibility	• Existing Main Road (Nablus-Qalqilya-Salfit)		Main road give chance to get services to the site	
Surrounding development	• Many new Housing projects developed around the site • The new trend of expansion toward the project site	• Many residential buildings at site itself	Near the developed Housing projects New services come to the site	The privacy of the site affected by the nearby projects
Side condition	• Majority has good slope and can be developed	There are a hill can be developed as low density	Suitable for recreational area and low density	
Location	• A very good location • At Main road intersection • Between 2 governorate		New Polices support the projects at this location	Separation of land between the two governorates
Zoning of Site	• Strategic for residential use		Can be developed for any development	
Environmental condition	• Good for a quit place to live • Far from the noise of the city • Overpopulation was low • Solar access high at summer and good at winter		Attract people from the city to live their attracts people who care about the environment	Pollution from the main road Pollution from the aluminum factory may affect the people who live there .

Site Analysis- Opportunities





Scale 1:15000

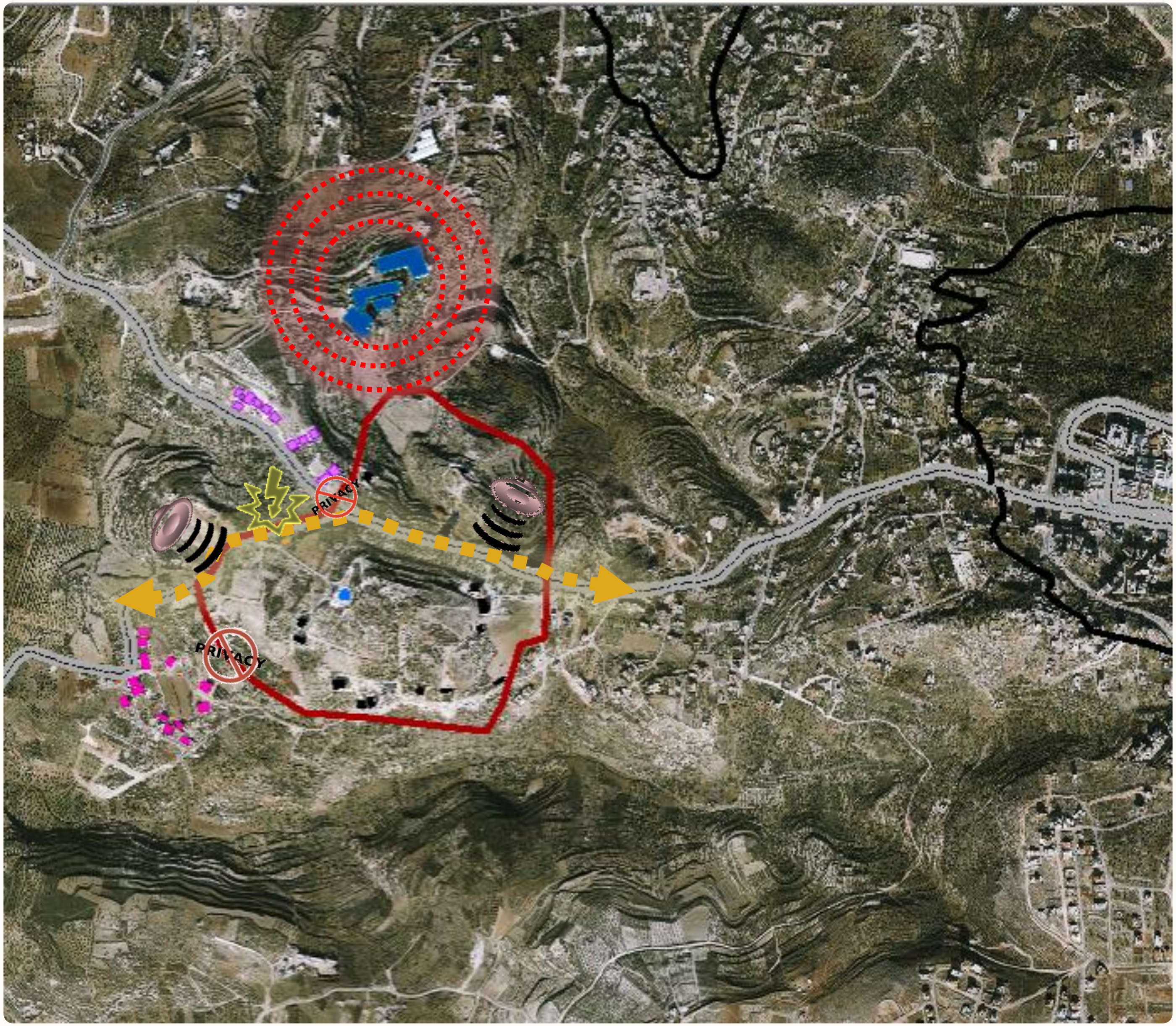
The best view from the site

New Housing projects

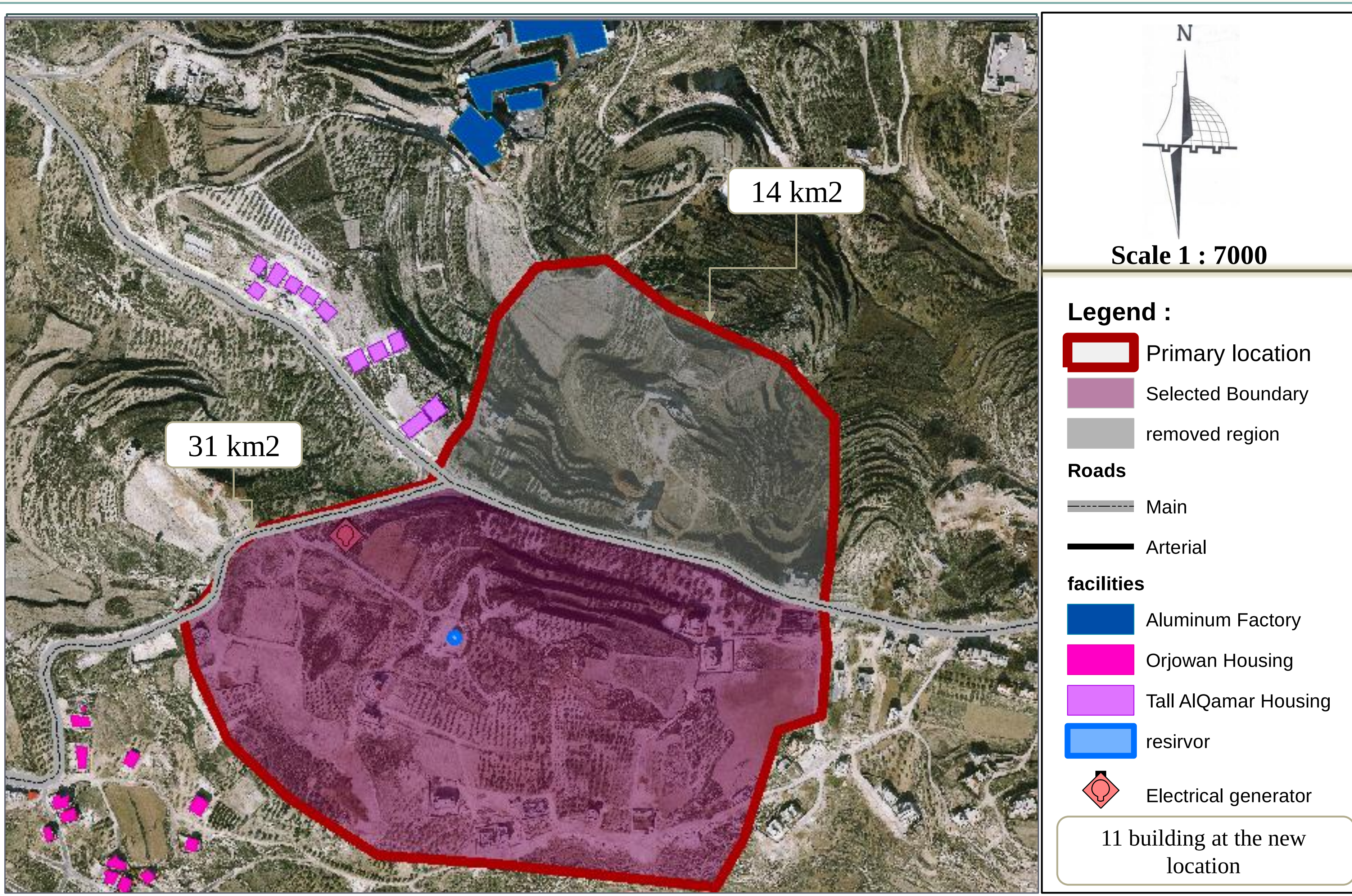
Attractive main street

Attractive use –NNU

Site Analysis- Constraints



Site new Boundary



Chapter3.
Project Definition :

VISION

Planning and Designing a new solar neighborhood depending on the Climate , Topography ,solar envelop and solar radiation to maximize the solar utility to everyone live there.

SOLAR

Project Objectives

– Planning & Designing new neighborhood which has the following criteria :

  – **Minimum fuel consumption**
  – **Maximum energy production**
  – **Maximum Solar Access**
  – **More livable**
  – **Cleaner**
  – **Healthier**

– Finally , **new approach** in Housing projects planning and **guidelines** in designing residential areas .

Solar Neighborhood Attitudes:

Designing **residential areas** and individual buildings according to the principles of solar architecture .

Utilization of **active and passive solar** energy and General utilization of **renewable energies**.

Direct use of the sun to **increase welfare** of people inside as well as outside of buildings and Emphasizing the aspects **nature and leisure** .

New approaches in general for a lasting development of residential areas .

Standards of solar neighborhood design

Orientation of streets and building structures to the sun;

Temperature control and use of daylight in the public realm;

Topography (land form, overall exposure, general situation);

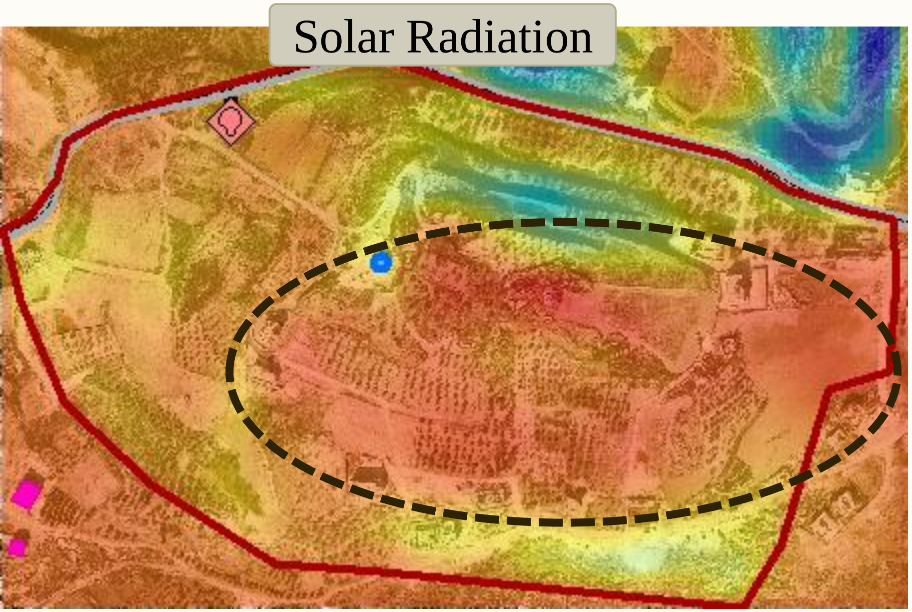
Direction and intensity of wind (alignment of streets, sheltered public spaces, systematic ventilation

vegetation and distribution of planted areas

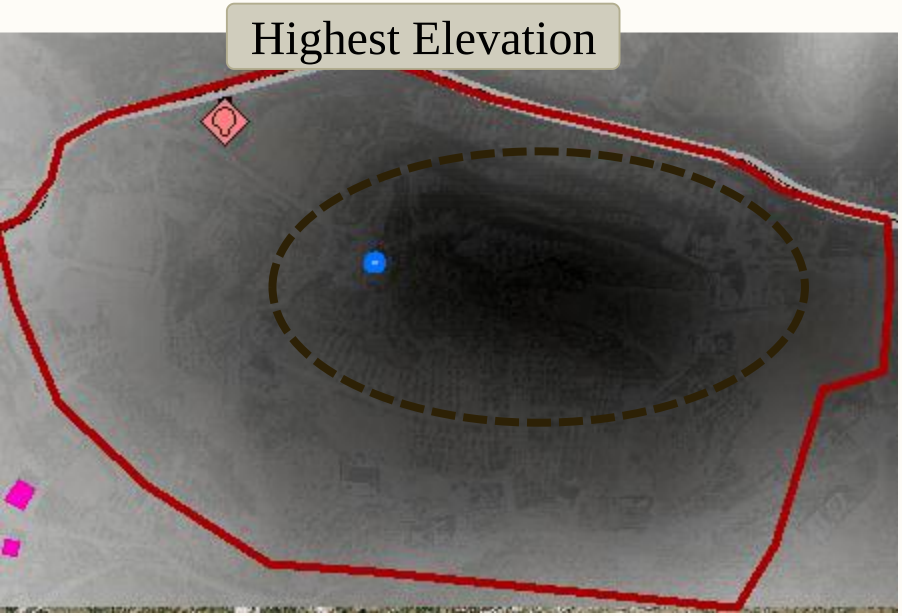
Neighborhood Elements

- Housing Services
- Daily needs :
- Educational (kindergarten)
- Recreational (playground's – gardens)
- Social services – cultural – religious
- Commercial services
- Health services
- Roads
- Public services

Conceptual plan



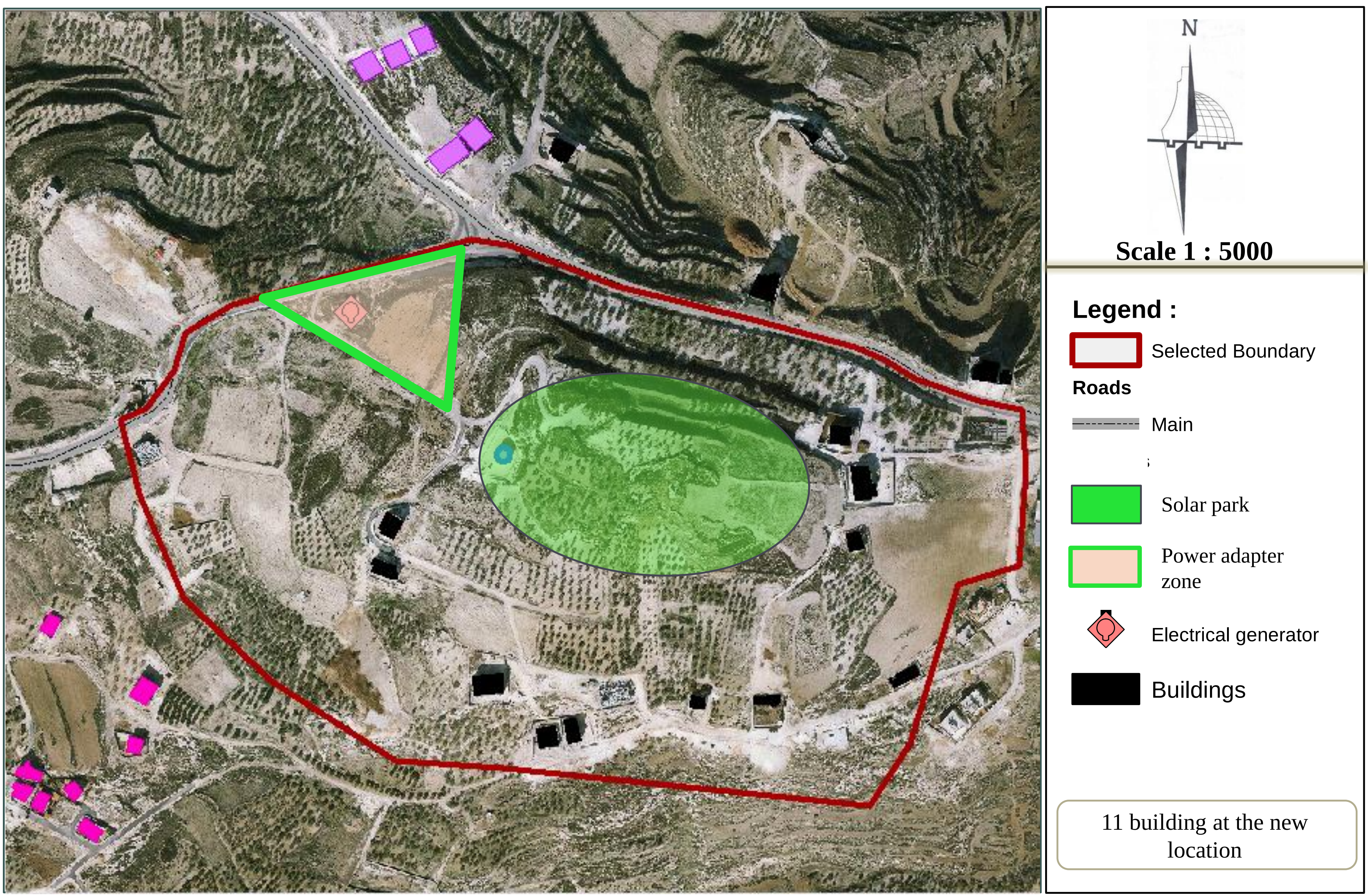
The highest solar radiation at the site at summer and winter
This was good at winter but also harmless at summer because of high radiation and stronger solar access .



The highest elevation at the site , but also have lower slop , and nearly at the same area
So it has the best view to other area's from this point

So , the best use for this area was a **green area** that can control solar radiation and access at summer and winter and for the good view to the whole site .

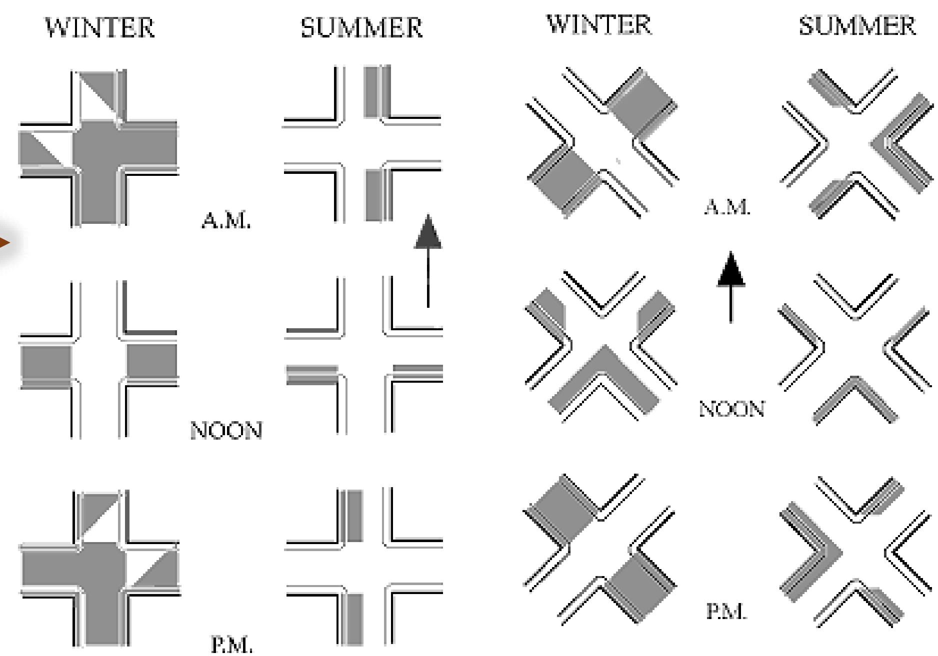
Initial land use map



Solar Neighborhood Planning stage :
- Street Pattern and Orientation -

- It was important for making street orientation for the biases for Land-use planning decisions .
- Two types of orientation :
  - as west-east /north south grid
  - With angle related to sun north-east /south-west

The best orientation was with angel to the sun, to maximize solar access at winter and make shadows at summer .

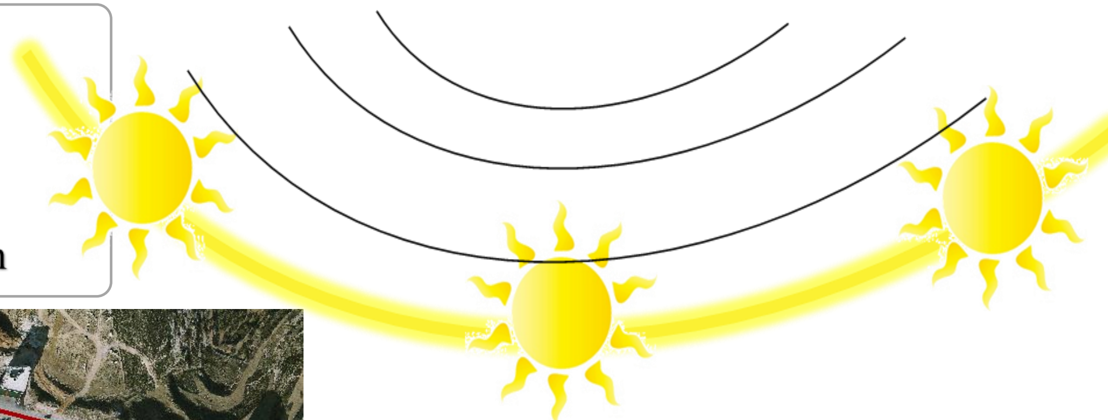


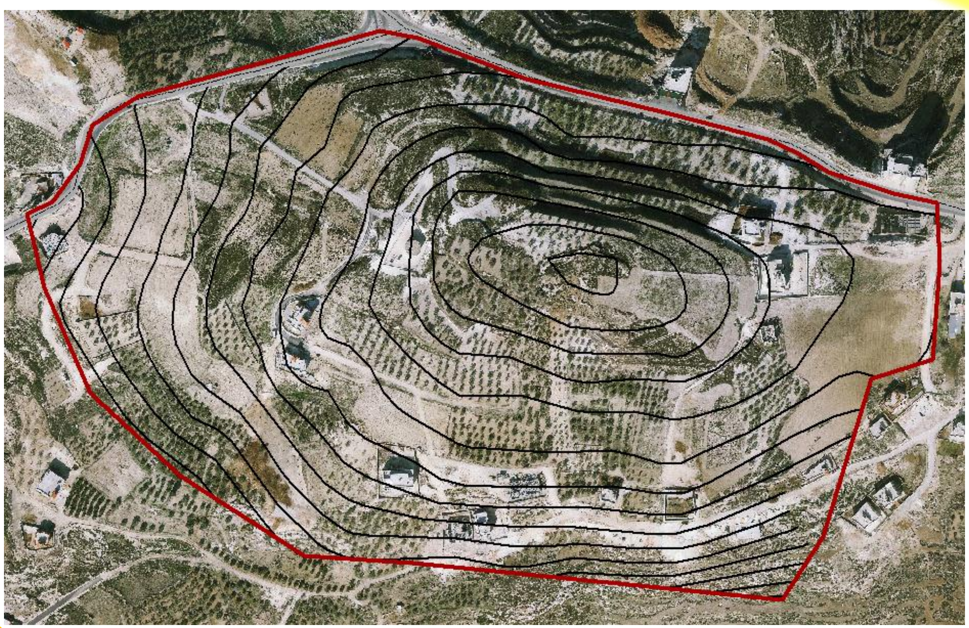
Street Orientation Concept :

- The most appropriate Orientation is directed the buildings with street orientation.
- streets orientation is with the conduct of the **sun line** .

Streets orientation :

- East-west with sun angel
- Sun with itinerary of street
- To embrace the streets by the sun





The topography of the site greatly help in directing the streets, so that the region is elliptical hill

Legend :

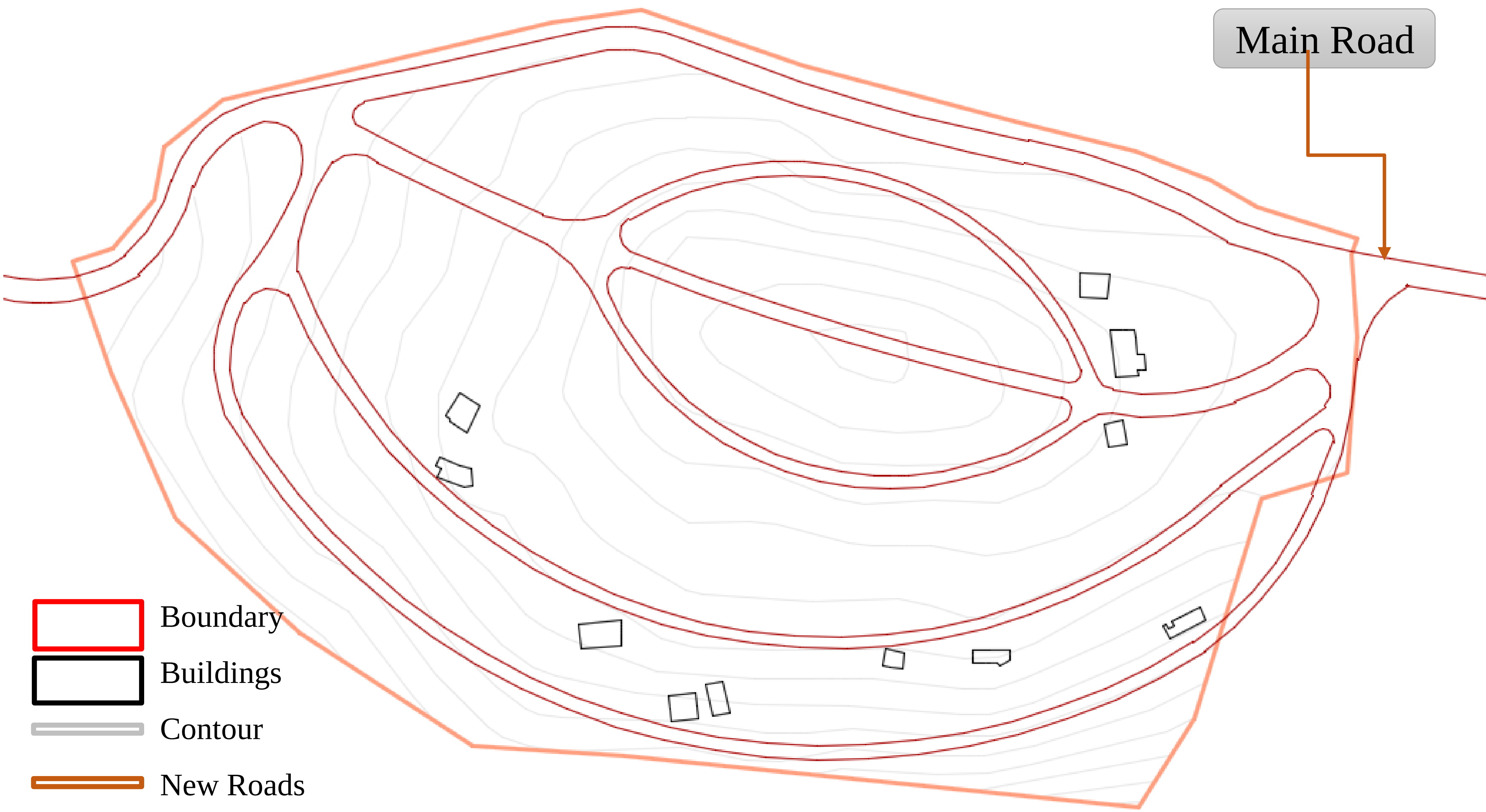
Roads

Main

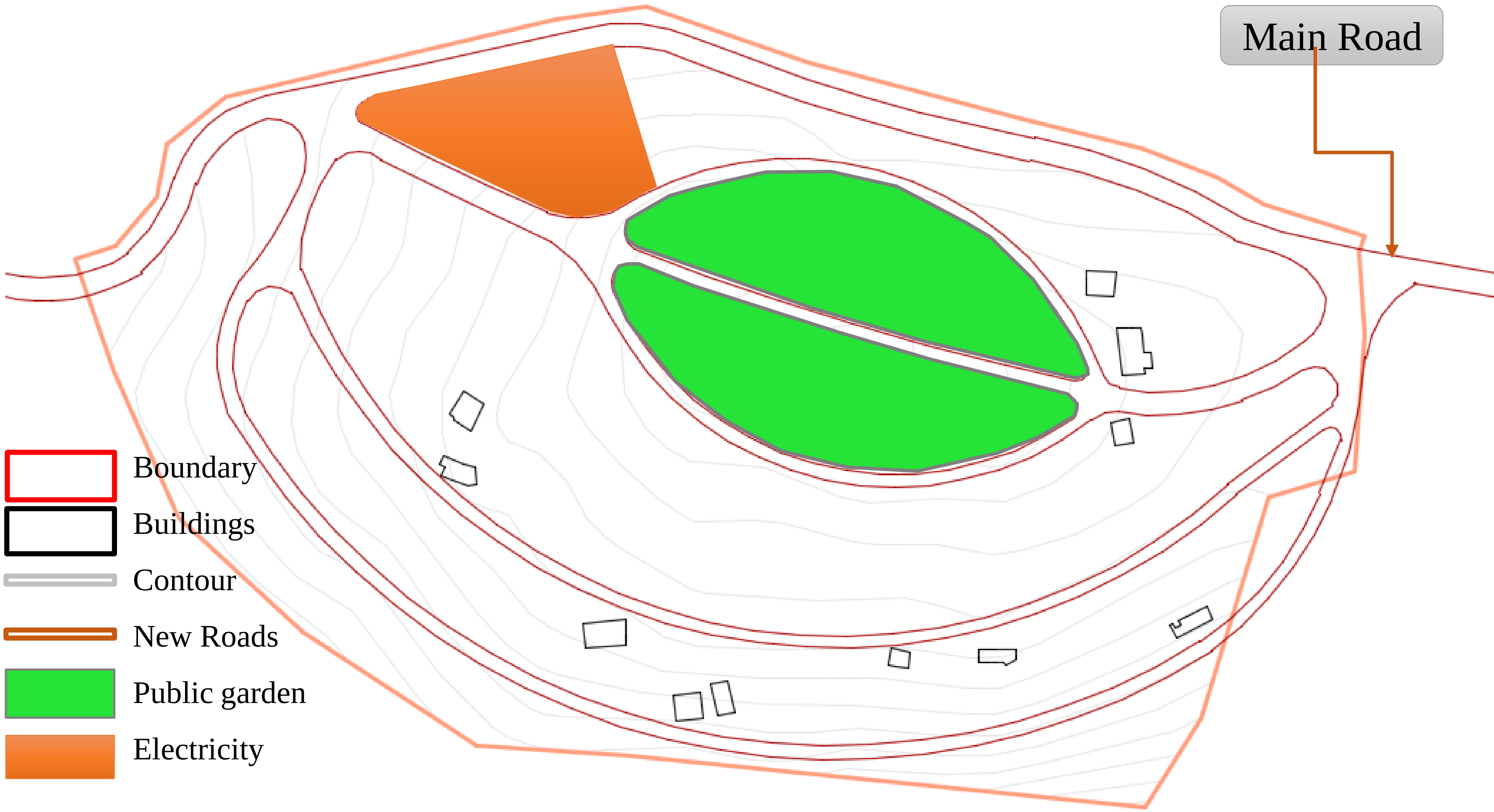
Selected Boundary

Contour_location

New Proposed Roads



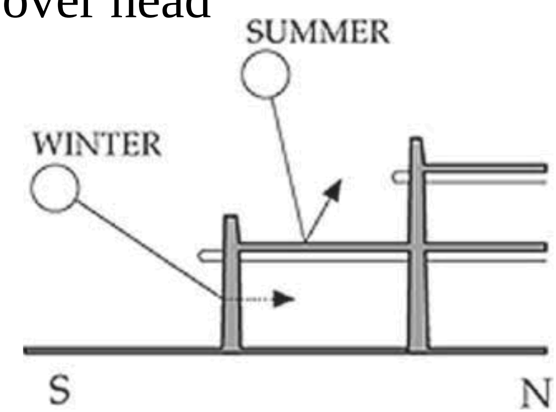
New Road network with initial land uses

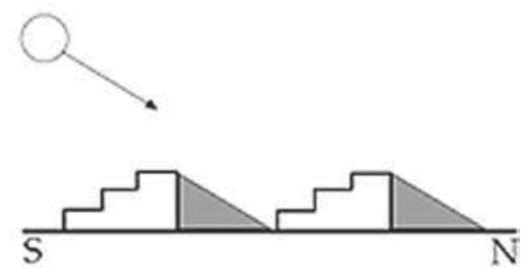


Solar Neighborhood Planning stage :
- Buildings Orientation -

At summer :

- At morning : sun comes directly from east
- At afternoon : sun comes directly from west
- At midday :sun nearly over head





At winter :

- Sun has lower angels than summer and needed all the day

Main Goals :

At winter … minimum shadows

At summer … high shadow at midday

Buildings Orientation :

Analysis of the shadows:

Building sites was chose depending on trying to orient buildings , by the way the building area’s **distributed randomly**

- , So that these buildings were directed direction that match **street orientation to maximize the entry of the sun's rays at first.**
- Buildings and spaces initially will be controlled in the design phase later, but spaces rate between **150-600 m2.**
- the region in general **classification housing B** where housing by which the maximum allowed is **4 floors.**
- Shadows are analyzed at the level of time and height of the buildings:

Times :

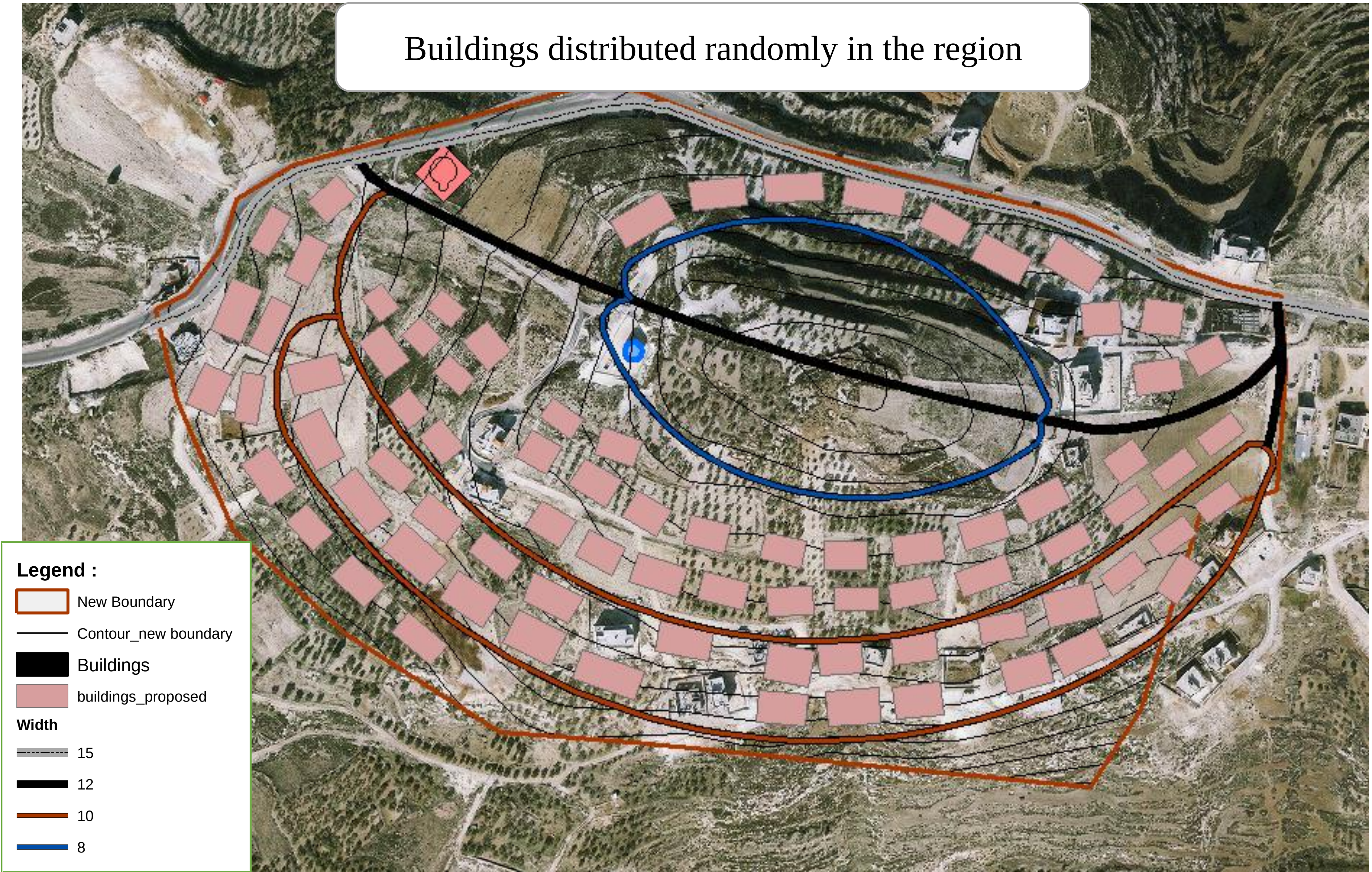
- Winter (9-12 - 3)
- Summer (10-2 -5)

Highs:

- Two floors (villas)
- Four floors (the Buildings)

Buildings Orientation :

Analysis of the shadows:



Buildings Orientation :

Analysis of the shadows:

Case 1 - Proposed Buildings – 2 floors

Boundary

Existing Buildings

Proposed Buildings

New Roads

Buildings Orientation :

Analysis of the shadows:

Case 2 - Proposed Buildings – 4 floors

Boundary

Existing Buildings

Proposed Buildings

New Roads

Case 1 :At Winter :

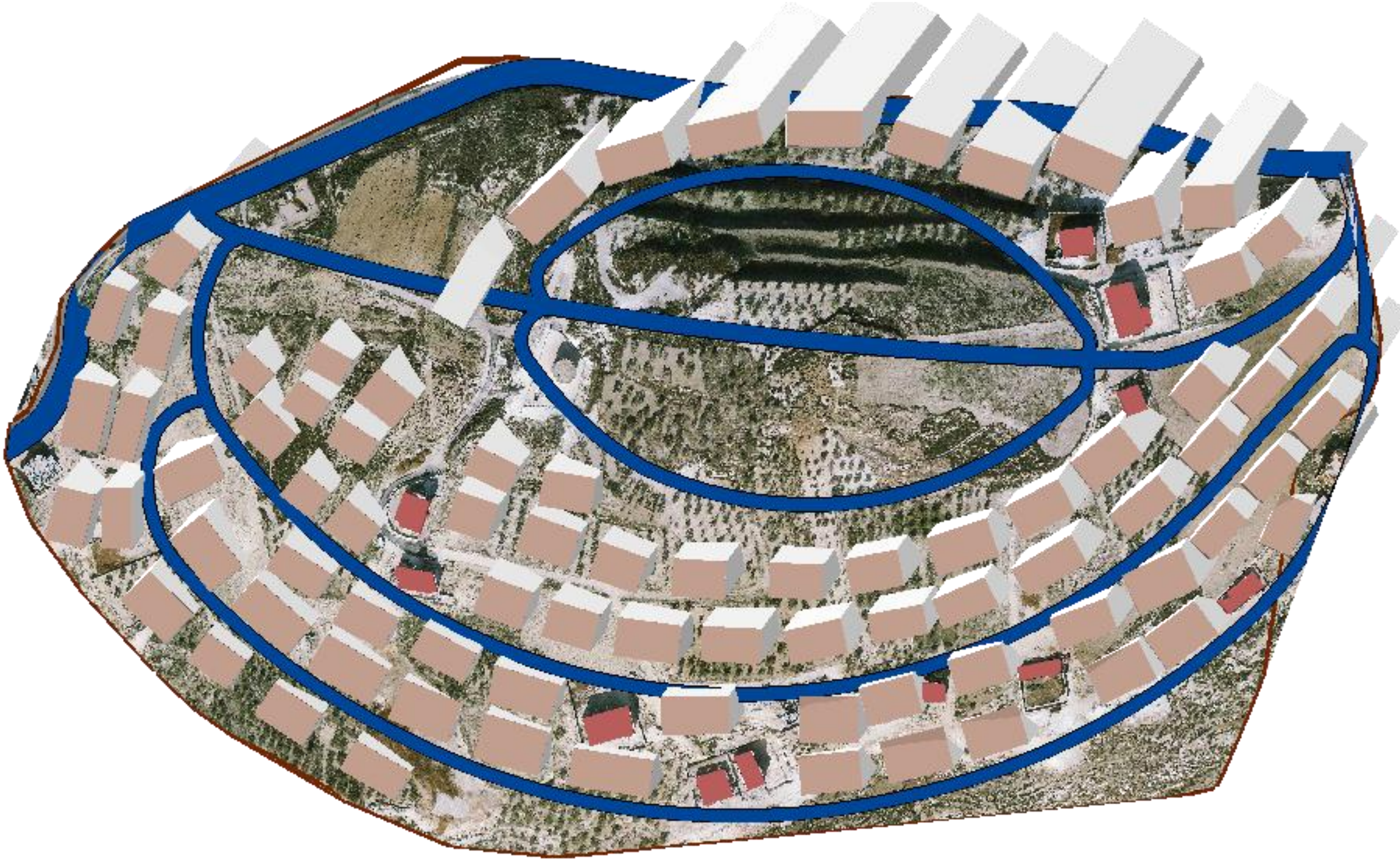
Shadows from Proposed Buildings – 2 floors– at 9 a.m.

Case 1 :At Winter :

Shadows from Proposed Buildings – 2 floors– at 12 p.m.

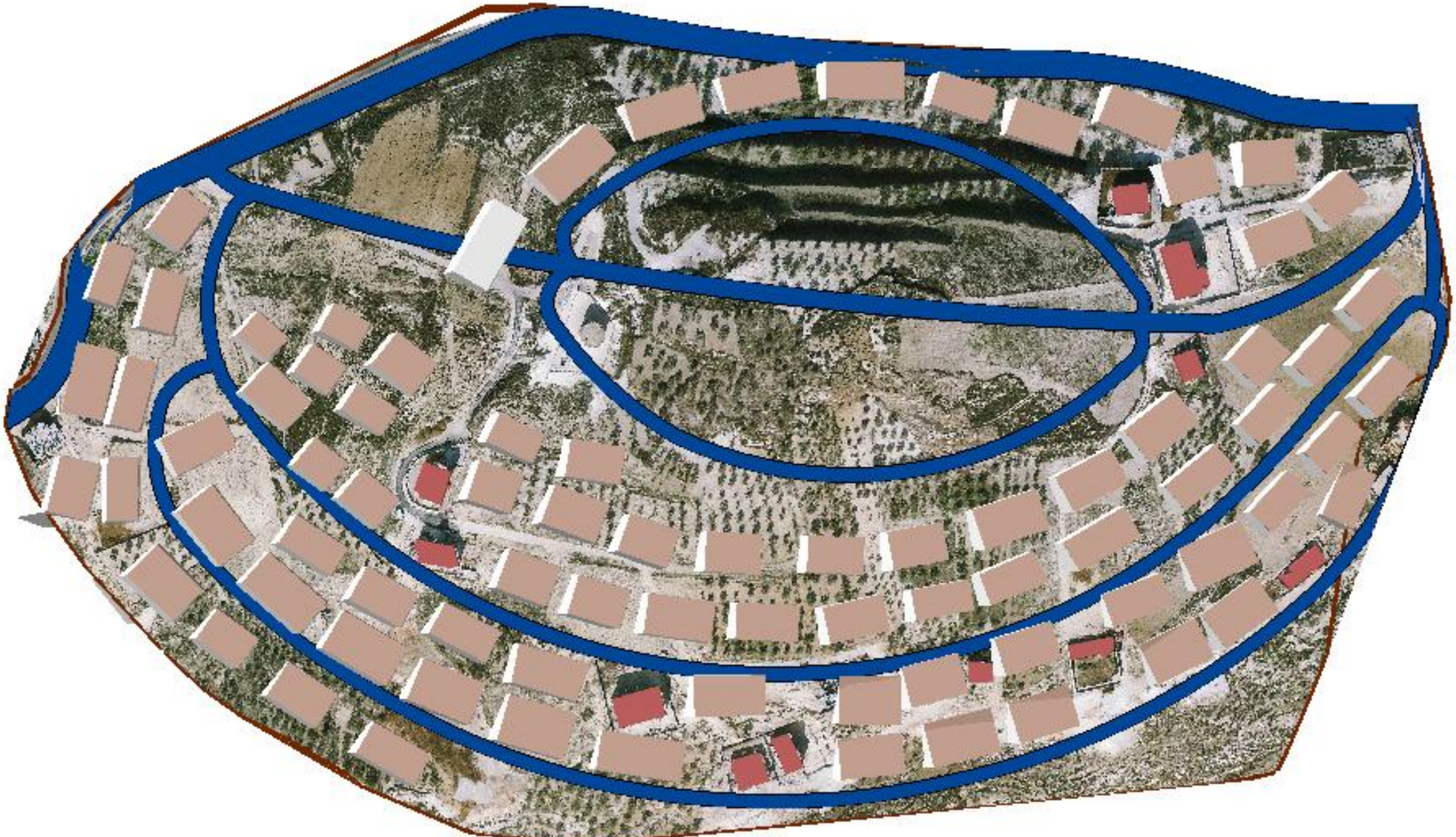
Case 1 :At Winter :

Shadows from Proposed Buildings – 2 floors– at 3 p.m.



Case 1 :At Summer :

Shadows from Proposed Buildings – 2 floors– at 10 a.m.

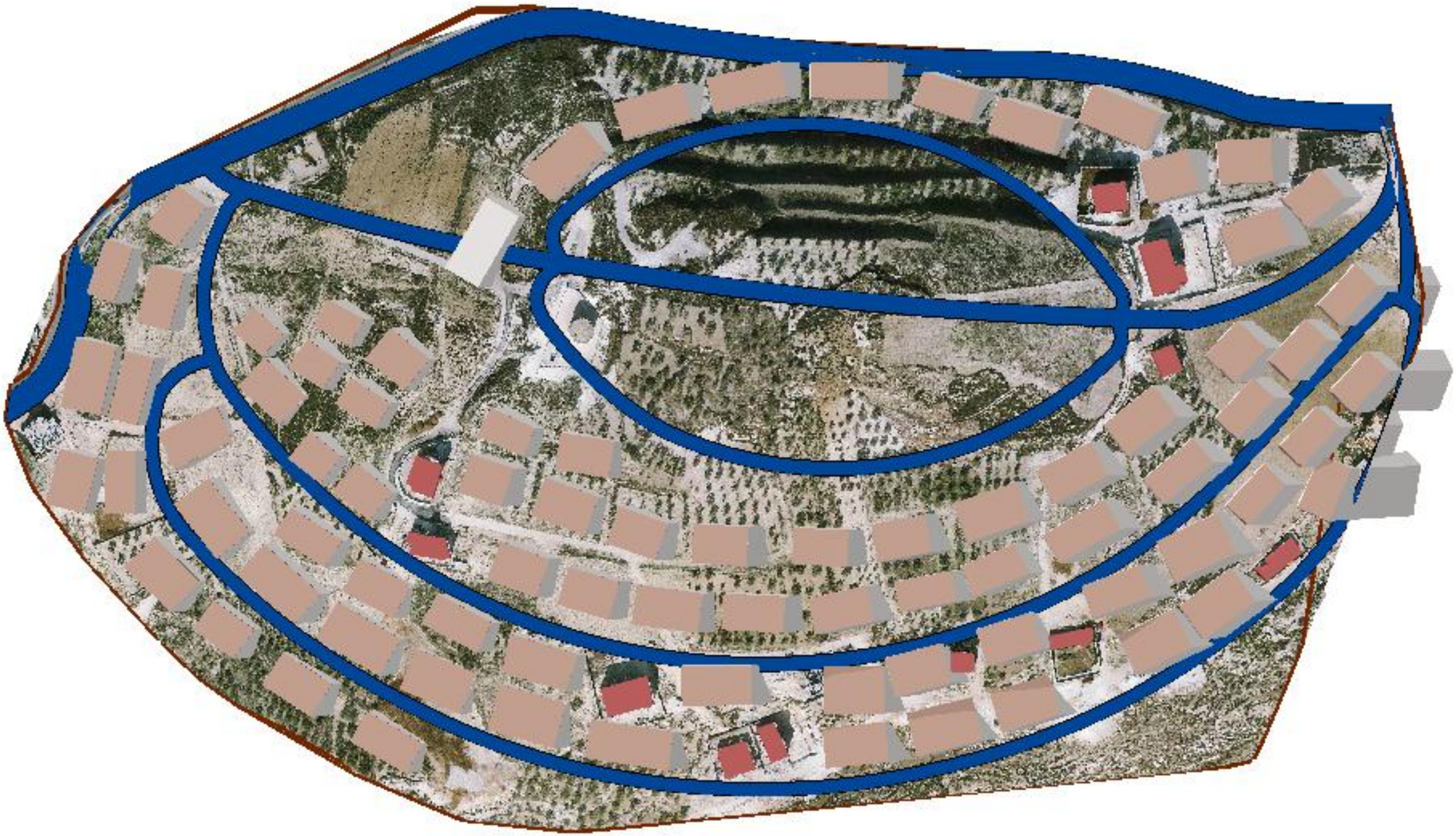


Case 1 :At Summer :

Shadows from Proposed Buildings – 2 floors– at 2 p.m.

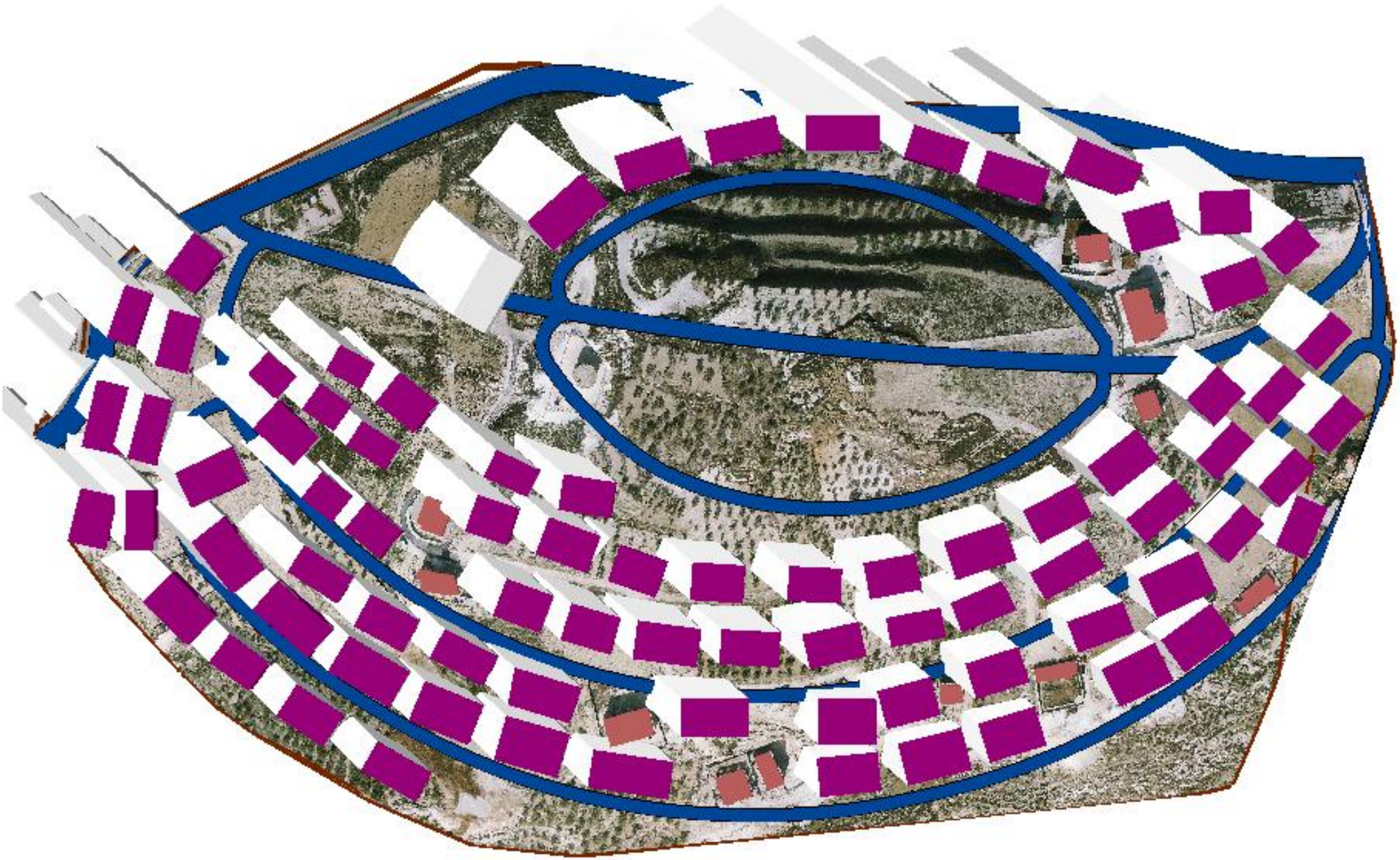
Case 1 :At Summer :

Shadows from Proposed Buildings – 2 floors– at 5 p.m.



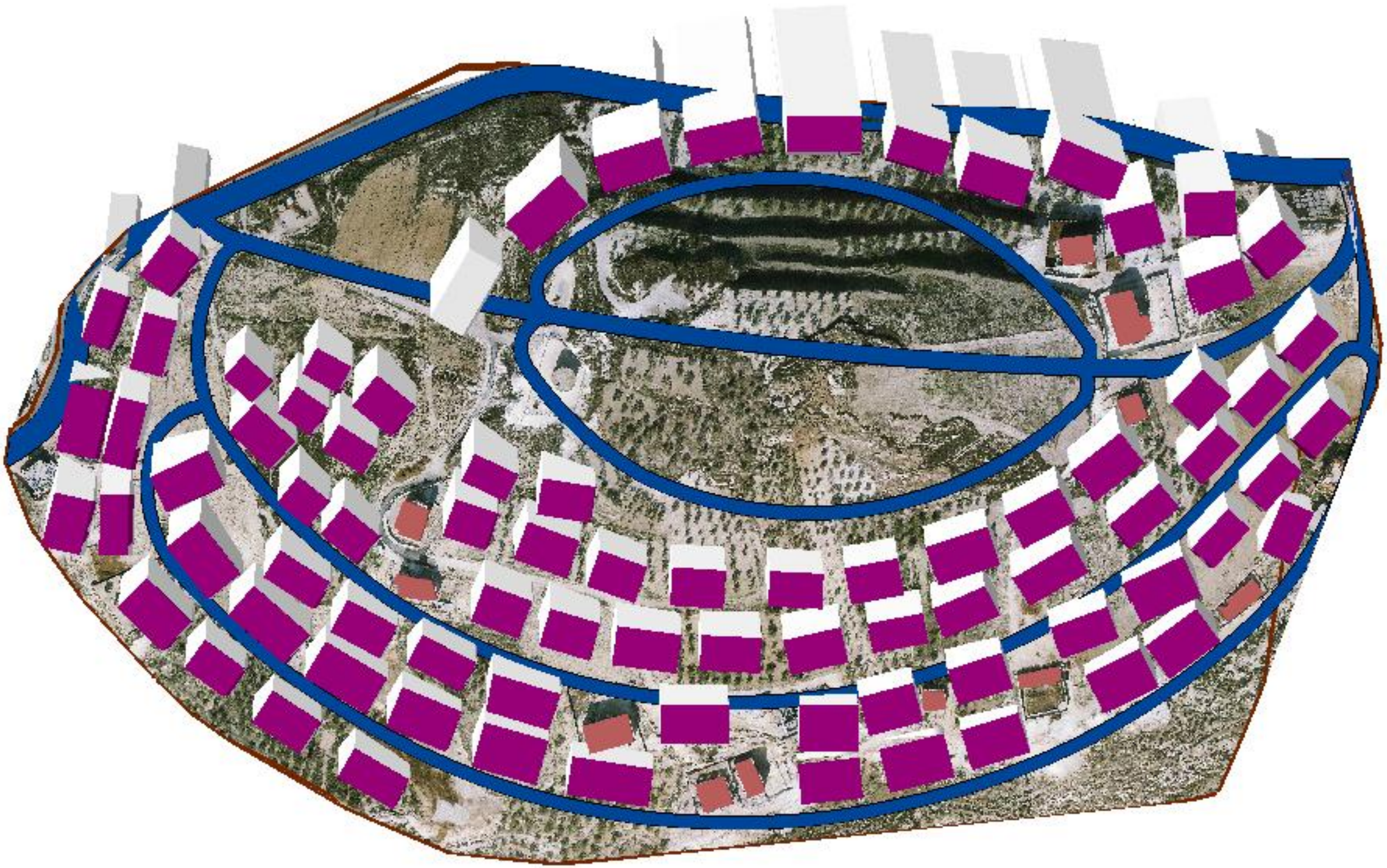
Case 2 : At Winter :

Shadows from Proposed Buildings – 4 floors– at 9 a.m.



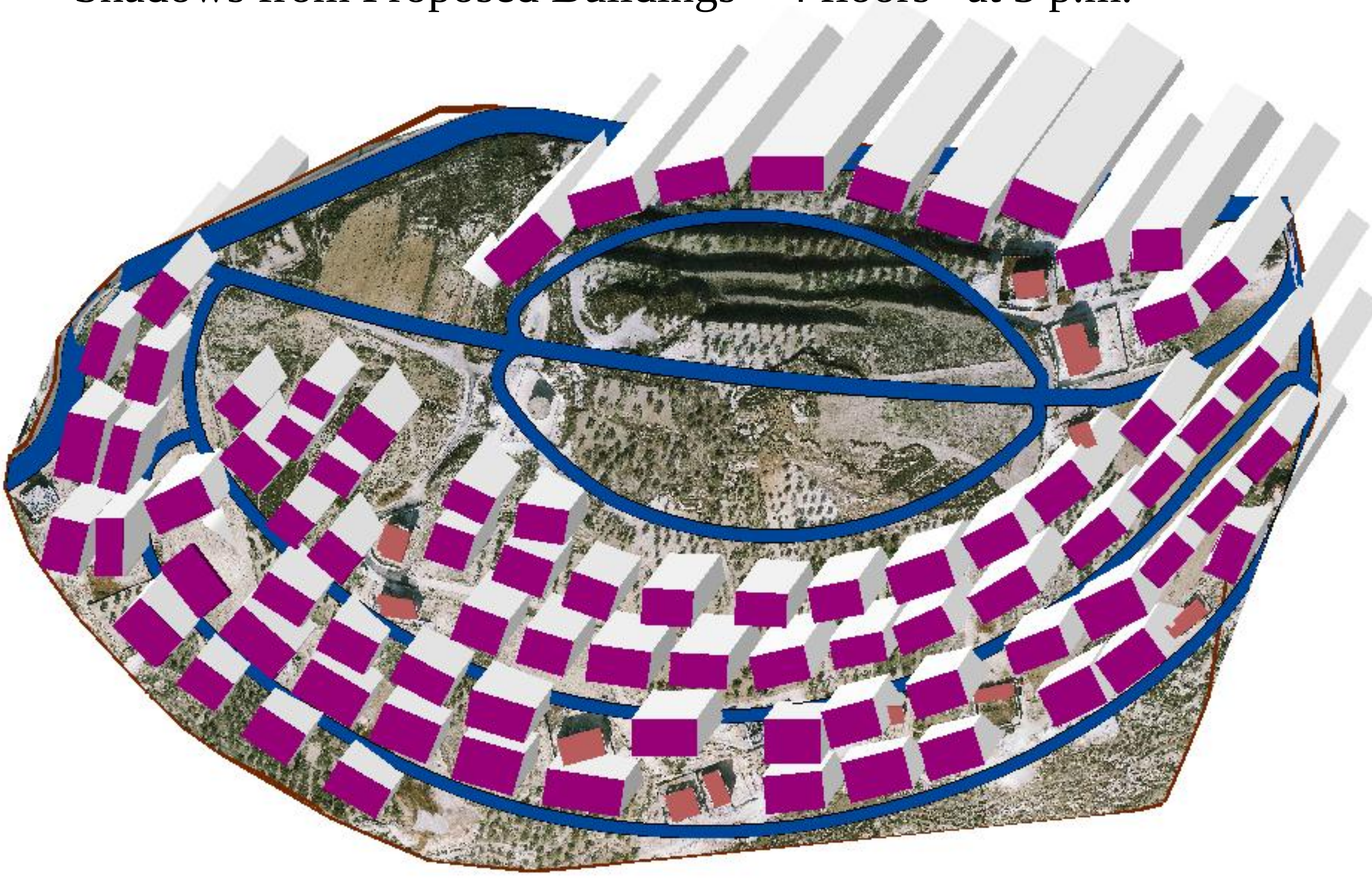
Case 2 : At Winter :

Shadows from Proposed Buildings – 4 floors– at 12 p.m.



Case 2 : At Winter :

Shadows from Proposed Buildings – 4 floors– at 3 p.m.



Case 2 :At Summer :

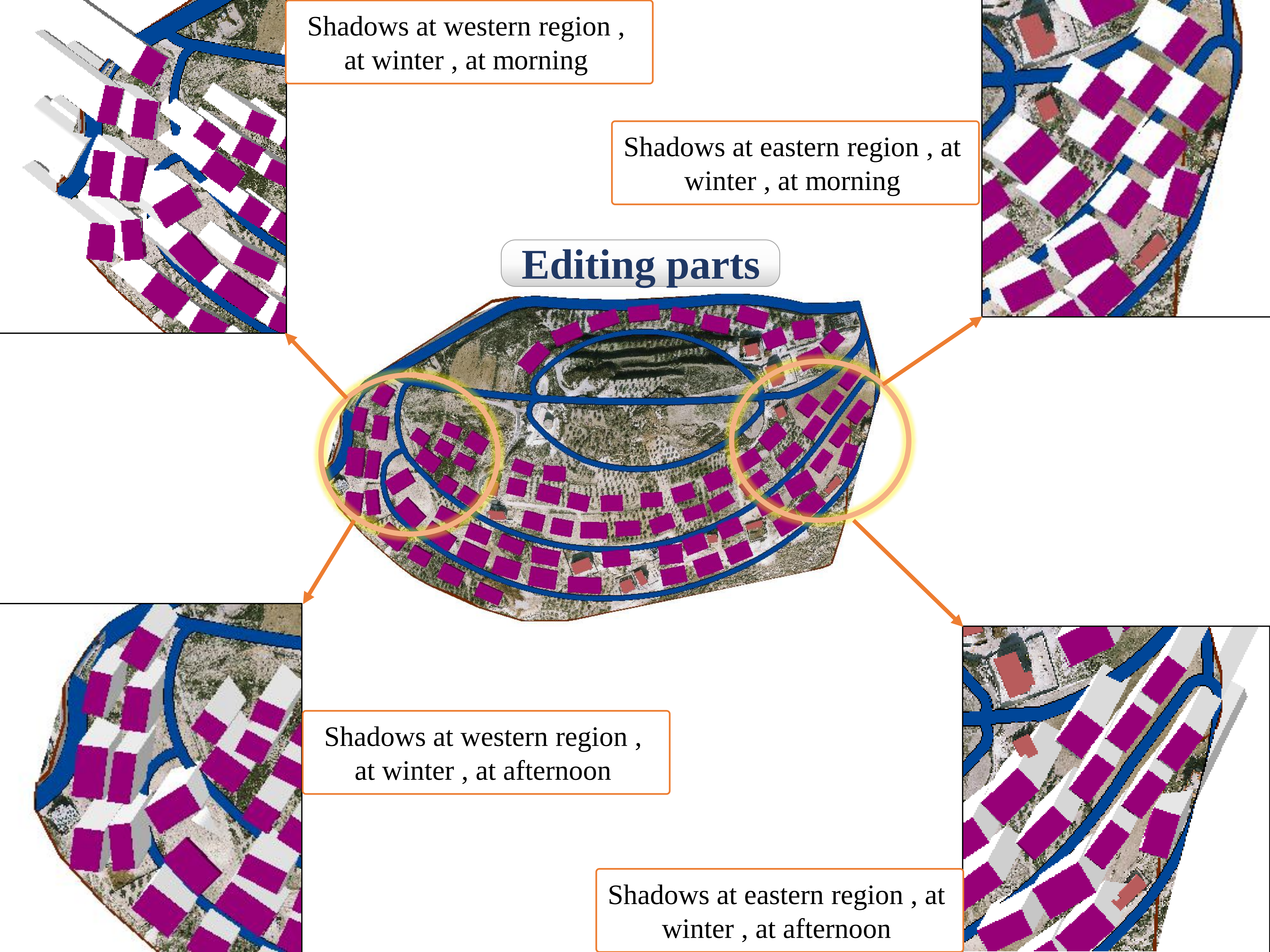
Shadows from Proposed Buildings – 4 floors– at 10 a.m.

Case 2 :At Summer :

Shadows from Proposed Buildings – 4 floors– at 2 p.m.

Case 2 :At Summer :

Shadows from Proposed Buildings – 4 floors– at 5 p.m.


Editing parts
Shadows at western region , at winter , at morning
Shadows at eastern region , at winter , at morning
Shadows at western region , at winter , at afternoon
Shadows at eastern region , at winter , at afternoon

Buildings Orientation :

Analysis of the shadows:

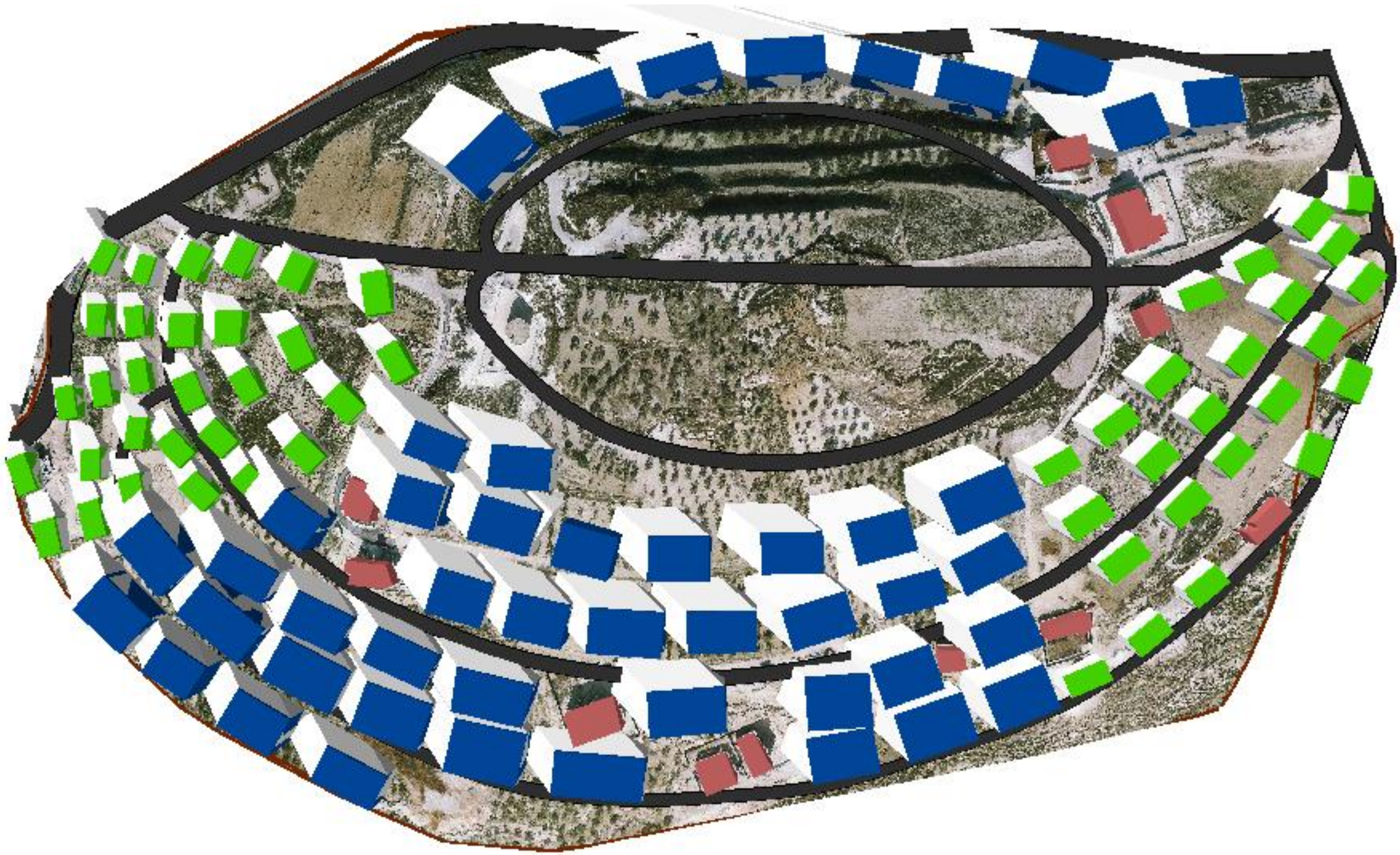
Case 3 :low density building at west and east

less density ,more spaces , should have at most 2 floors high , buildings area's decreased to **maximum 250 m2**

3D-Model for the new proposed building in case 3

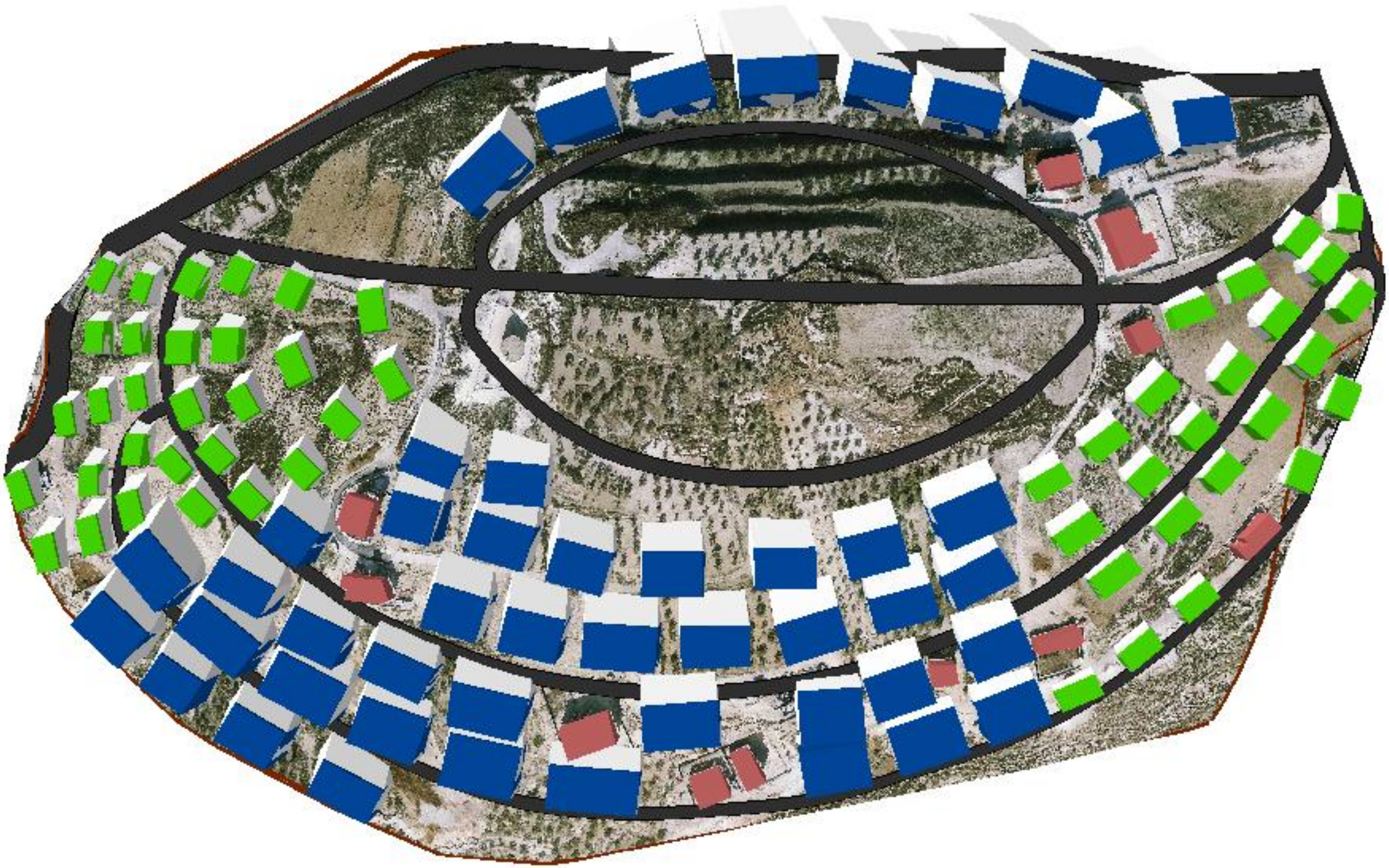
Case 3: At Winter :

Shadows from Proposed Buildings– at 9 a.m.



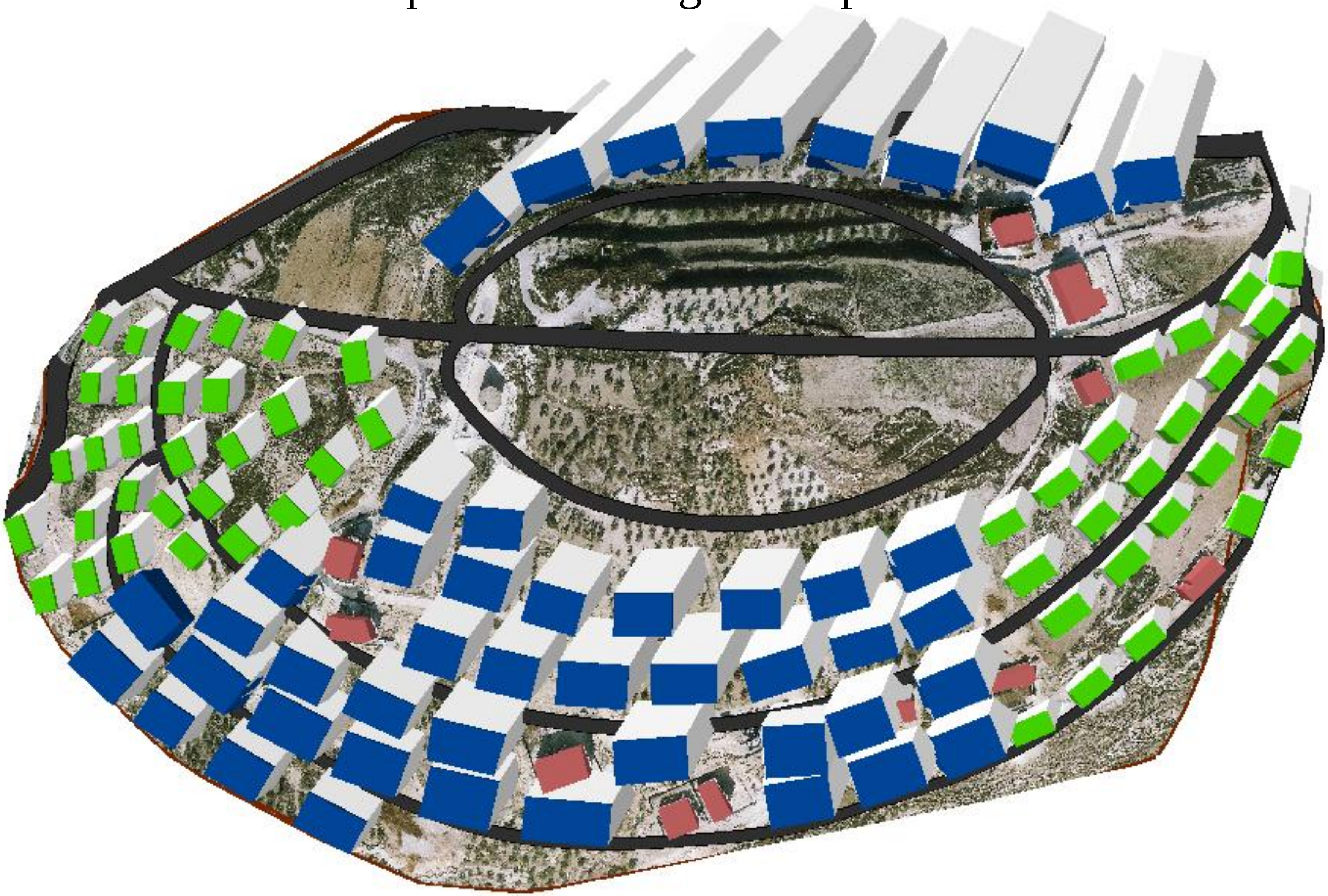
Case 3: At Winter :

Shadows from Proposed Buildings– at 12 p.m.



Case 3: At Winter :

Shadows from Proposed Buildings– at 3 p.m.



Case 3 : Problem

- After studding shadows from case 3 at winter , it shows that the edited buildings which's 2 floors have better less shadows than before .
- but there is a problem with buildings near the street as shown in pictures below , mostly at west , so it should be far from streets to minimize shadows at winter.

Shadows from case 3 ,western area ,buildings at street at 3 p.m. at winter

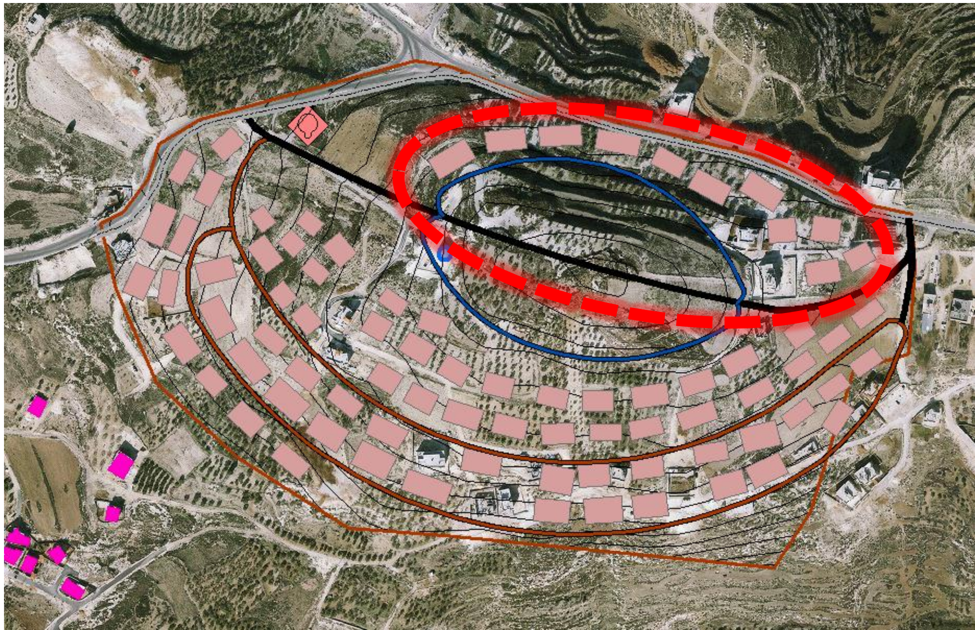
Buildings Orientation :

Analysis of the shadows:

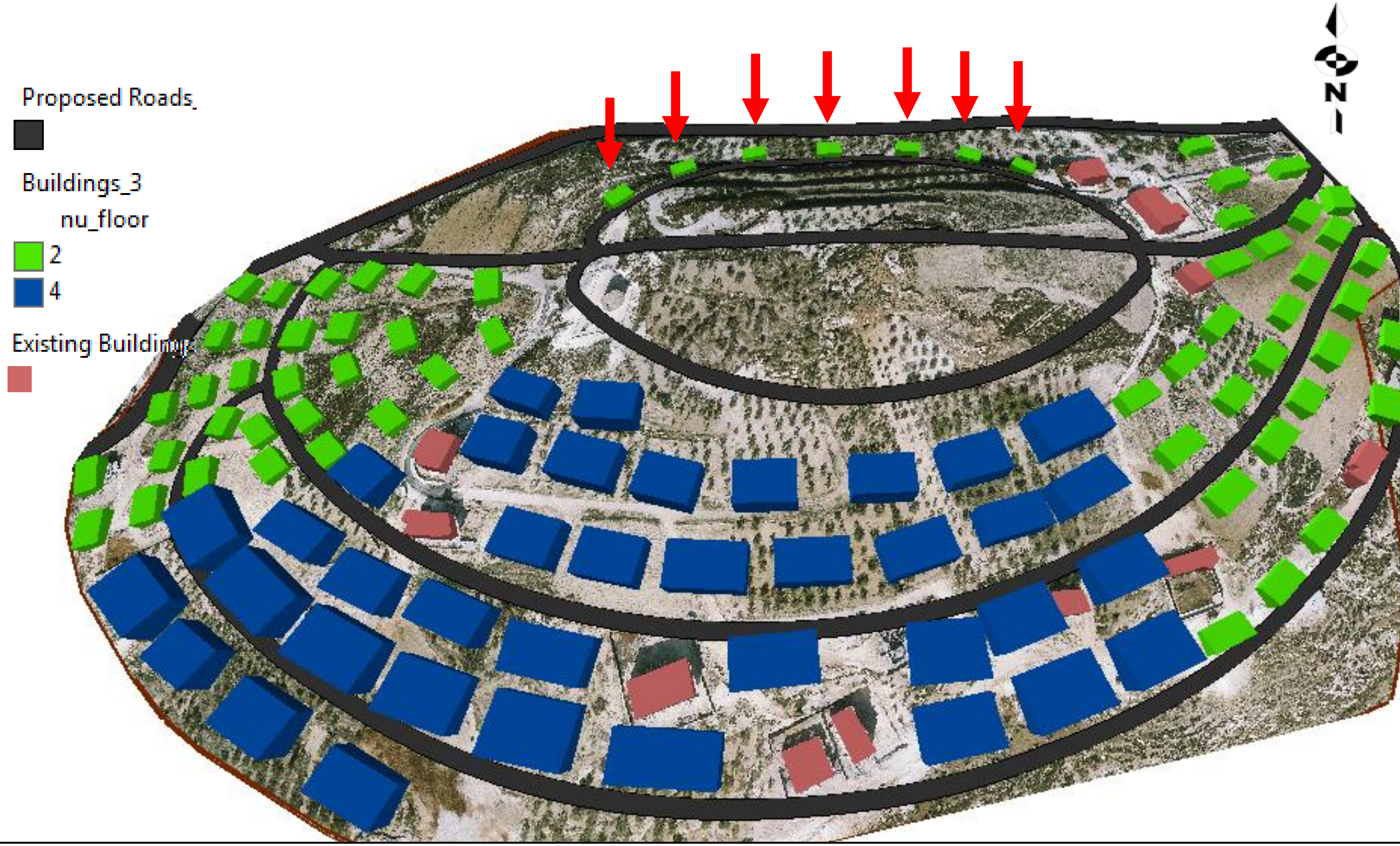
Case 4:

- At this case we will study the buildings at the north:
- These building will have tow side of shadows :
  1. From the hill on building ,this results from the topography of the area .
  2. The second was made by buildings on the surrounding .

- These buildings by default have 2 or 4 floors and have the highest shadow at the region .
- The shadows of these building affect the surroundings highly and mainly the main street at the region at north.
- Also the topography at the north decreasing so it affected by it .



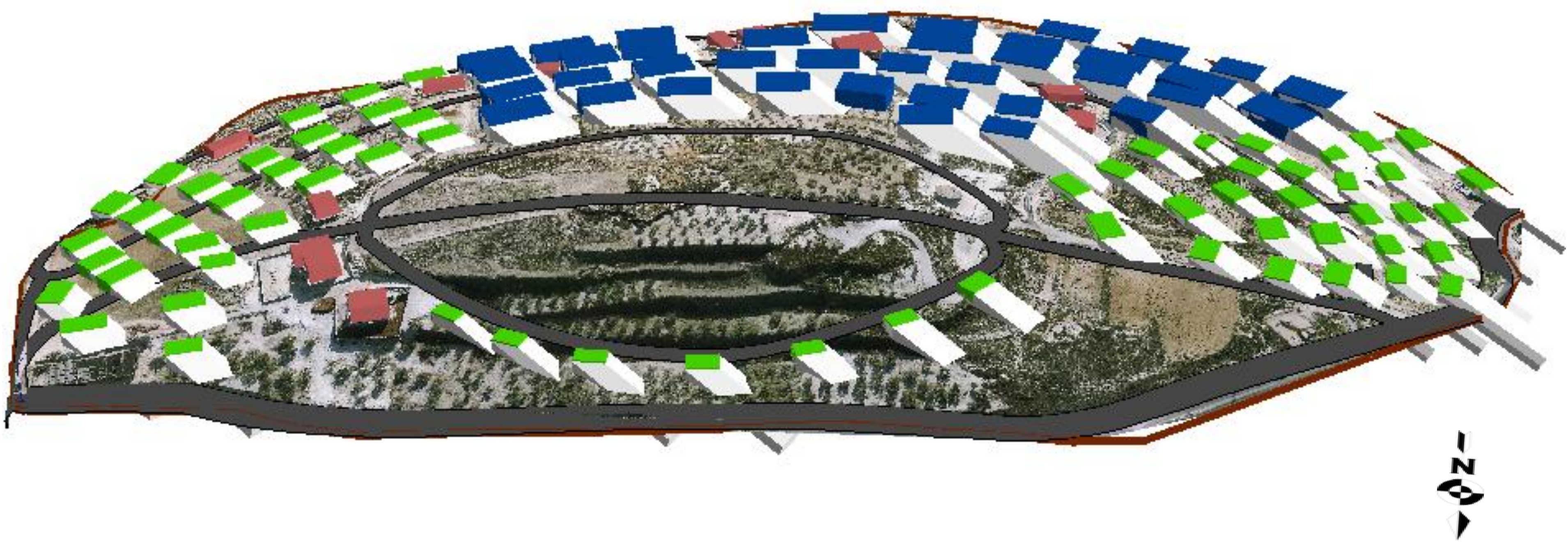
3D-Model for the new proposed building in case 4



The northern buildings have **2 floors,** more spaces, also the **area will arrange from 100-150 m2 .**

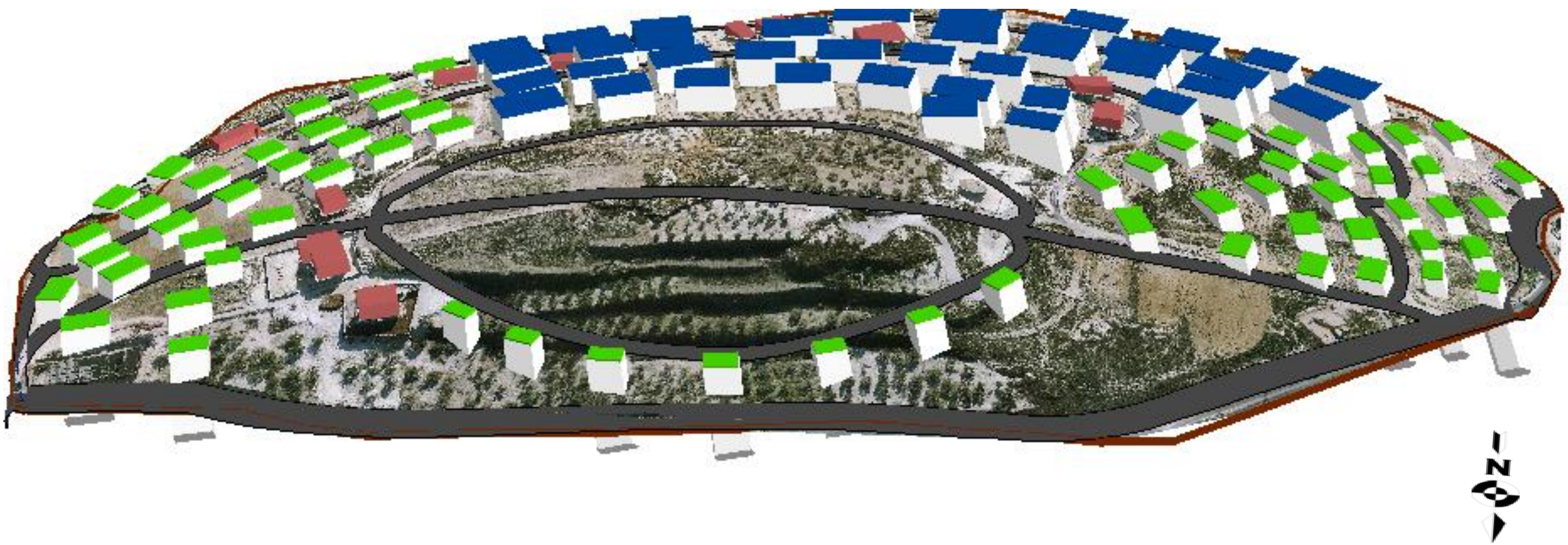
Case 4: At Winter :

Shadows from Proposed Buildings– at 9 a.m.



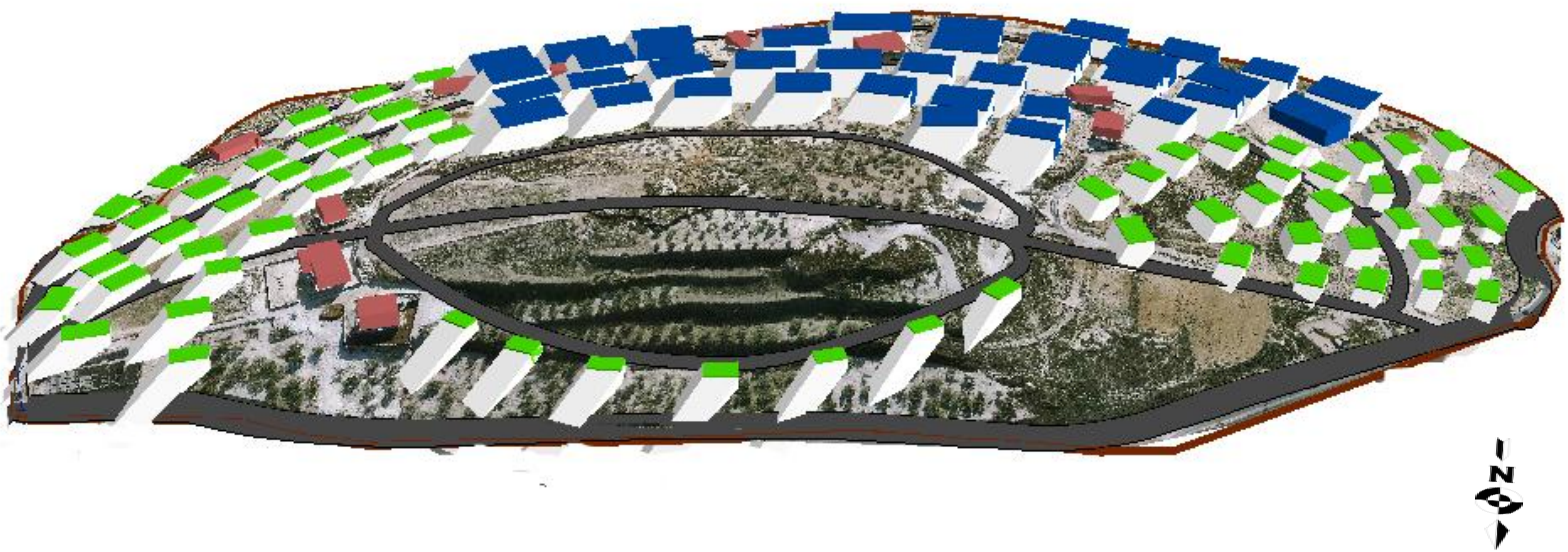
Case 4: At Winter :

Shadows from Proposed Buildings– at 12 p.m.



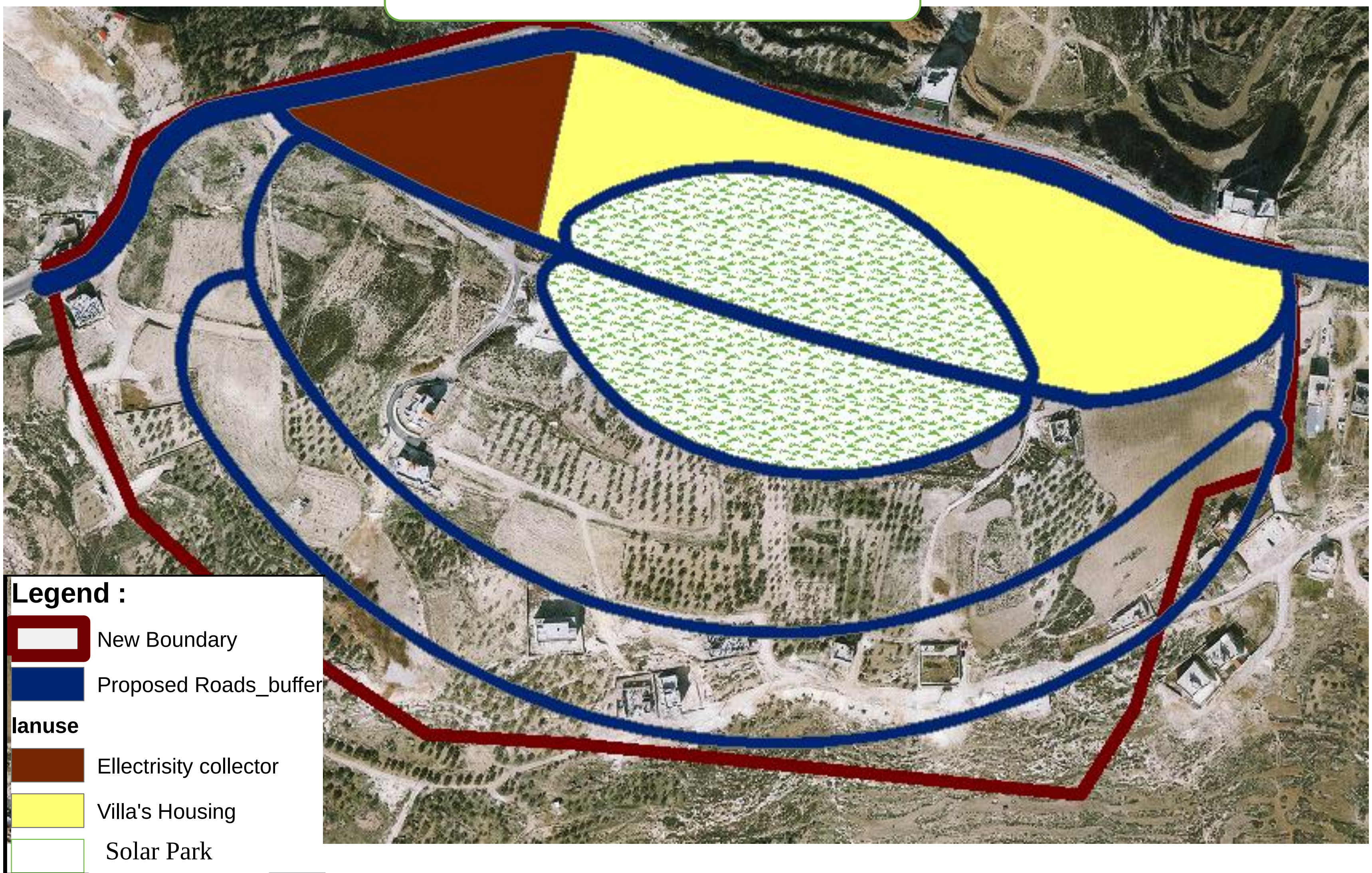
Case 4: At Winter :

Shadows from Proposed Buildings– at 3 p.m.



From that :

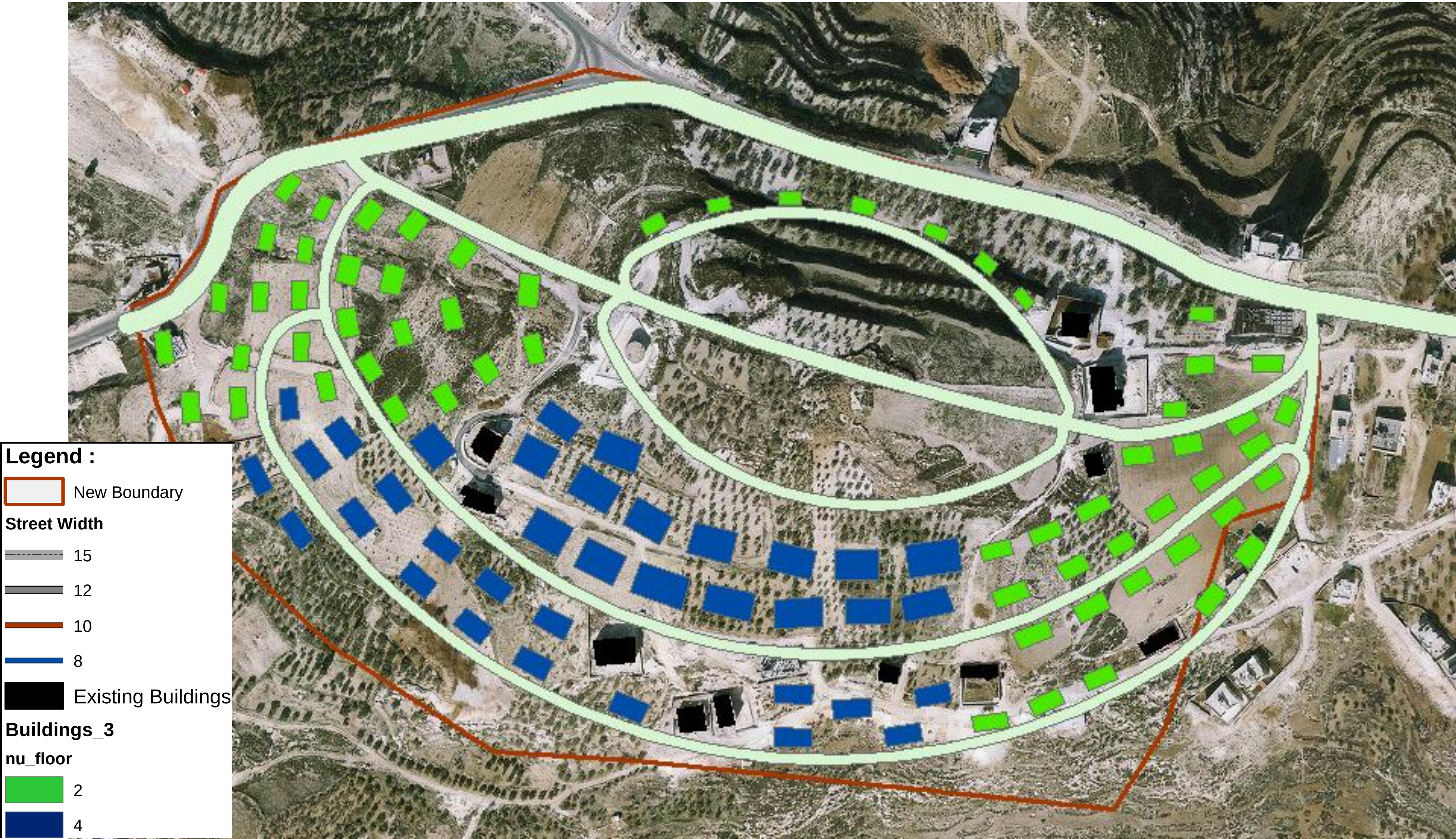
Initial Land use zones



Buildings Orientation :

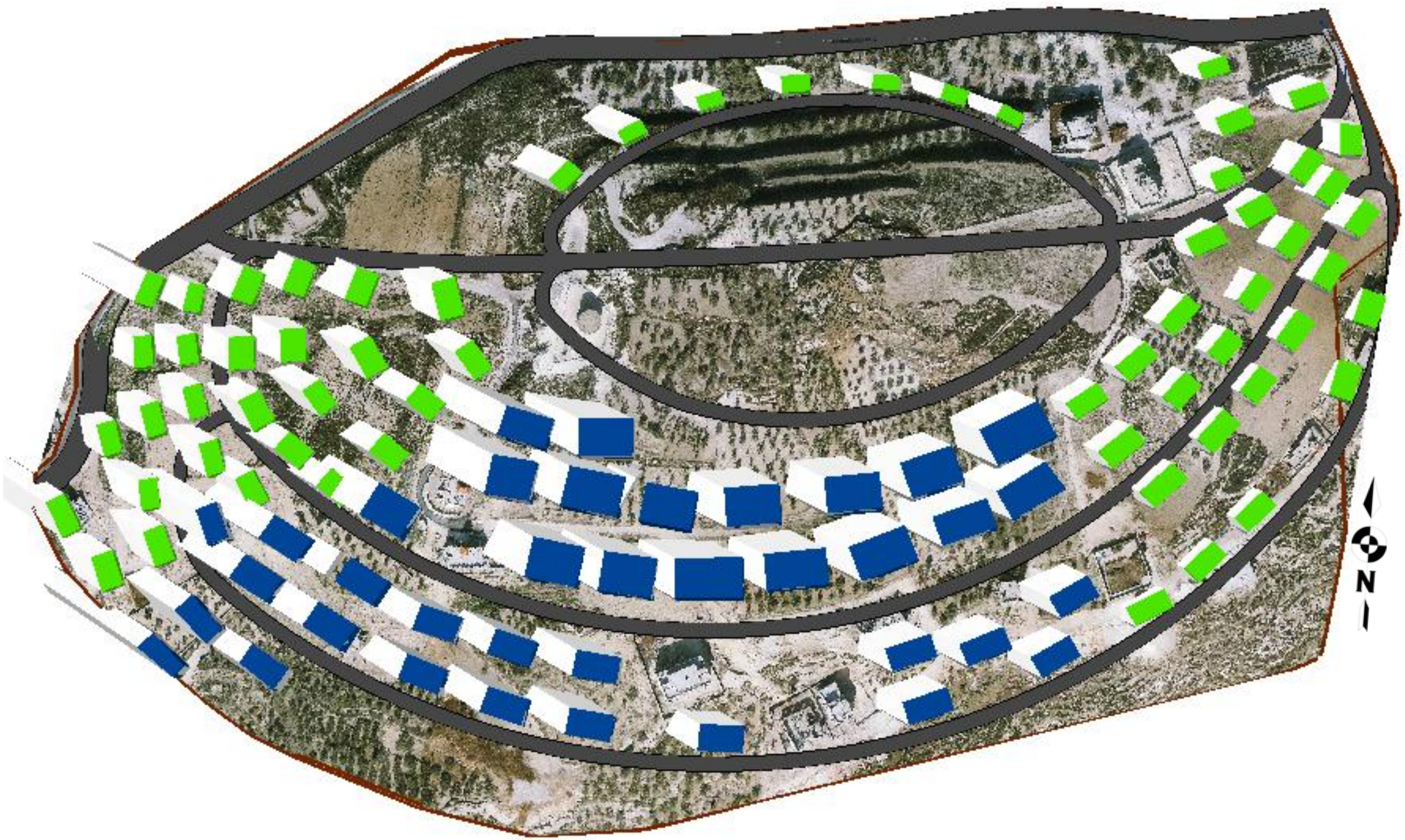
Analysis of the shadows:

Case 5 :southern buildings-more space , 4floors , less area



Case 5: At Winter :

Shadows from Proposed Buildings – at 9 a.m.

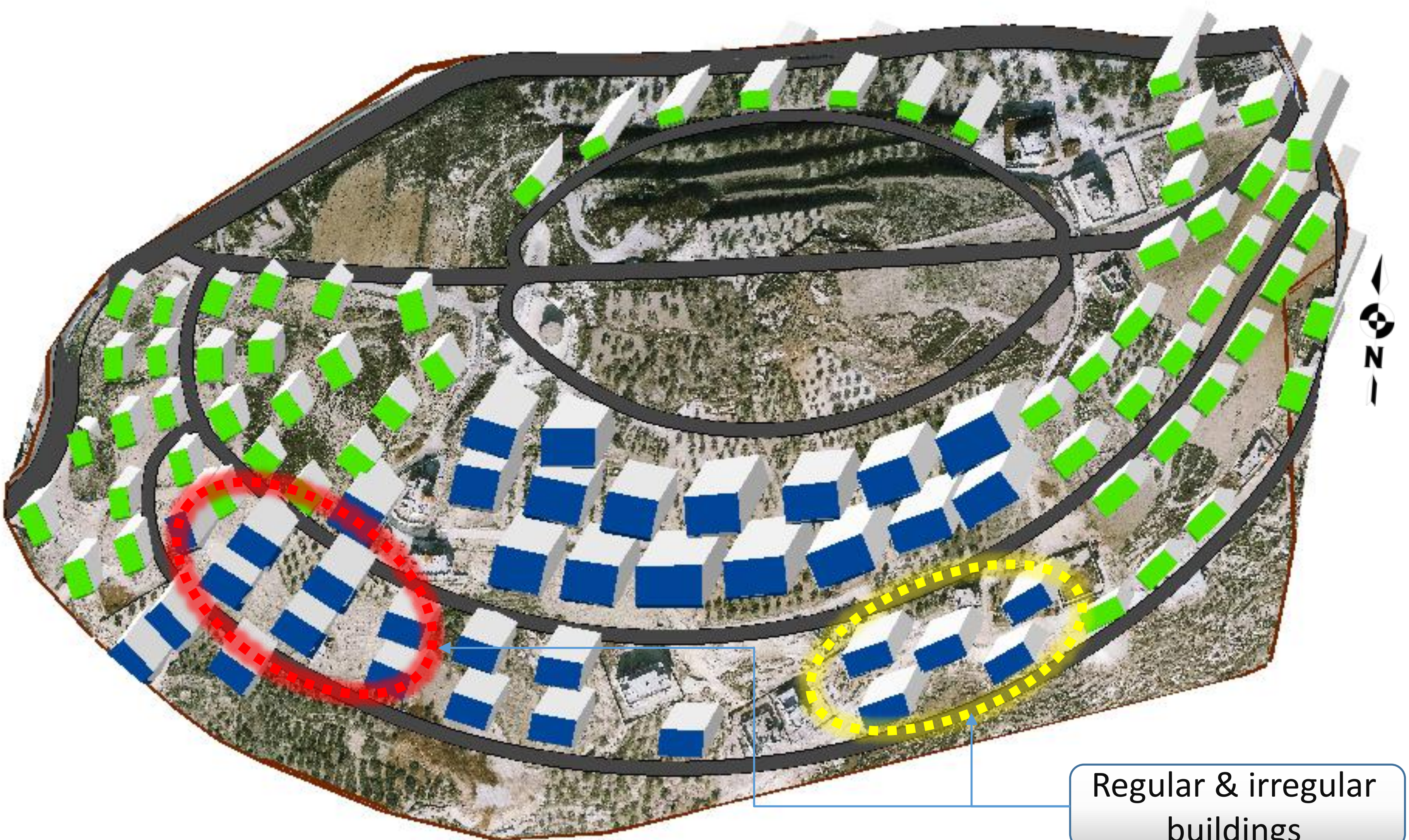


Case 5: At Winter :

Shadows from Proposed Buildings – at 12 p.m.

Case 5: At Winter :

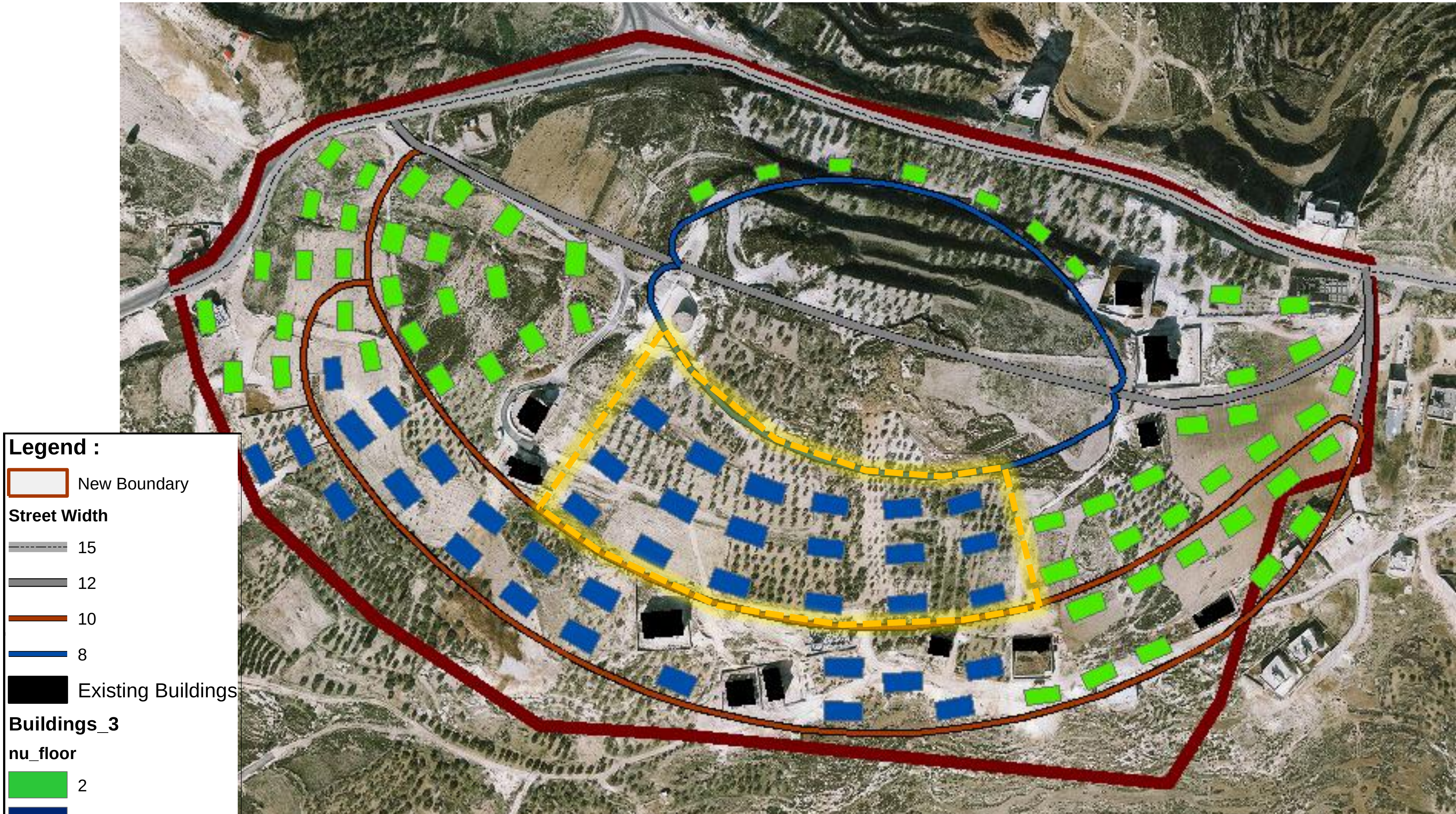
Shadows from Proposed Buildings – at 3 p.m.



Buildings Orientation :

Analysis of the shadows:

Case6 : low density buildings at center,4 floors



Case 6: At Winter :

Shadows from Proposed Buildings – at 9 a.m.

Case 6: At Winter :

Shadows from Proposed Buildings – at 12 p.m.

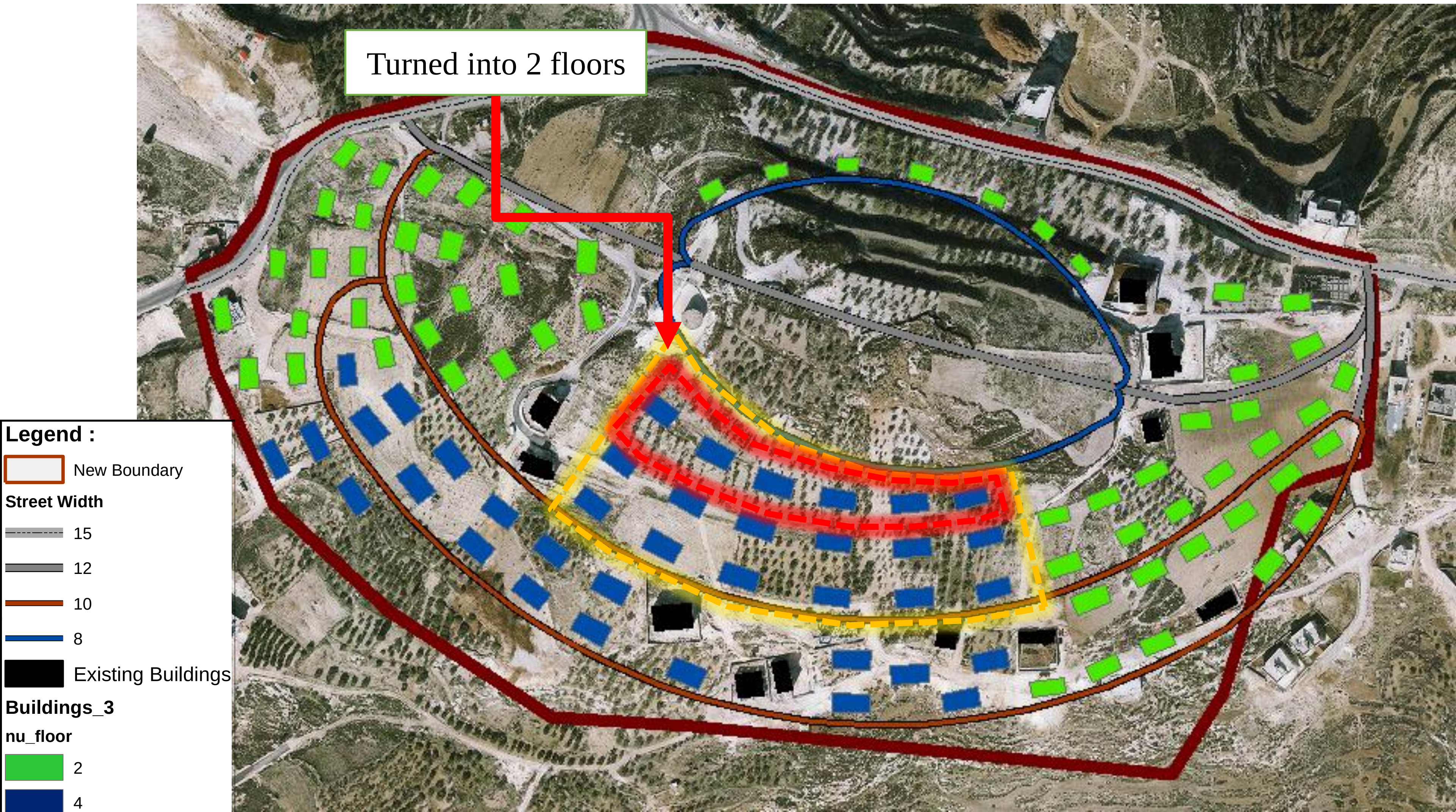
Case 6: At Winter :

Shadows from Proposed Buildings – at 3 p.m.

Buildings Orientation :

Analysis of the shadows:

Case7 : from 4 to 2 floors-regular pattern



Case 7: At Winter :

Shadows from Proposed Buildings – at 9 a.m.

Case 7: At Winter :

Shadows from Proposed Buildings – at 12 p.m.

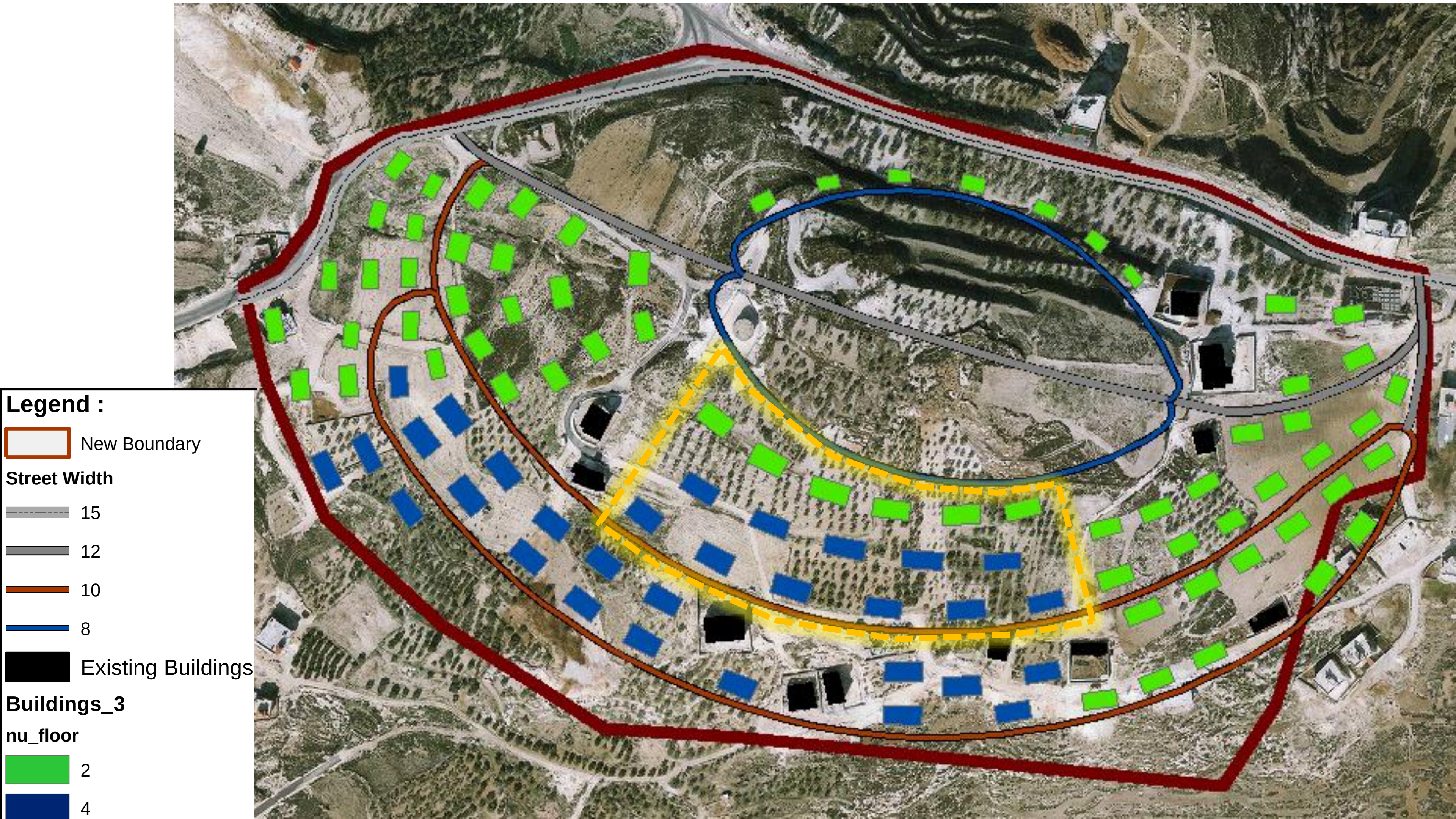
Case 7: At Winter :

Shadows from Proposed Buildings– at 3 p.m.

Buildings Orientation :

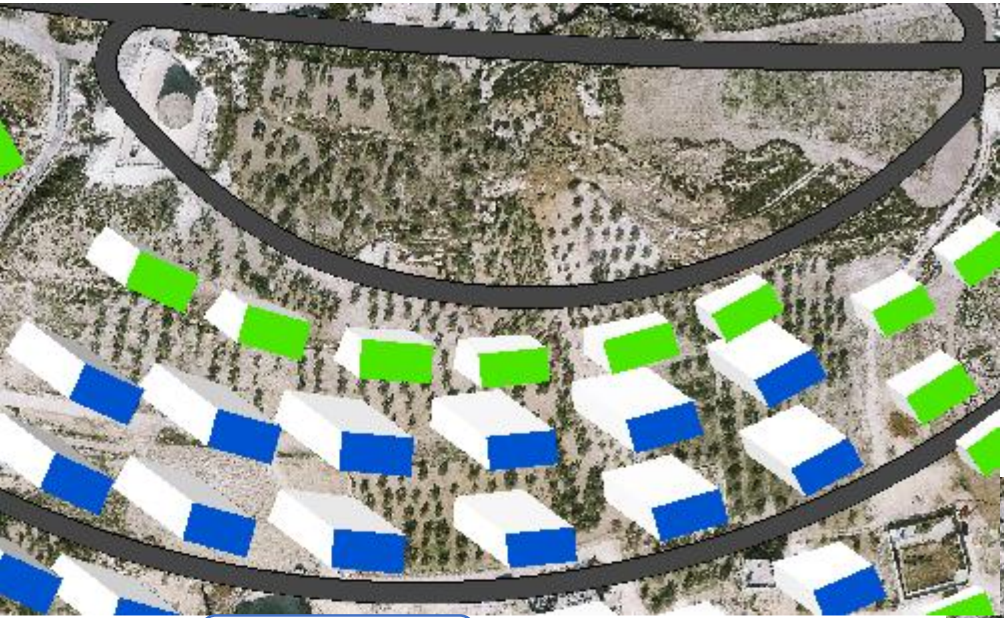
Analysis of the shadows:

Case8: Irregular building pattern



Case 8: At Winter :

Shadows from Proposed Buildings – at 9 a.m.



Before

After

Case 8: At Winter :

Shadows from Proposed Buildings – at 12 p.m.

Before

After

Case 8: At Winter :

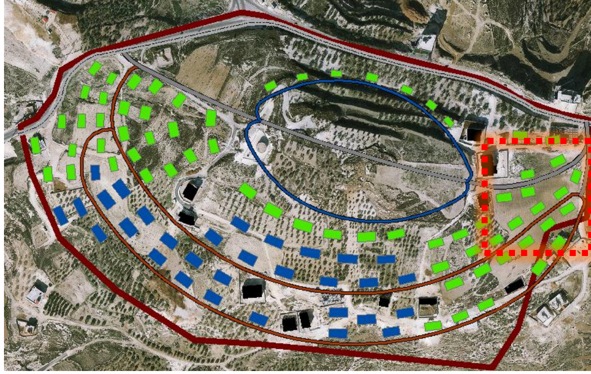
Shadows from Proposed Buildings – at 3 p.m.

Before

After

Buildings Orientation :

Analysis of the shadows:



Case9: street shadow problems -East

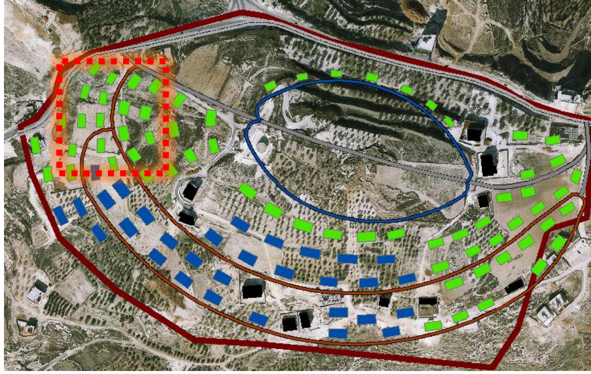
Shadows at winter from proposed buildings on street at

9 a.m.

3 p.m.

Buildings Orientation :

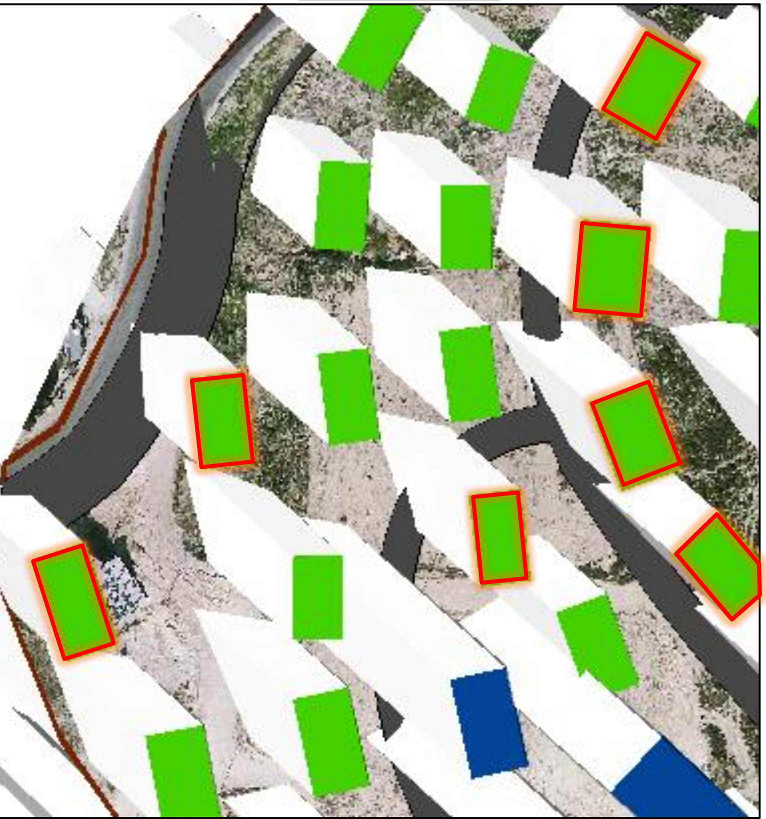
Analysis of the shadows:



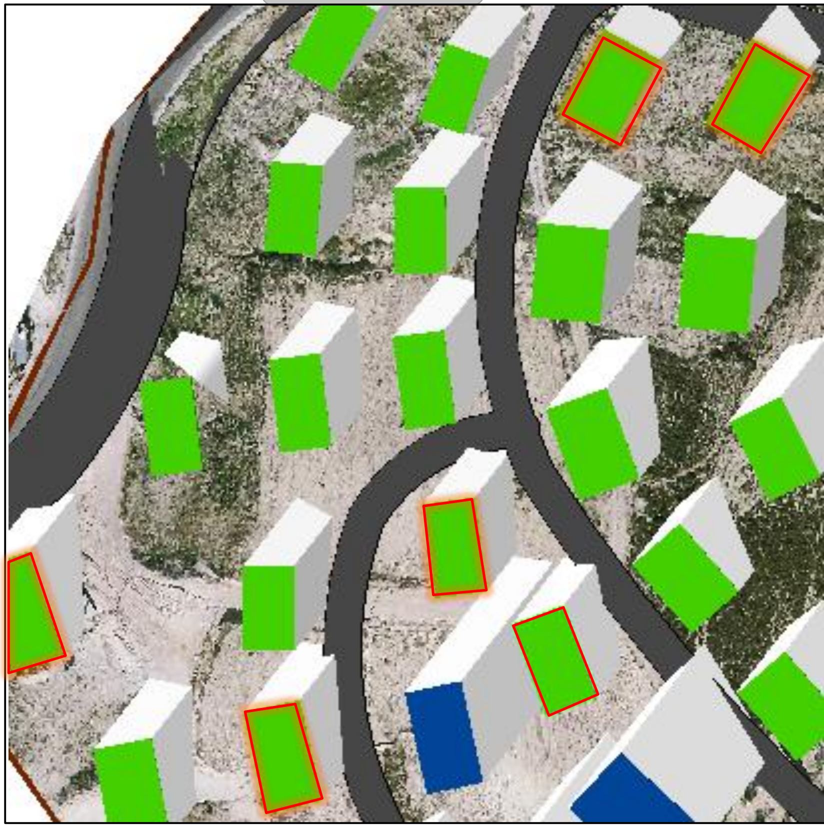
Case9: street shadow problems -West

Shadows at winter from proposed buildings on street at

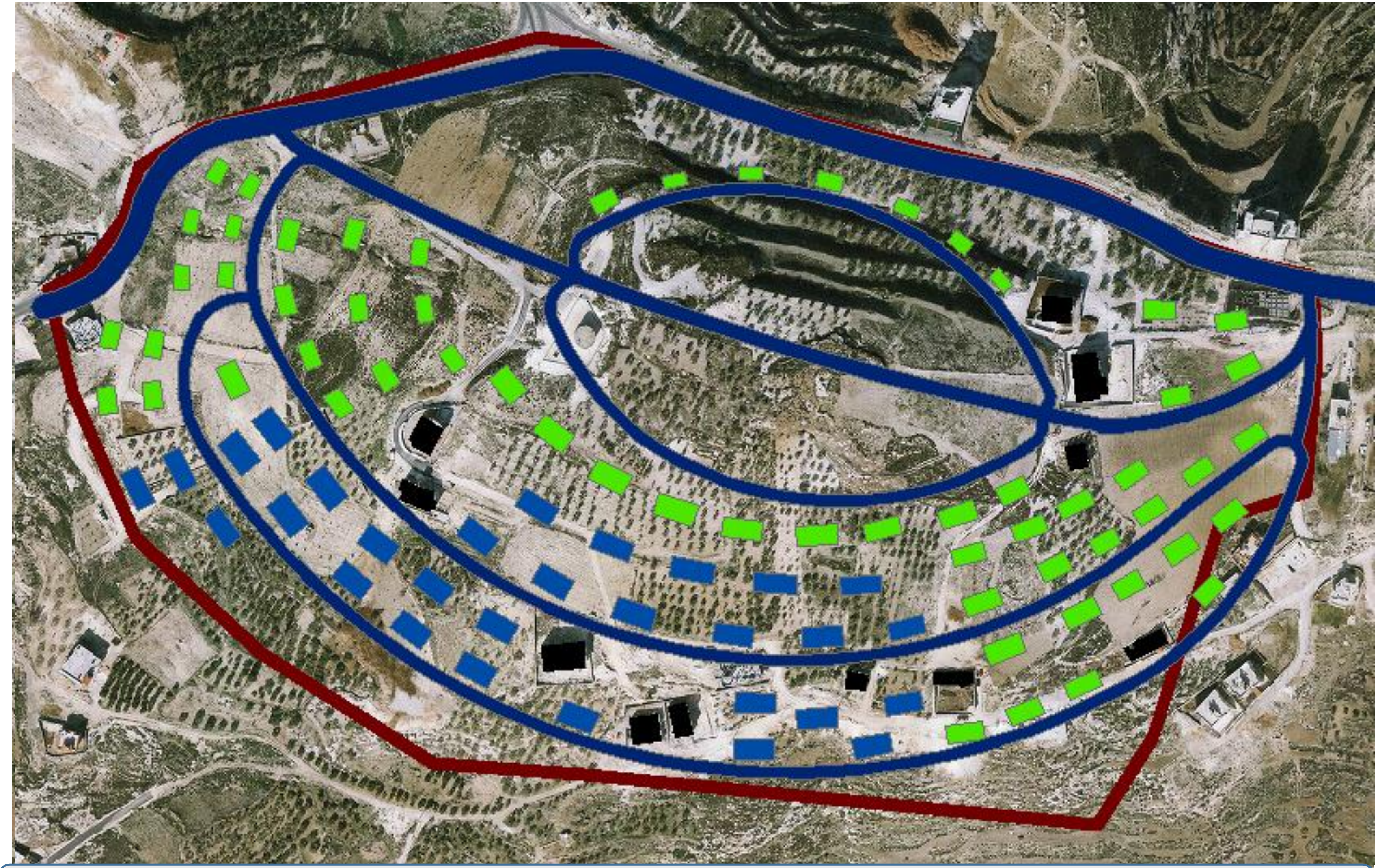
9 a.m.



3 p.m.



New change in buildings at east and west



Solution :

increase the set back from streets , but increase the frontage setback more than the backyard .

New buildings at east and west – 3D

Solution :

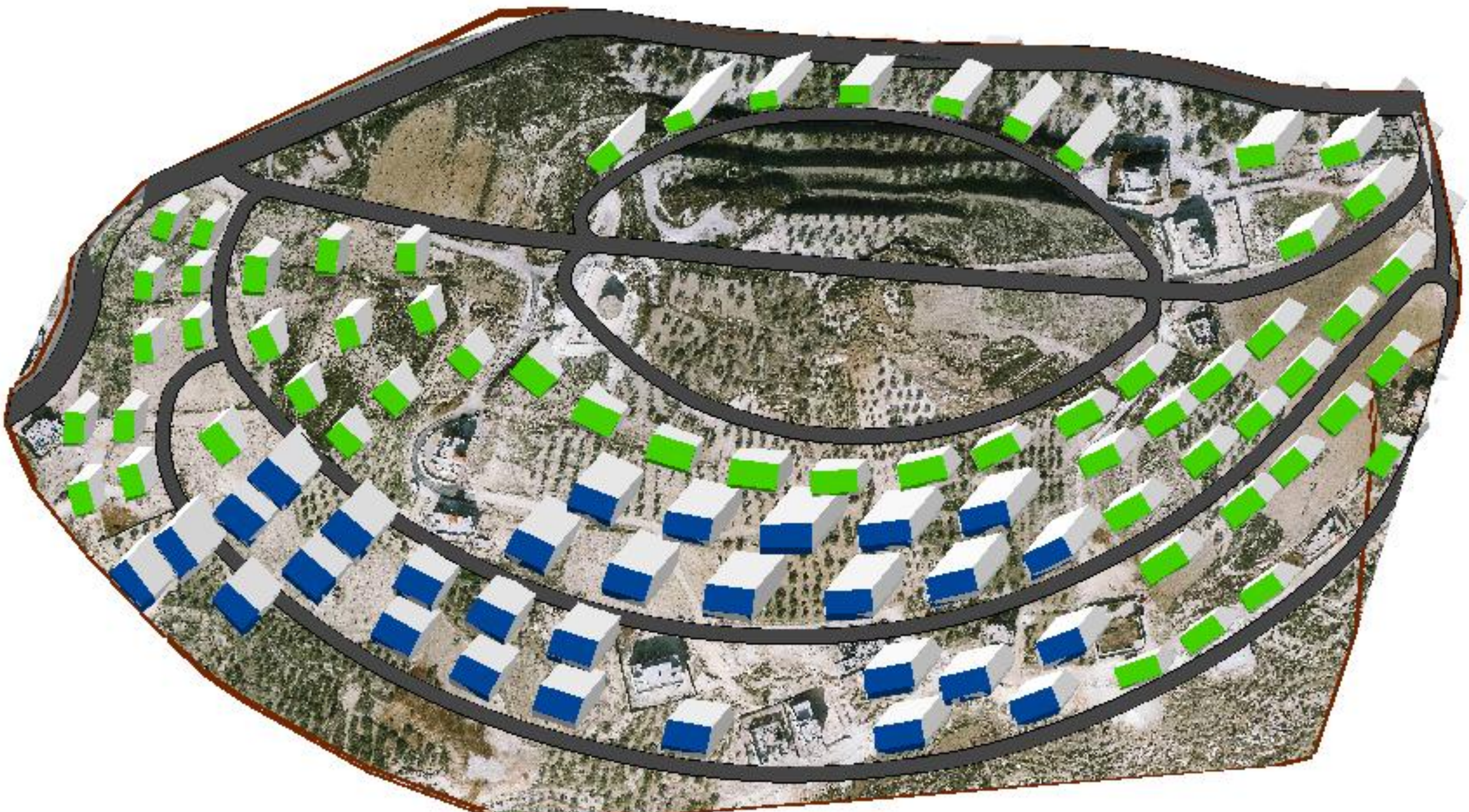
increase the set back from streets , but increase the frontage setback more than the backyard .

Case 9: At Winter :

Shadows from Proposed Buildings – at 9 a.m.

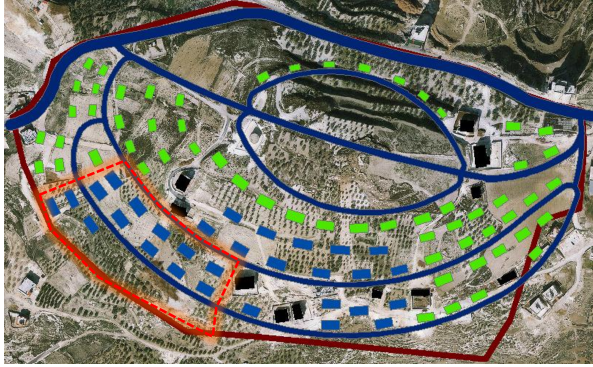
Case 9: At Winter :

Shadows from Proposed Buildings– at 3 p.m.



Buildings Orientation :

Analysis of the shadows:



Case10: street shadow problems

Shadows at winter from proposed buildings on street at

N

9 a.m.	3 p.m.
	

New buildings at middle and south – 3D

Solution :
increase the set back from streets , but increase the frontage setback more than the backyard .

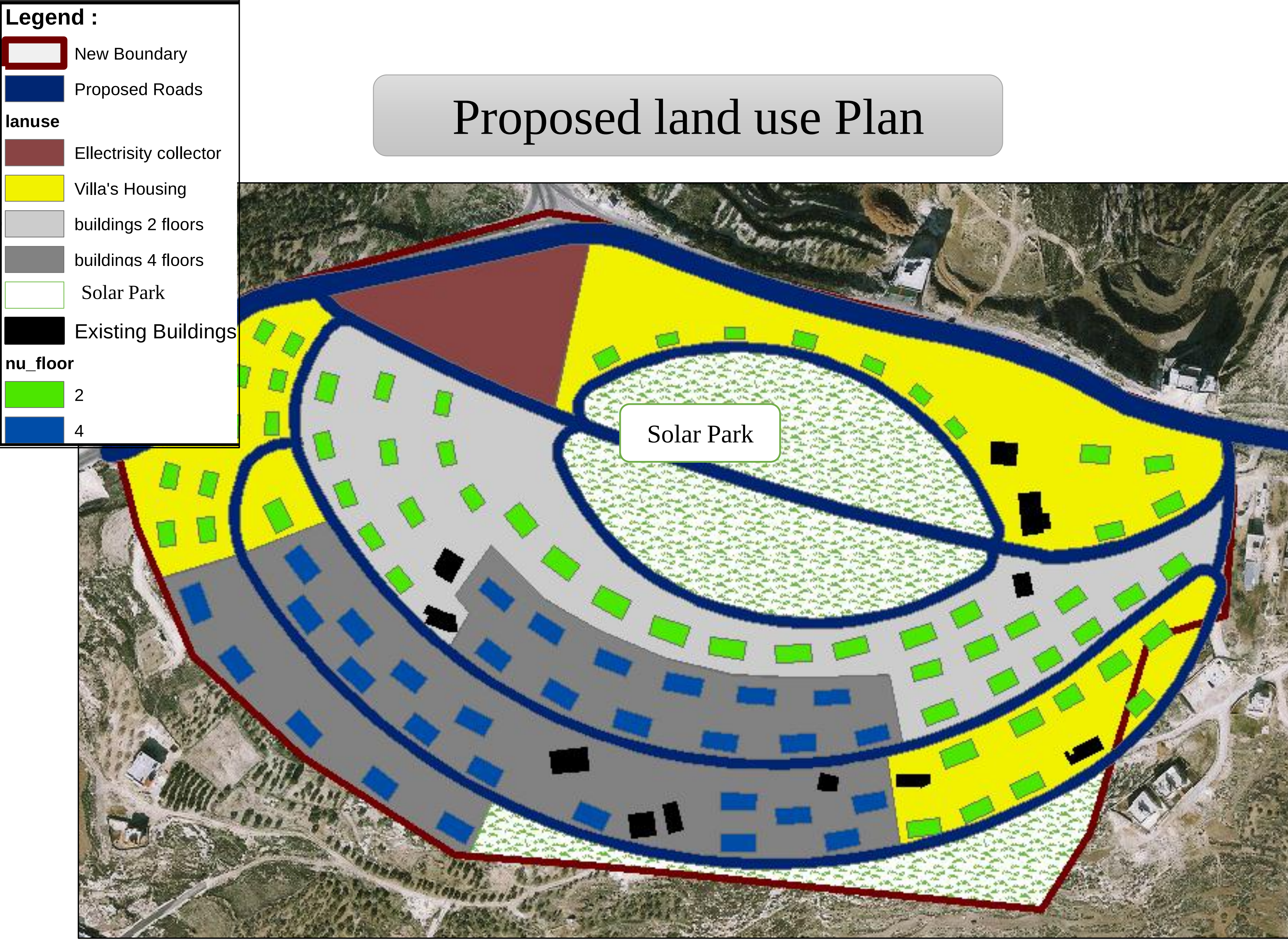
Case 10: At Winter :

Shadows from Proposed Buildings – at 9 a.m.

Case 10: At Winter :

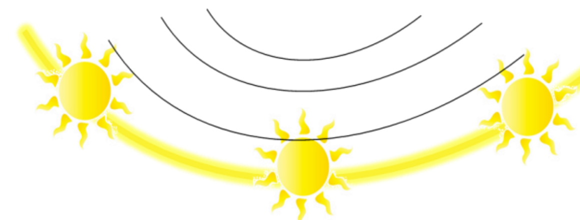
Shadows from Proposed Buildings – at 3 p.m.

Proposed land use Plan



Regulation for Building Solar Urban Environment

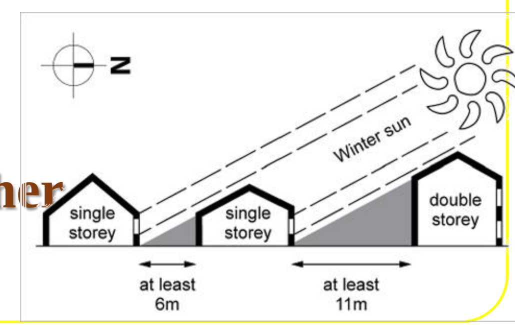
- Area' with **high radiation** percent mustn't be used as residential area's , but green area's or solar collectors .
- The best **street orientation** with the line of sun access, to maximize it at winter .



- **Built Up area formation :**

- **Distance** between building & buildings **height** and their area's can be assumed by winter sun
- Depending on the idea of maximizing the sun access at winter and minimizing it at summer
- How ?
- **By shadow analysis !!**

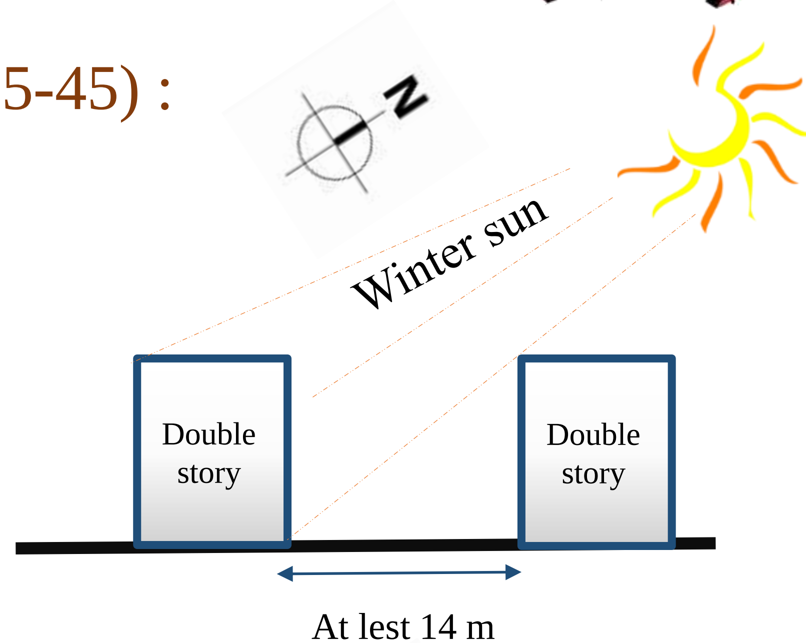
shadows from any building mustn't cover the other

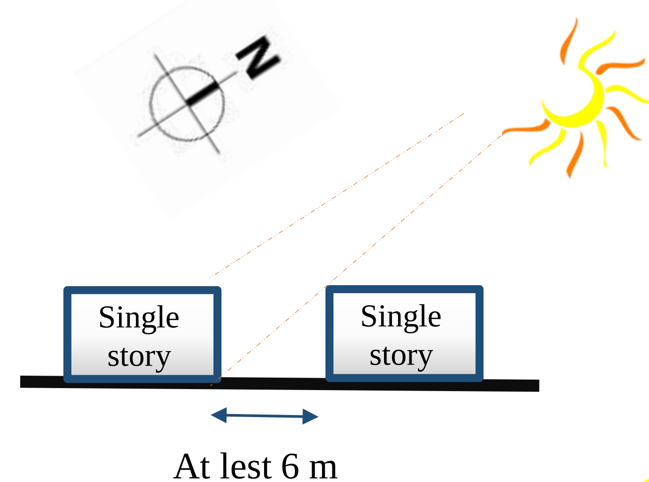


Regulation for Building Solar Urban Environment

I. East-west Buildings with angle of(25-45) :

- Area should be less than 250 m2
- Spaces between building minimum 14 m
- Building heights reach 2 floors .





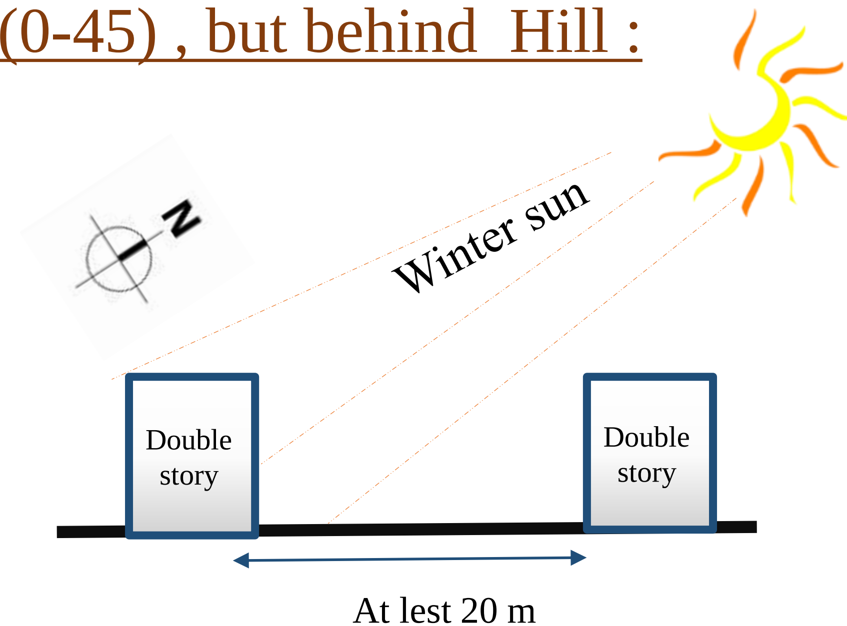
Regulation for Building Solar Urban Environment

I. East-west Buildings with angle of(25-45) :

- Area should be less than 250 m2
- Spaces between building minimum 14 m
- Building heights reach 2 floors .

II. East-west Buildings with angle of(0-45) , but behind Hill :

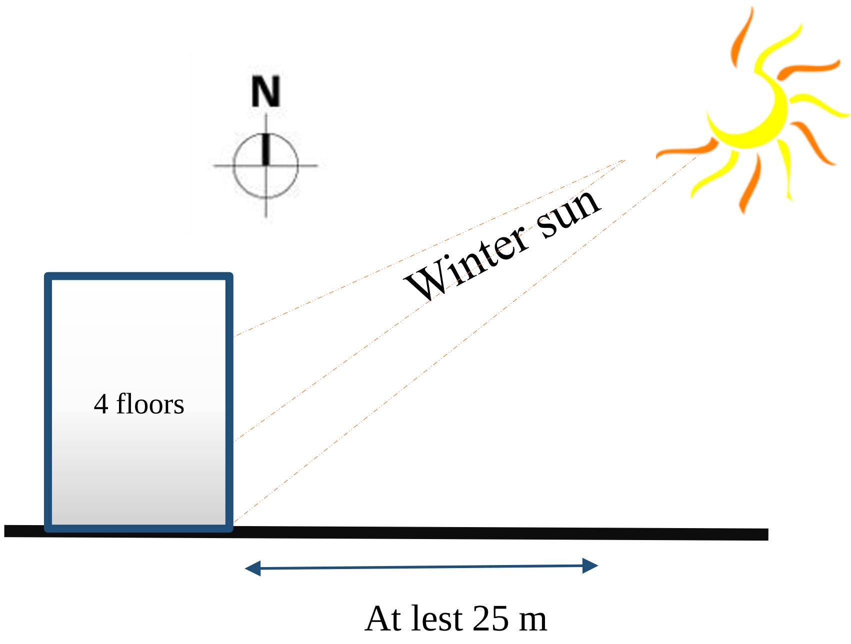
- Area should be less than 150 m2
- Spaces between building minimum 20 m
- Building heights reach 2 floors .
- Sorted as Villa's housing .



Regulation for Building Solar Urban Environment

III. East-west Buildings :

- Area should be less than 350 m2
- Spaces between building minimum 25 m
- Building heights reach 4 floors .
- Sorted as Residential Buildings .

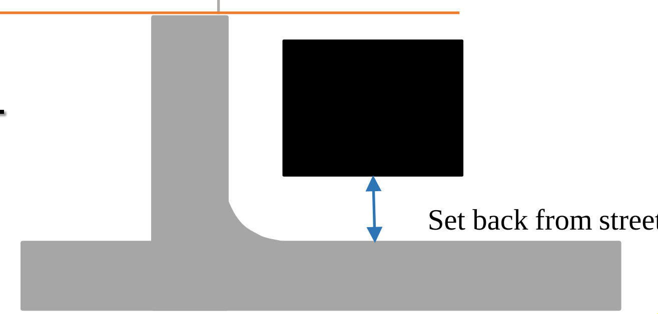


Regulation for Building Solar Urban Environment

Setbacks from streets:

Set back		Frontage set back		Beyond set back	
Number of floors		2 floors	4 floors	2 floors	4 floors
with angle of(25-45)	At east	7m	15 m	---	---
	At west	----	----	10 m	20 m
angle less than 25 degrees		3-5 m	12 m	---	---

according to building regulations at the selected area = ---



Solar Neighborhood Panning Elements

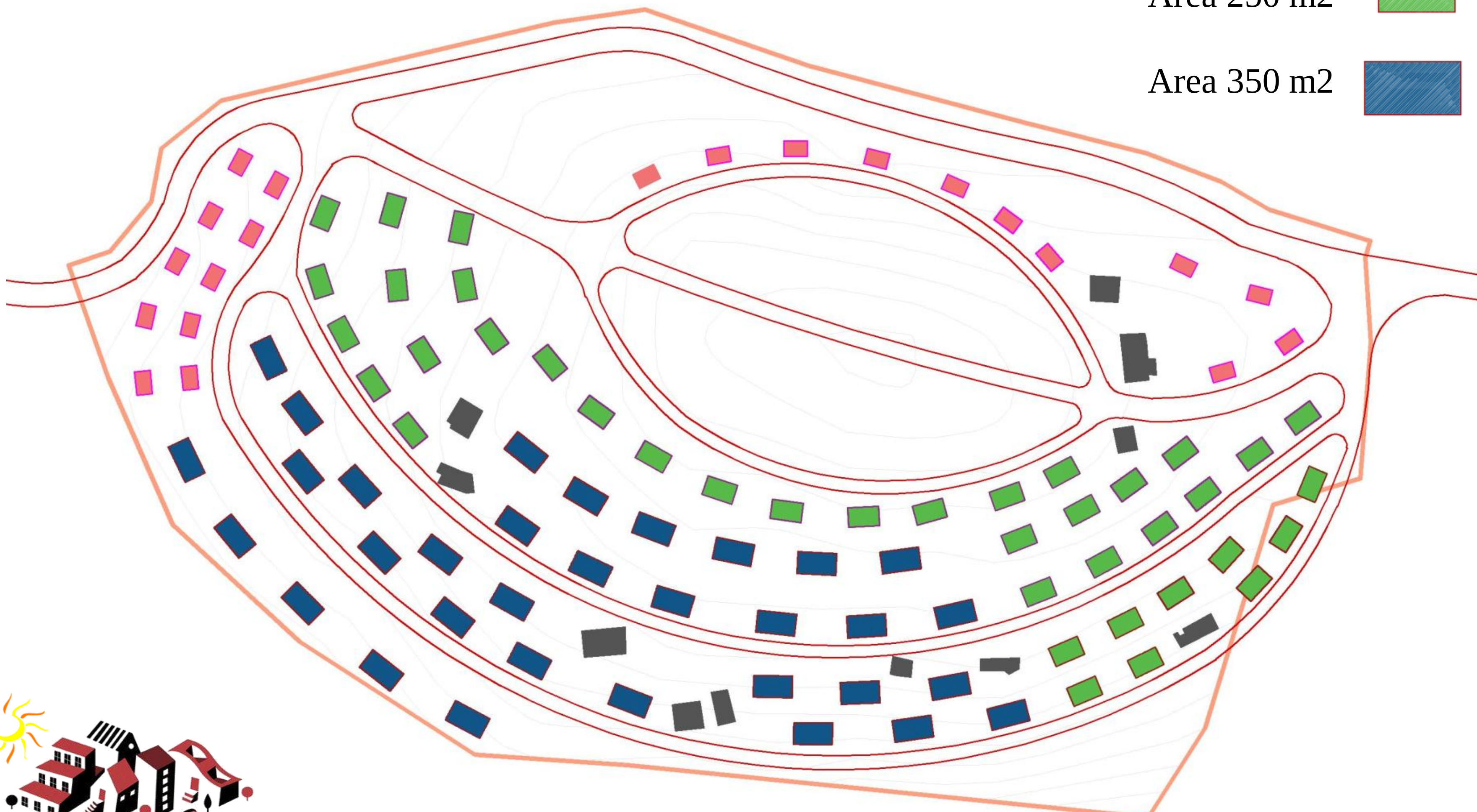
1. Buildings

Proposed Buildings by area :

Area 150 m2

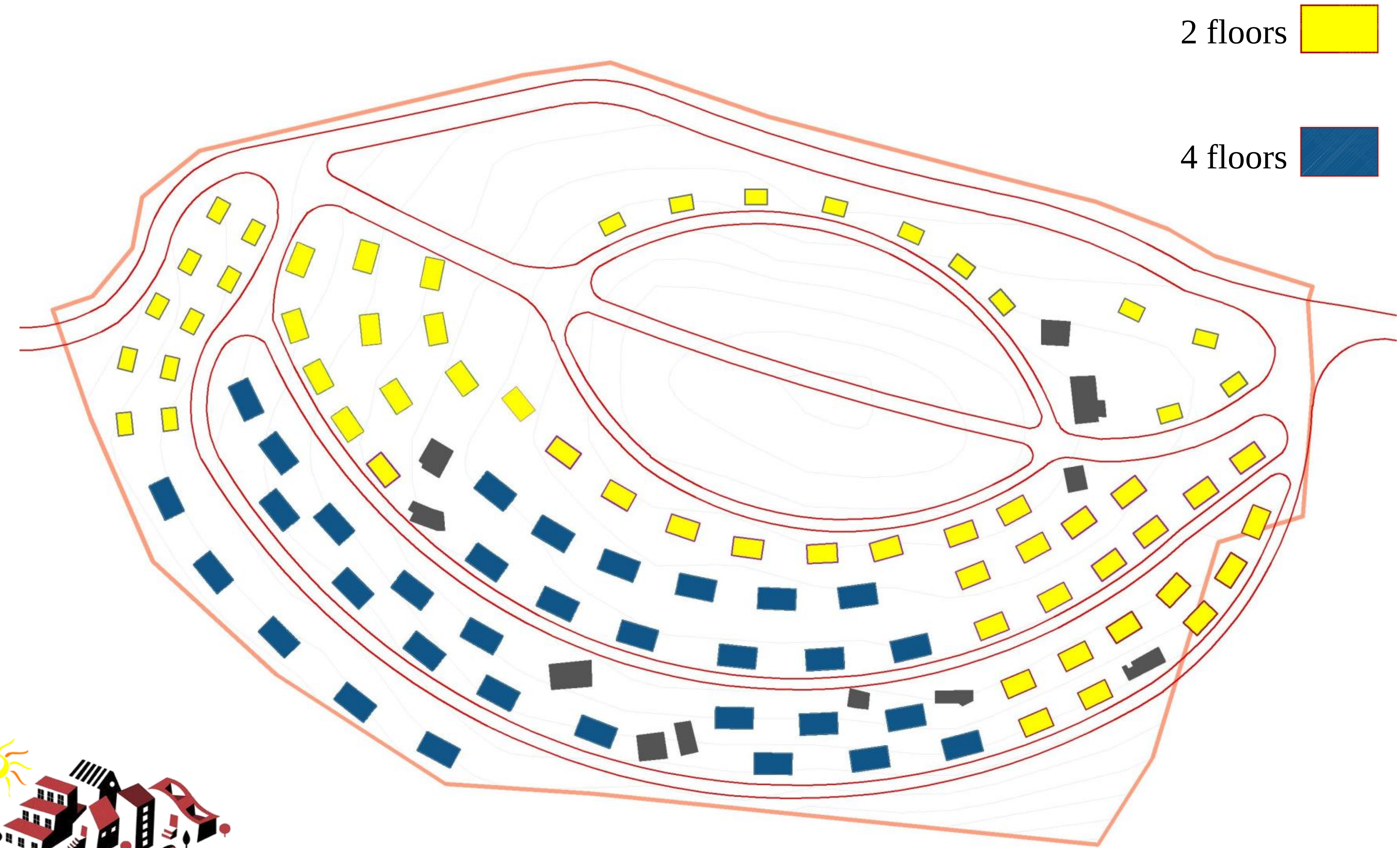
Area 250 m2

Area 350 m2

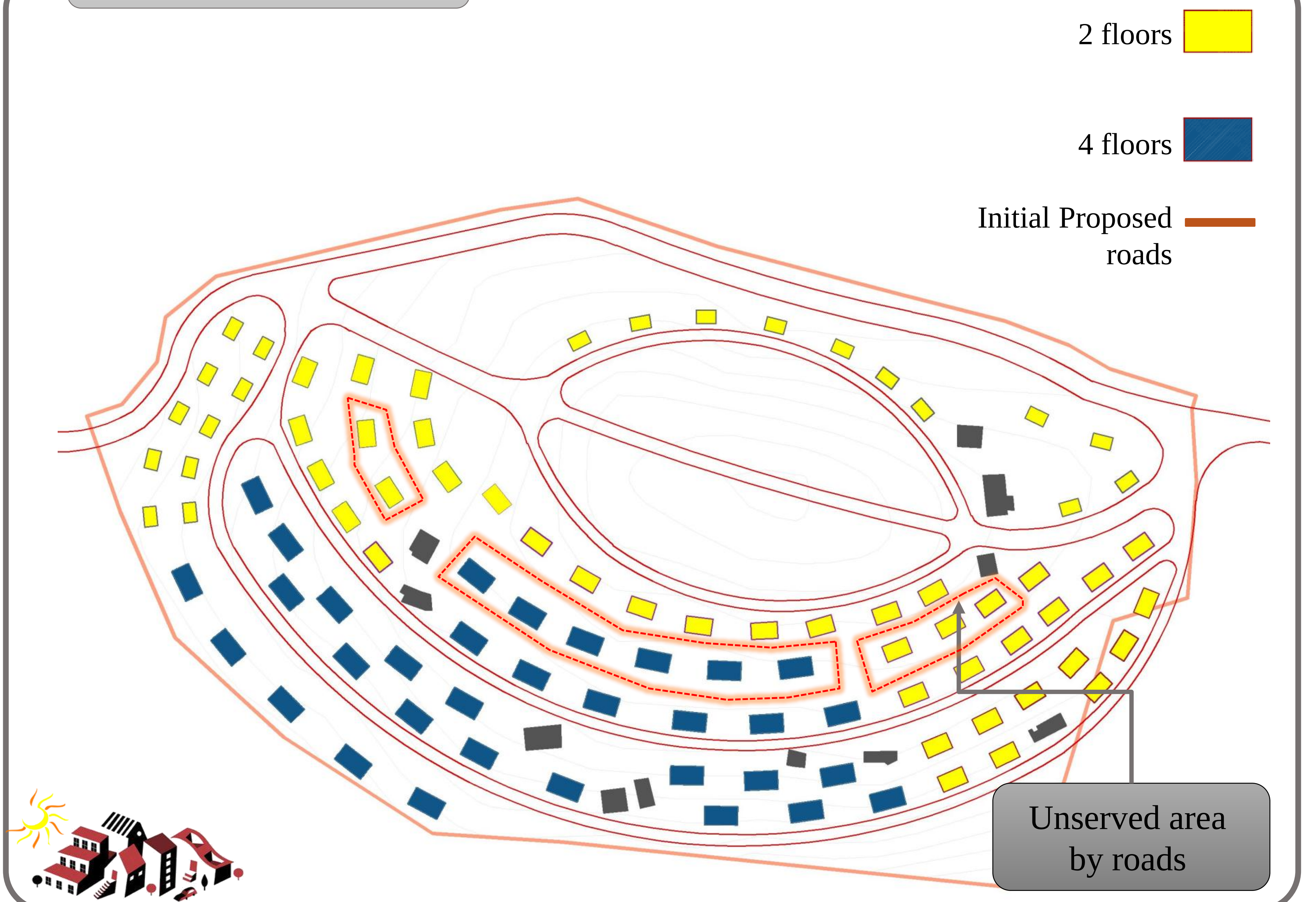


1. Buildings

Proposed Buildings by number of floors

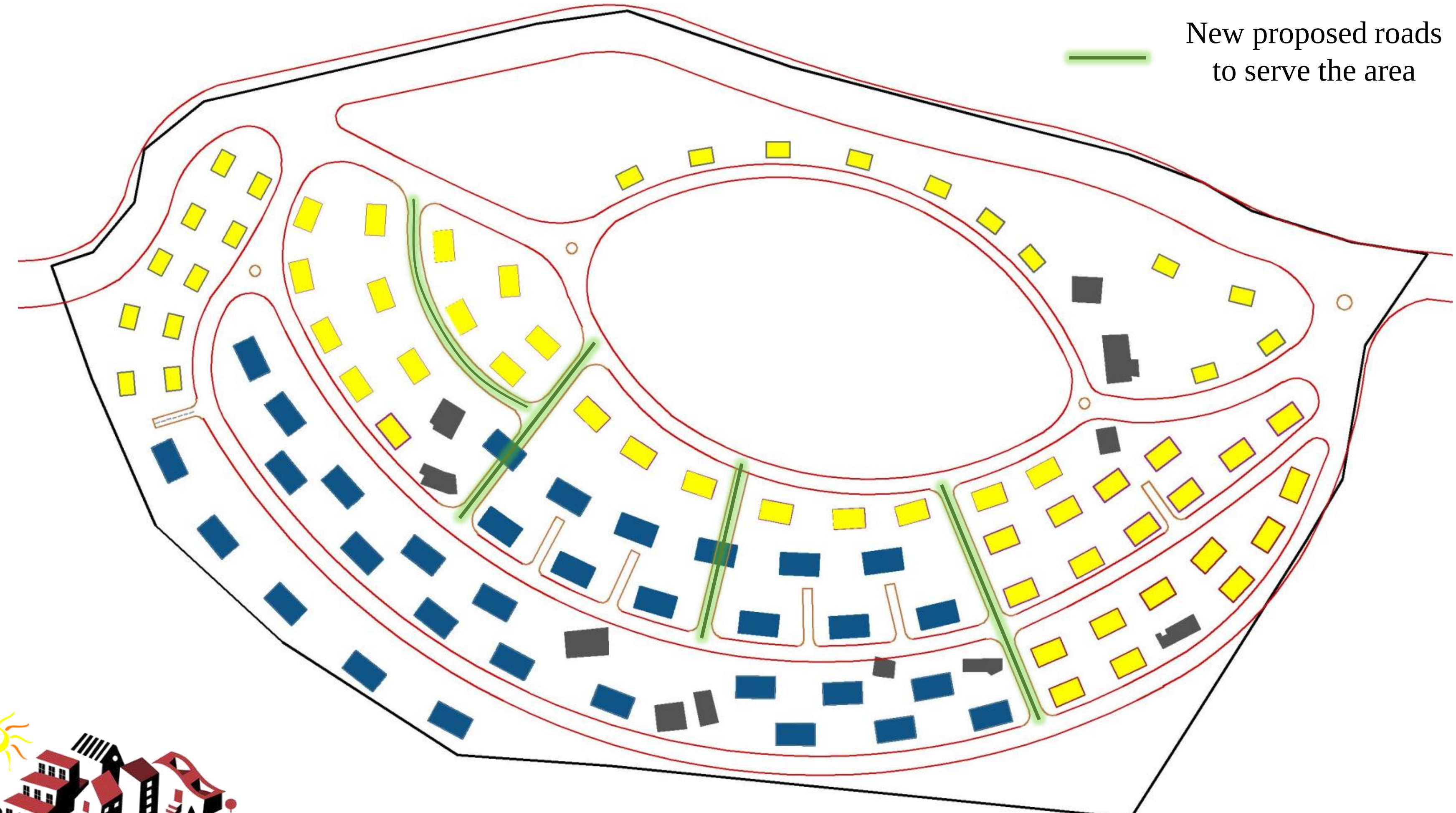


2. Road Network :



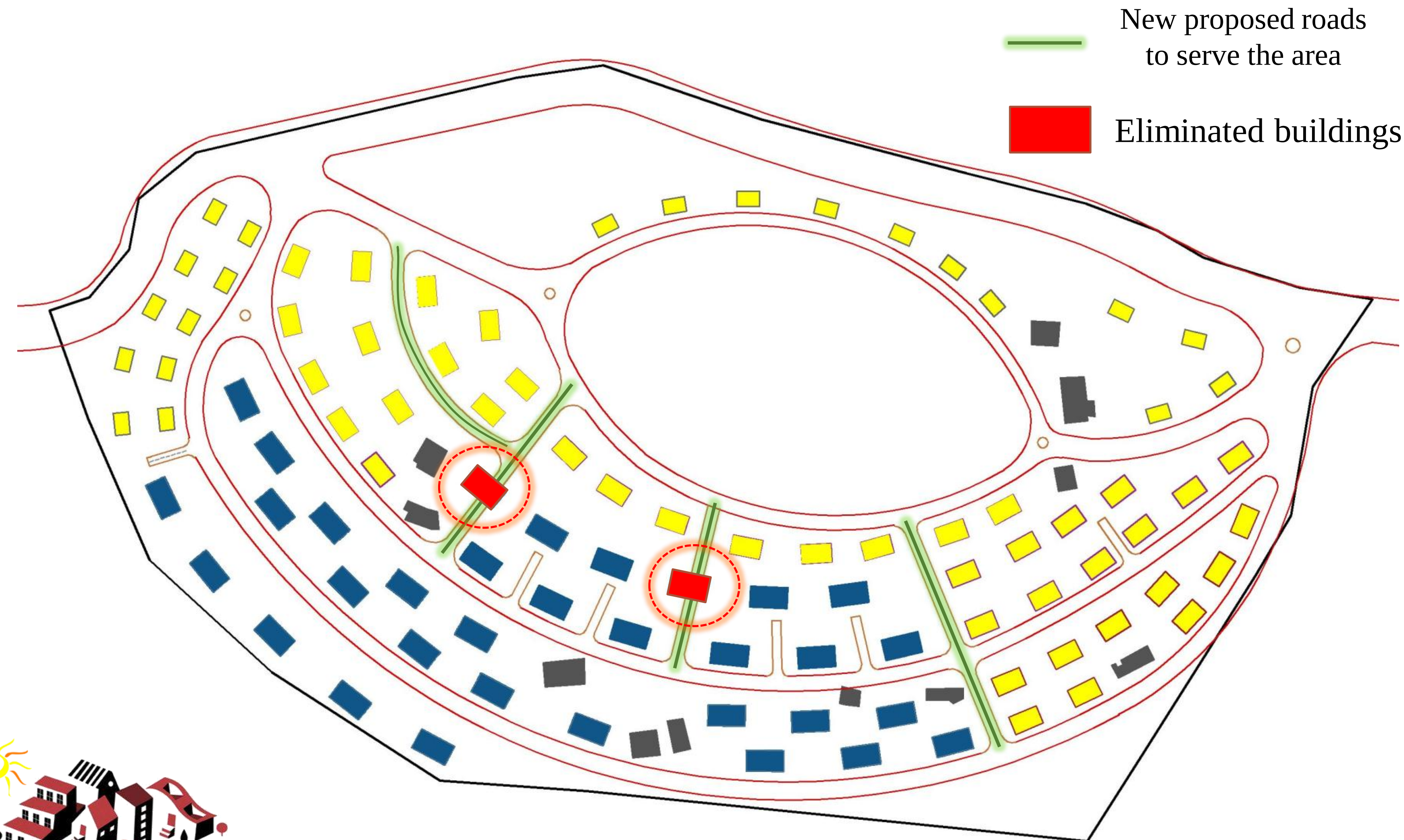
2. Road Network :

SO,
Solution



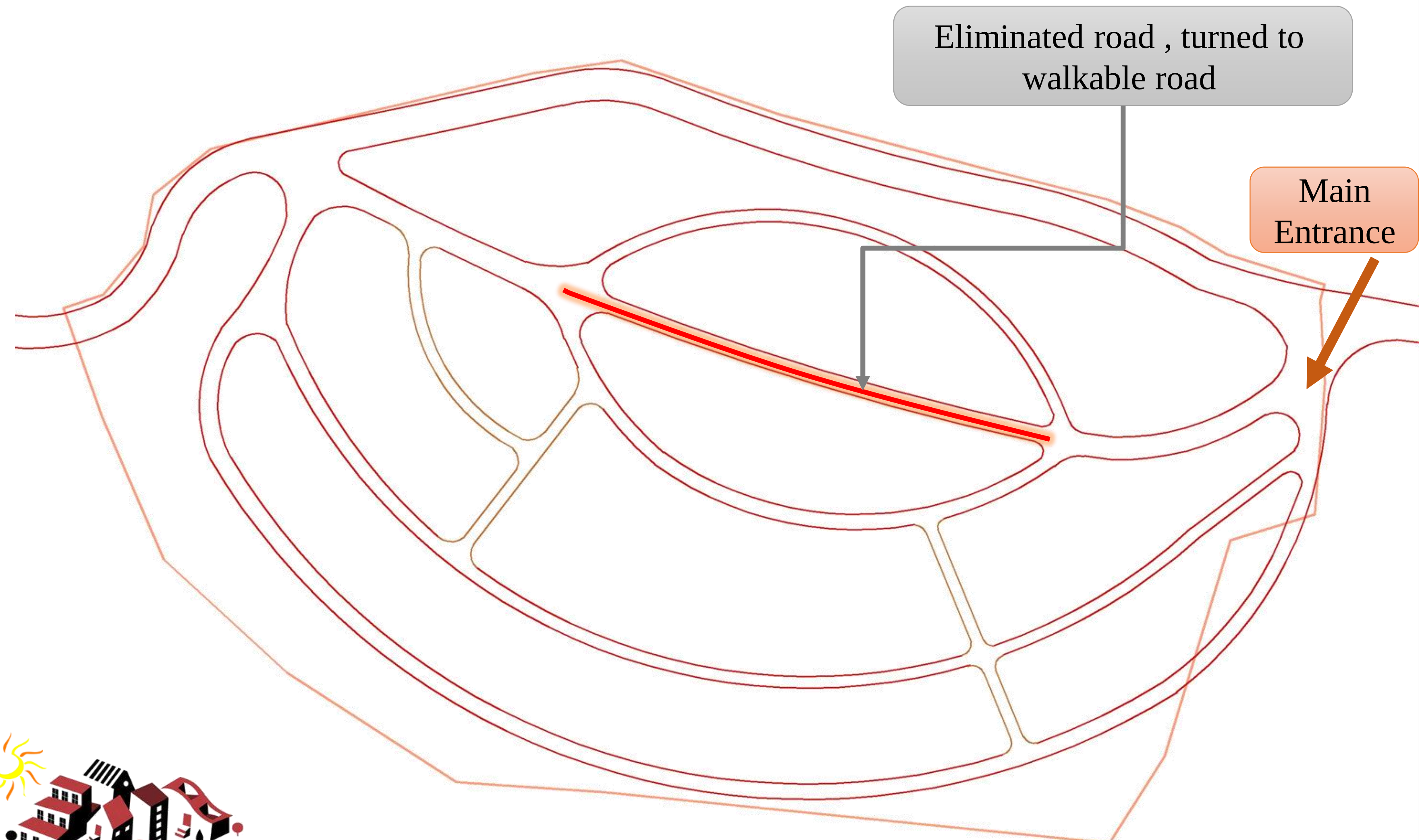
2. Road Network :

BUT , !

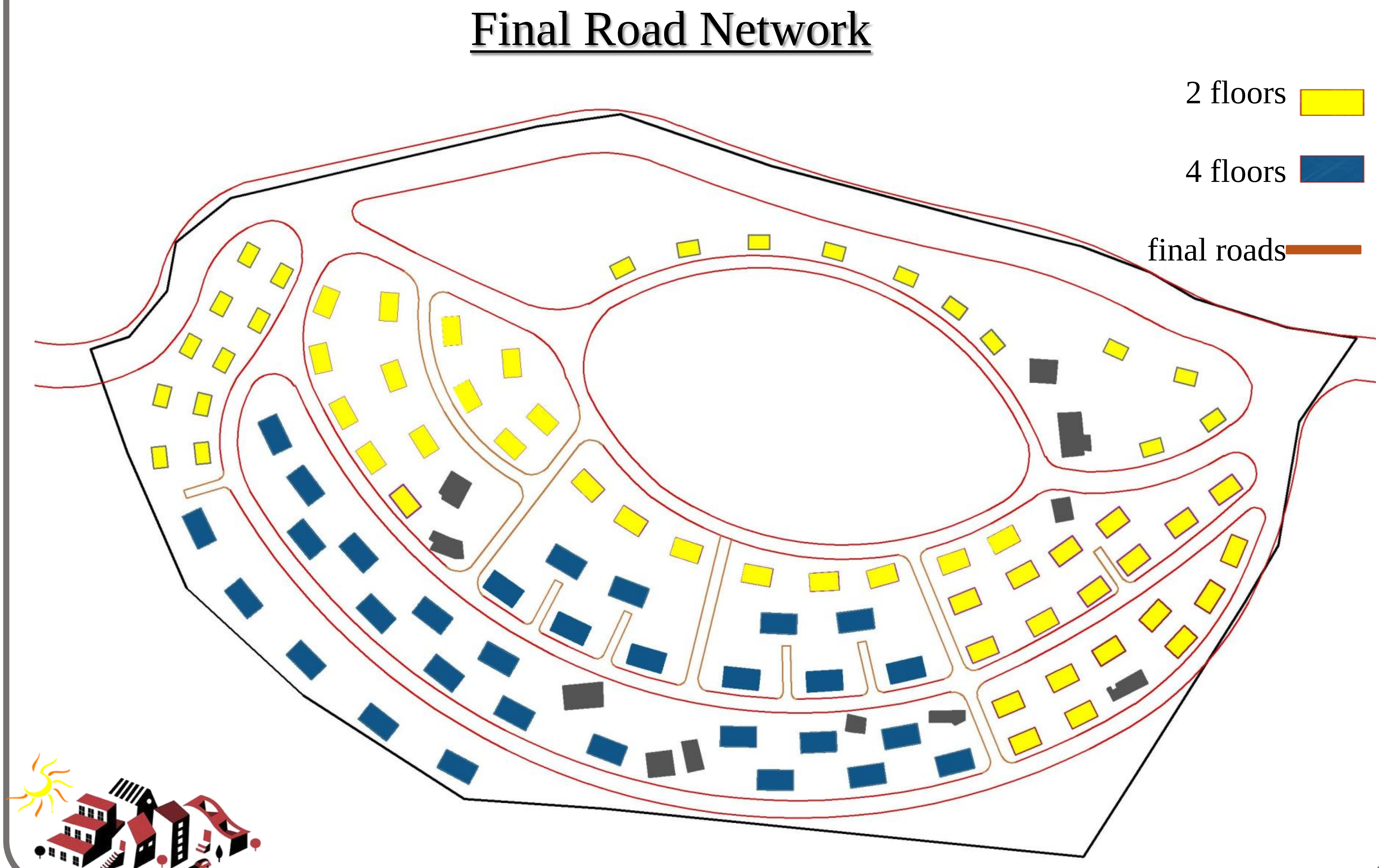


2. Road Network :

Final Road Network

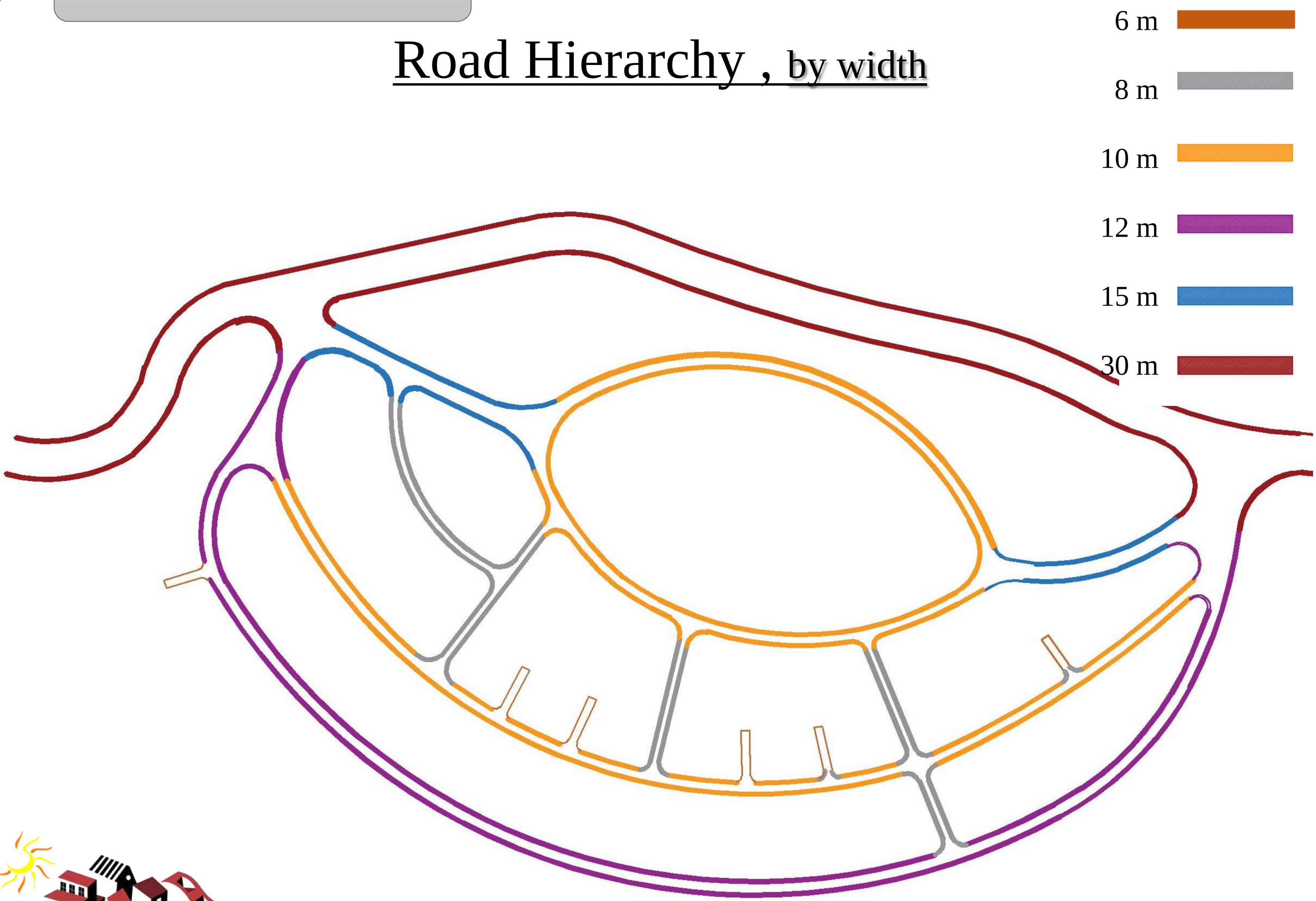


2. Road Network :



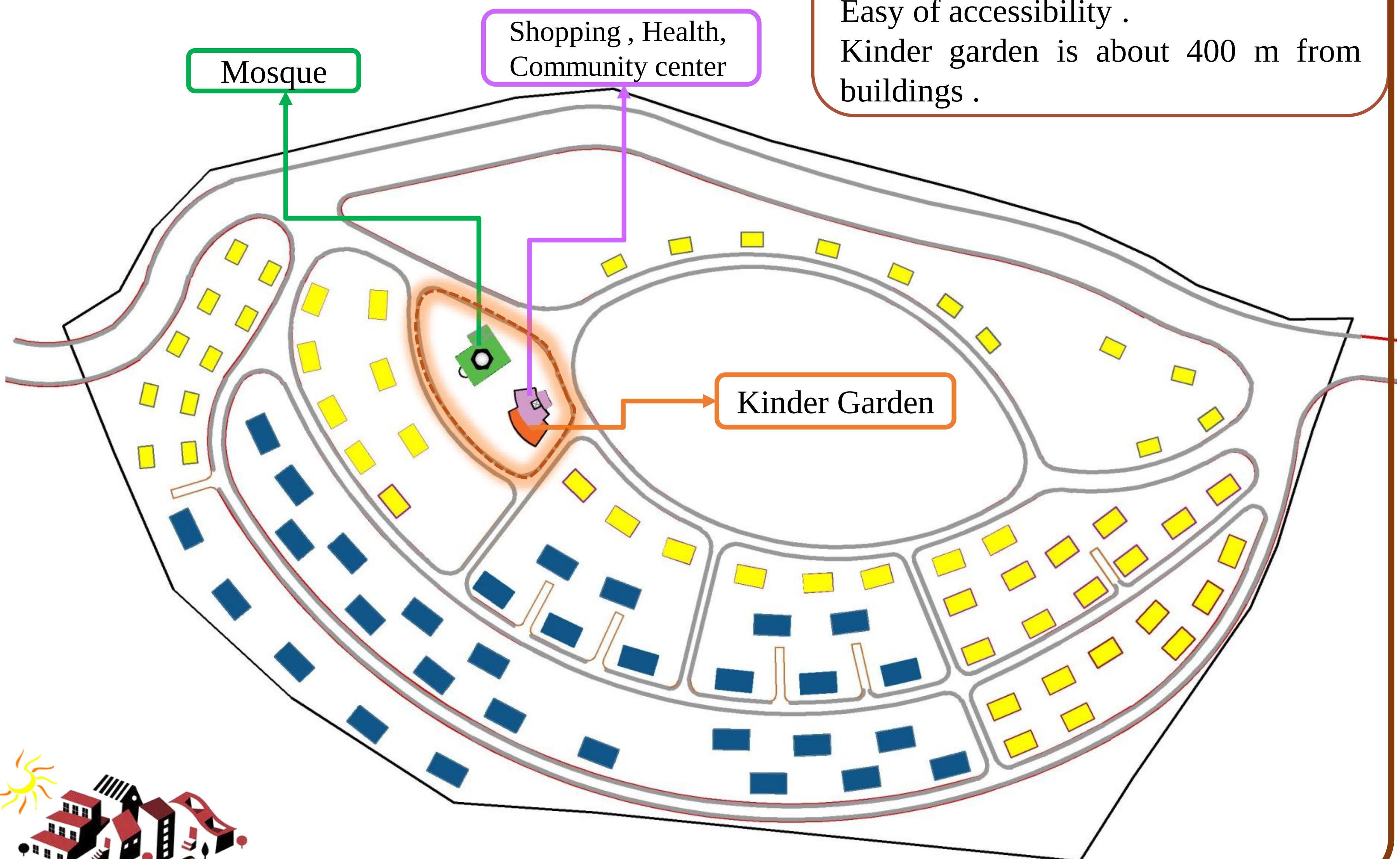
2. Road Network :

Road Hierarchy , by width



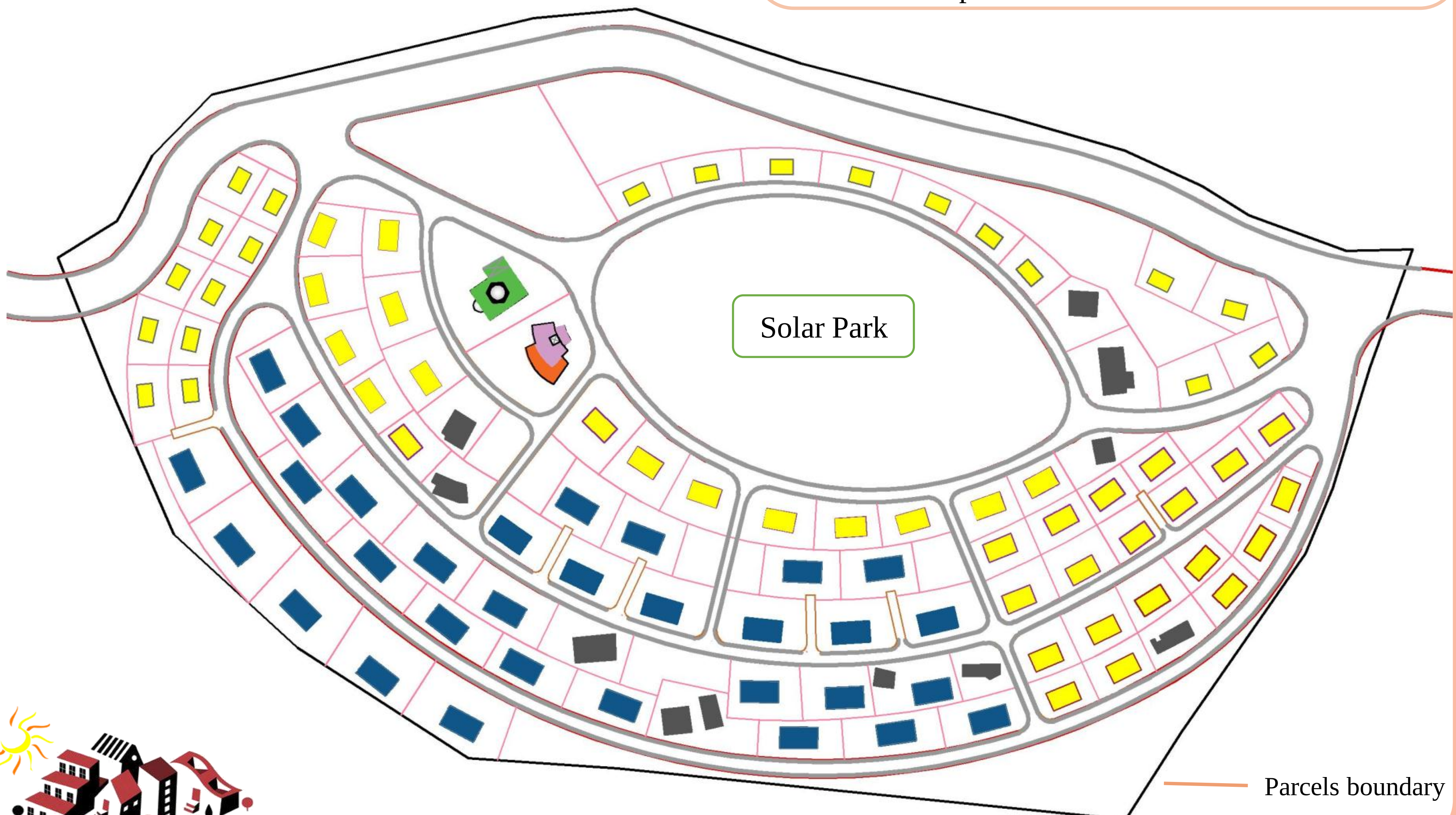
3. Public Services:

Justification :
Near the Neighborhood center
The Mosque at the main road entrance.
Easy of accessibility .
Kinder garden is about 400 m from buildings .



4. Parcelation:

- Parcels different by the buildings area
- Villa's parcels reach's 1000 m2 .
- Parcels of 2 floors less than 4 floors .
- Existing buildings extended their parcels around to reduce its shadows effect .
- Power adapter has about 10 hectare.



5. Green Area's:

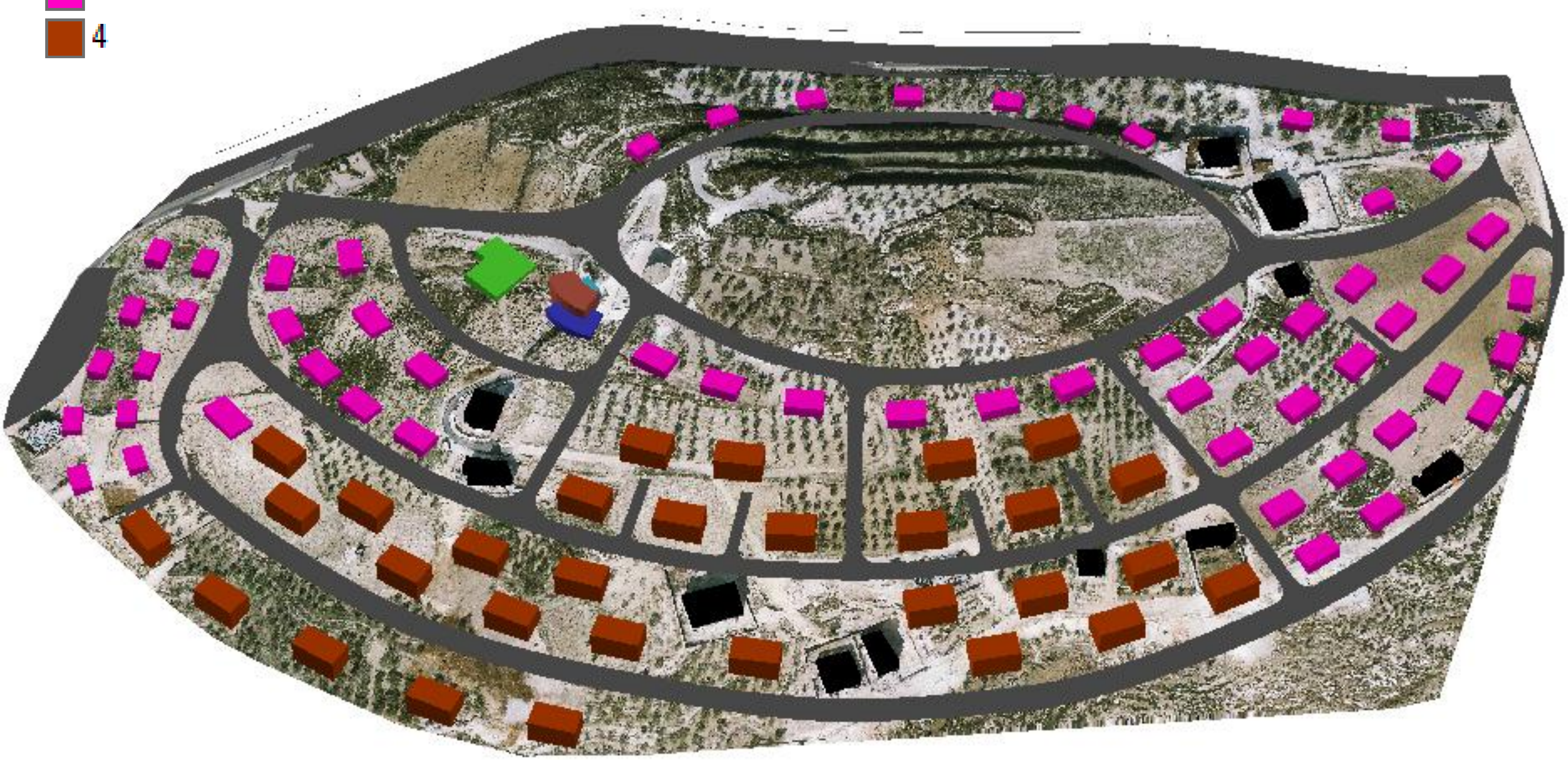
- Area around Power adapter will be Green barriers .
- Area's around the neighborhood will be Green barriers .
- Spaces between parcels will be green area's.
- The Green Belt between the main road and built up area .

Final 3d model for built-up area at the Arial photo

Mosque
Kinder garden
Mall
Services

Final buildings
nu_floors
2
4

3D Model
for final built-up area



Shadow Analysis

For the Final Built up area

Shadow Analysis

For the Final Built up Area

Winter – at 9 a.m.

Shadow Analysis For the Final Built up Area at Winter – at 9 a.m.

Shadow Analysis

For the Final Built up Area

Winter – at 12 p.m.

Shadow Analysis For the Final Built up Area at Winter – at 12p.m.

Shadow Analysis

For the Final Built up Area

Winter – at 3 p.m.

Shadow Analysis For the Final Built up Area at Winter – at 3 p.m.

Shadow Analysis

For the Final Built up Area

Summer – at 10 a.m.

Shadow Analysis For the Final Built up Area at summer – at 10a.m.

Shadow Analysis

For the Final Built up Area

Summer – at 2 p.m.

Shadow Analysis For the Final Built up Area at summer – at 2 p.m.

Shadow Analysis

For the Final Built up Area

Summer – at 5 p.m.

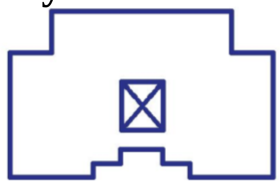
Shadow Analysis For the Final Built up Area at summer – at 5 p.m.

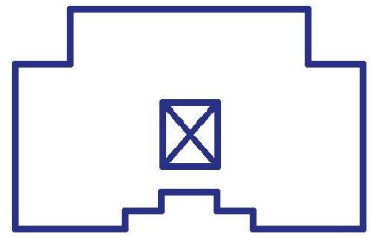
Solar Neighborhood Design Stage

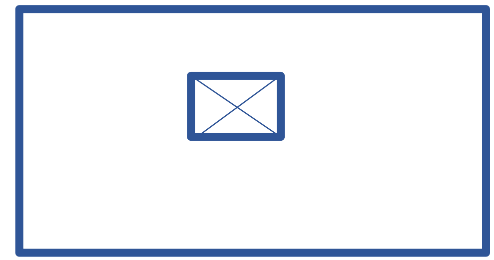
1. Neighborhood Units:

i. **Pattern and form**

ii. **Population capacity:**







Type	Villa’s	Building	Building
Number of floors	2	2	4
Area	150 m2	250 m2	350 m2
Departments	-	2	2-3
Number of Units	21 units	35 units	31 units
Population	21*5	35*2*2*5	31*4*3*5
Total . pop	105 person	700 person	1860 person
Total Population = 2665 person			

2. Parking

Demand & supply :

2 floors, Villa's = **2** for every one , at area it self

2 floors , buildings = 4 departments * 1 lots = **4** for every one

4 floors , buildings = 12 departments * 1 lots = **12** for every one .

Total parking area :

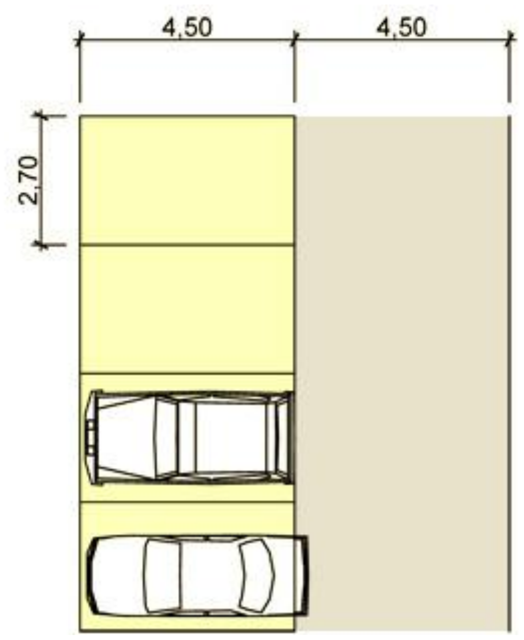
From Villa’s : **21*2 = 42 unit**

From 2 floor buildings : **4*35 = 140 unit**

From 4 floor buildings : **12*31 =372 unit**

Total demand = 554 unit

<u>**Needed area = 2.7 * 4.5 * 554 = 6731 m2**</u>

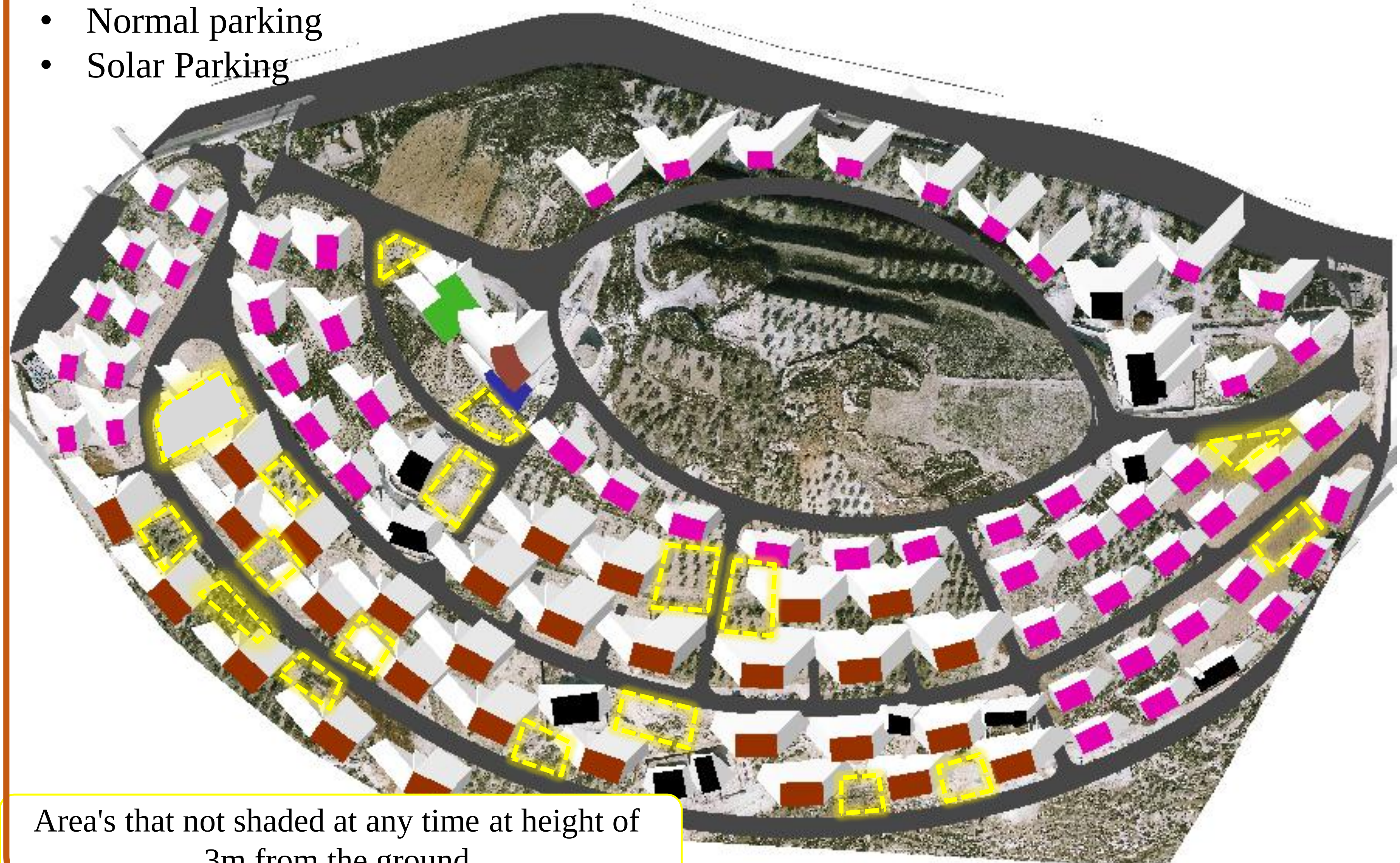


2. Parking

Tow types :

- Normal parking
- Solar Parking

Solar Parking Selected Locations



Area's that not shaded at any time at height of 3m from the ground

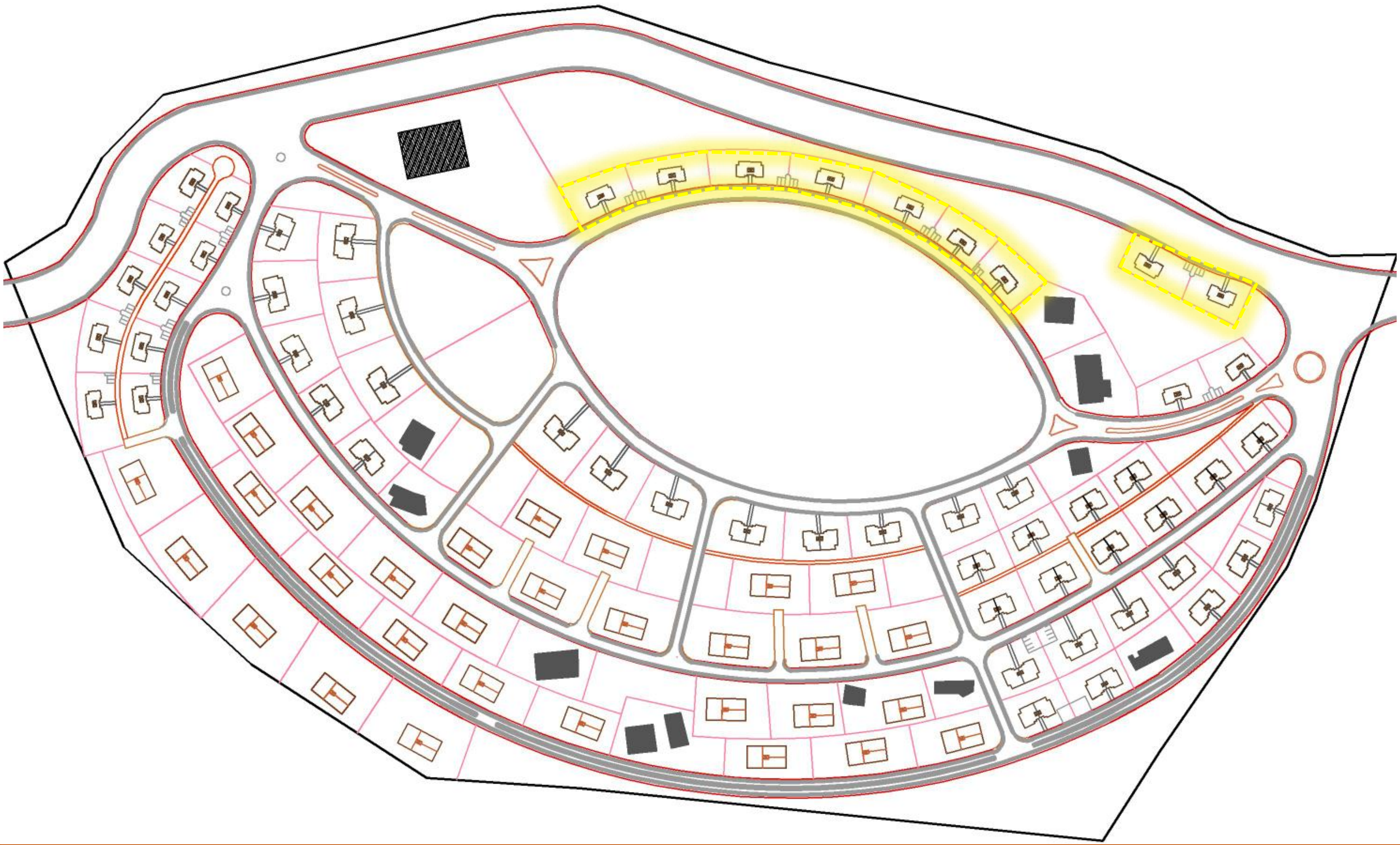
2. Parking

Tow types :

- Normal parking
- Solar Parking

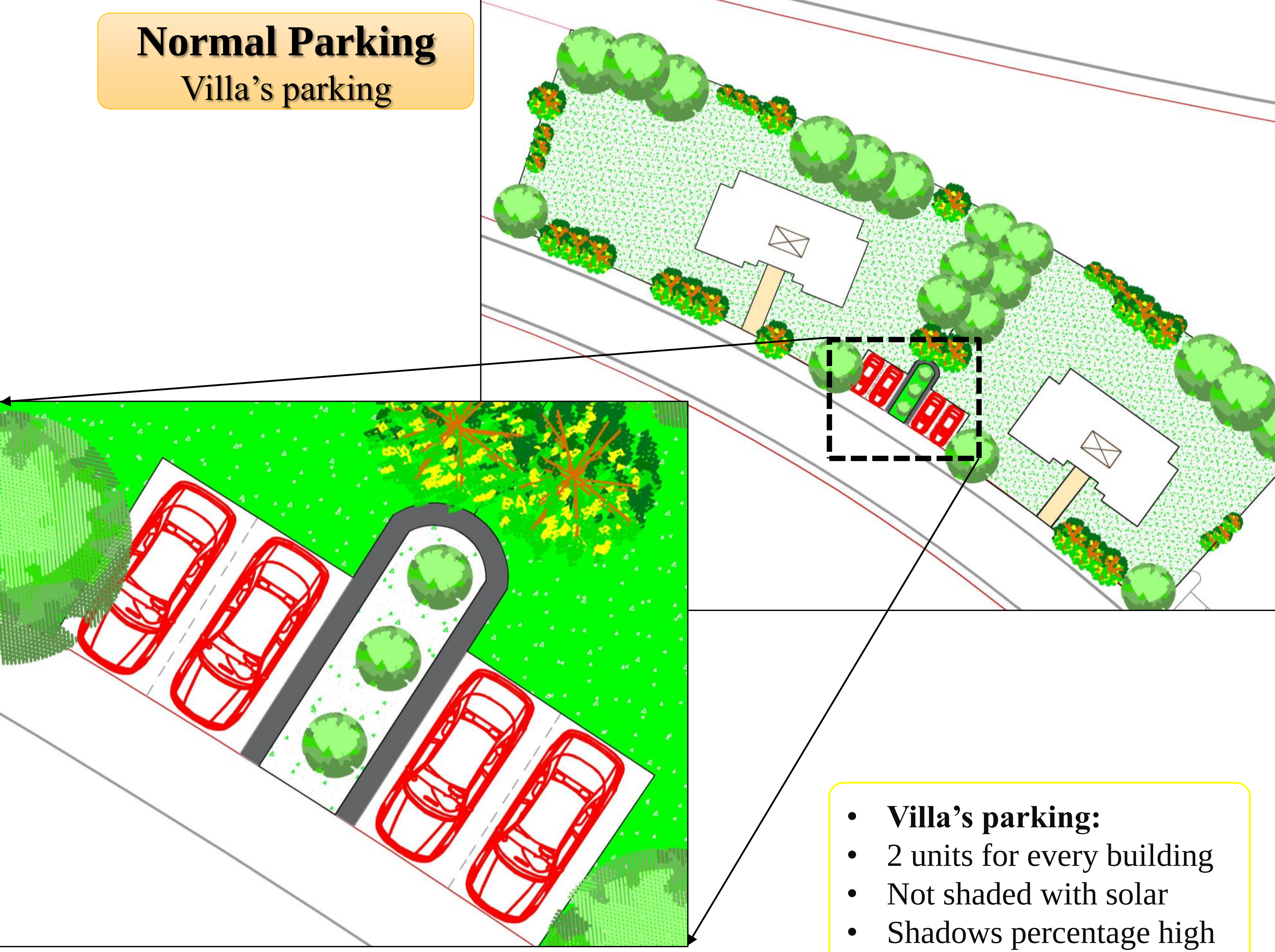
Norma parking Locations

- **Normal parking:**
- 2 units for every building
- Low solar access
- Shadows percentage high



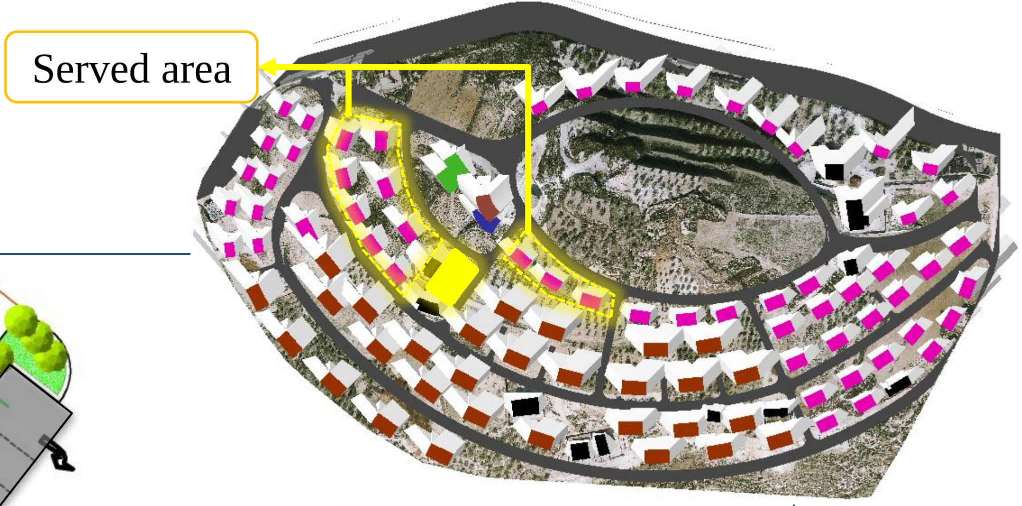
Normal Parking

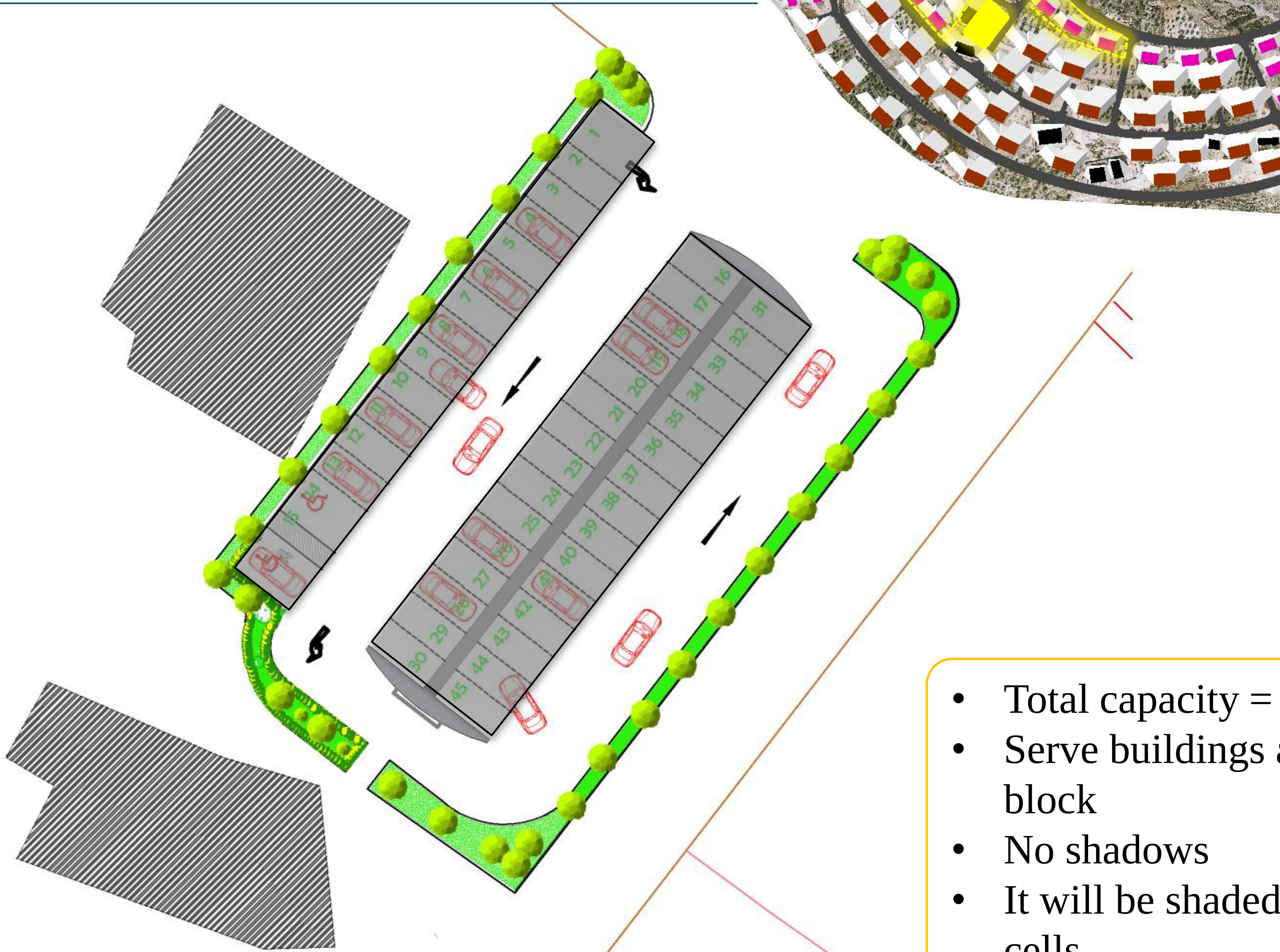
Villa's parking



- **Villa's parking:**
- 2 units for every building
- Not shaded with solar
- Shadows percentage high

Solar Parking – Buildings

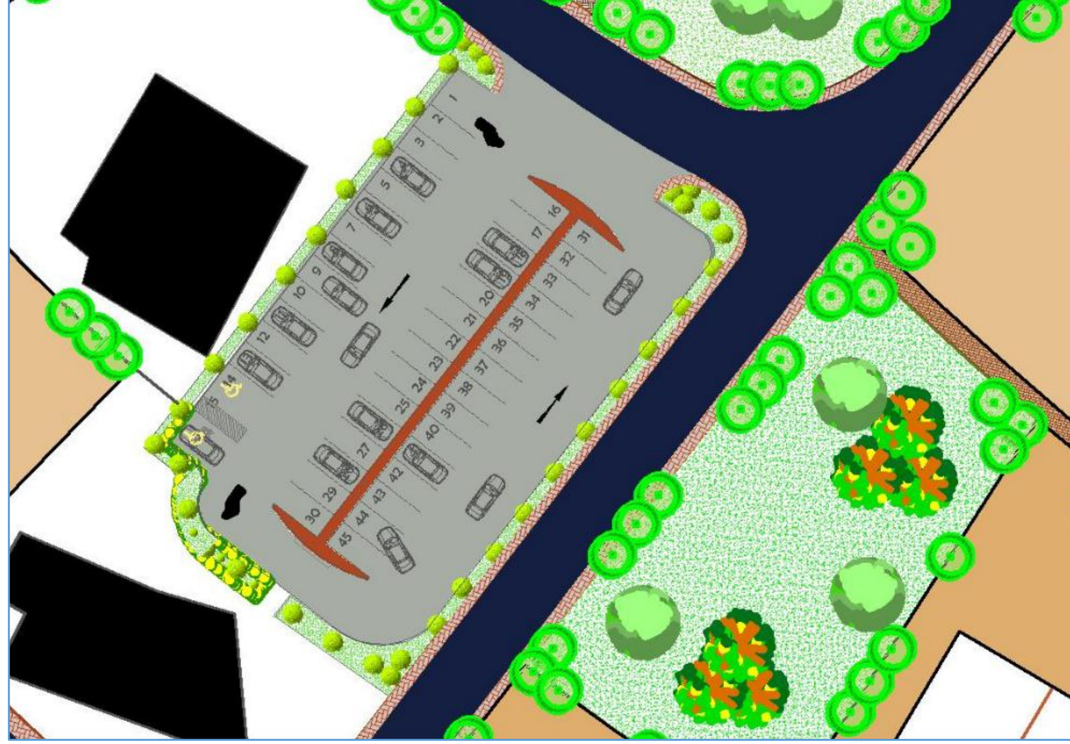




- Total capacity = 45 car
- Serve buildings at the block
- No shadows
- It will be shaded by solar cells

Scale 1:350

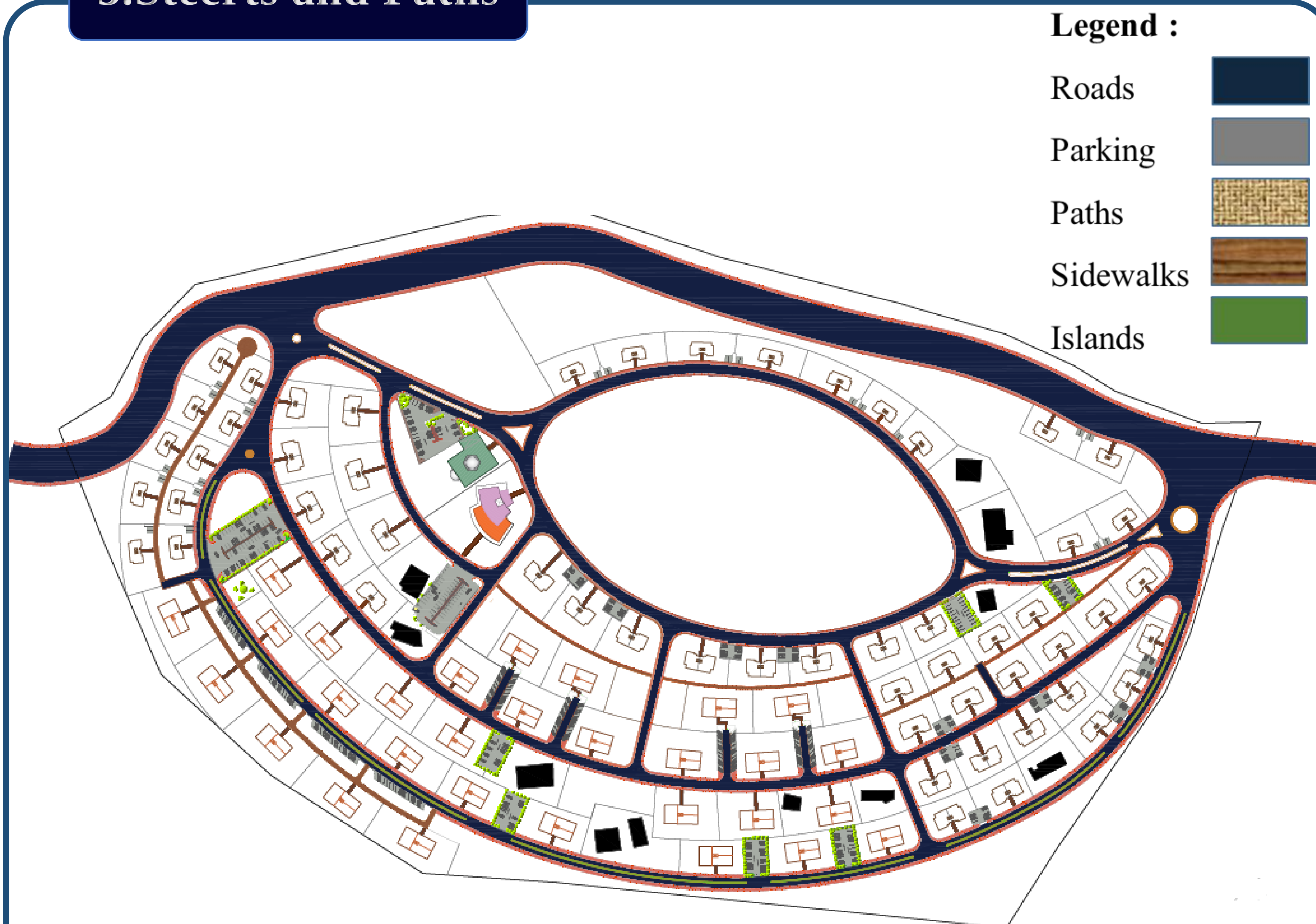
Solar Parking –
Buildings



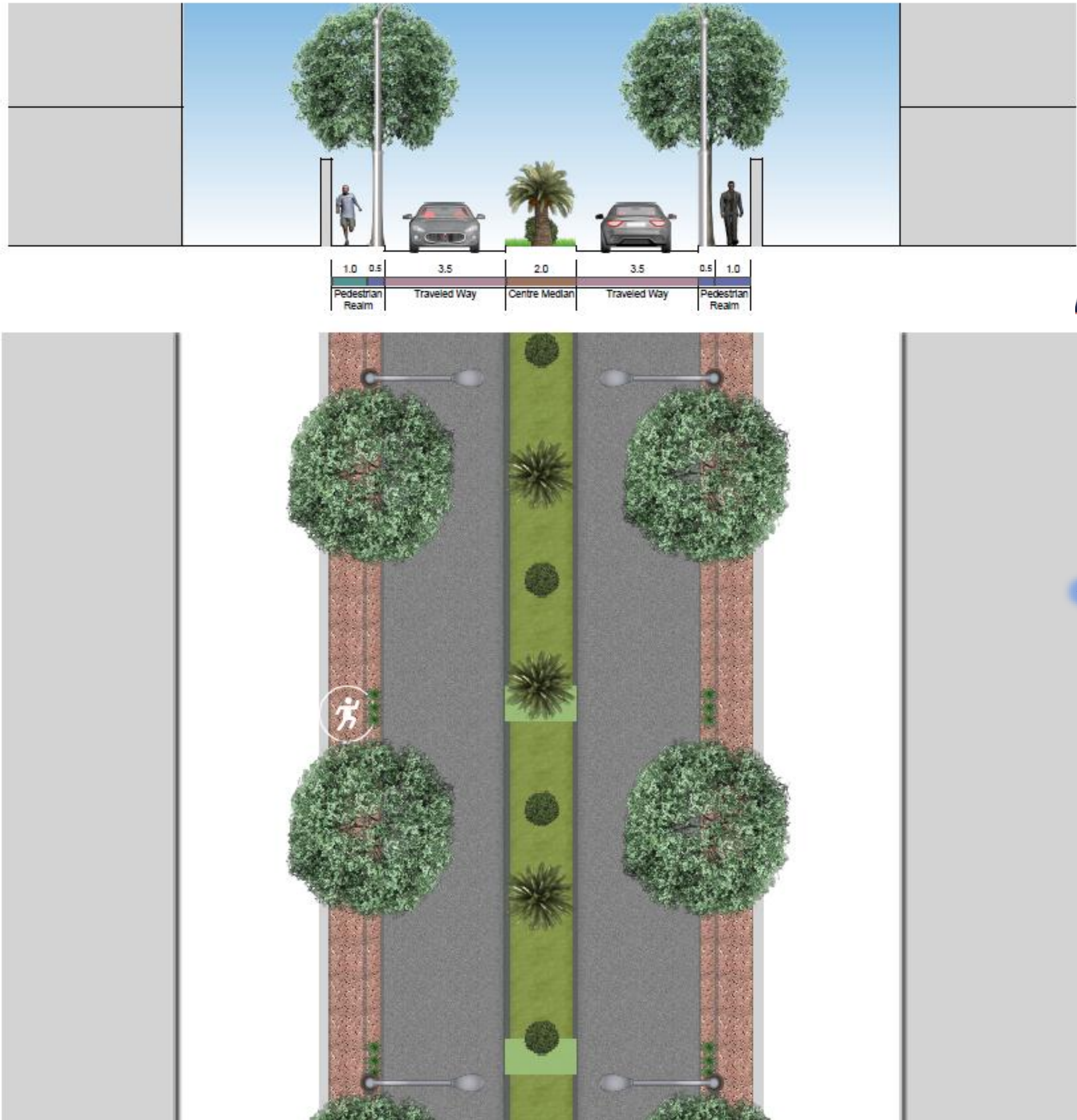
Solar Parking Cells :

the models and figures below show the solar shaded parking and how it seems after adding the solar cells for shading.

3.Steerts and Paths



3.Steerts and Paths



Ring Road Street Design
Width of 12 m

3.Steerts and Paths

Lighting system

Every 20 m solar lighting panel will used

parking lighting solar system

street lighting solar system

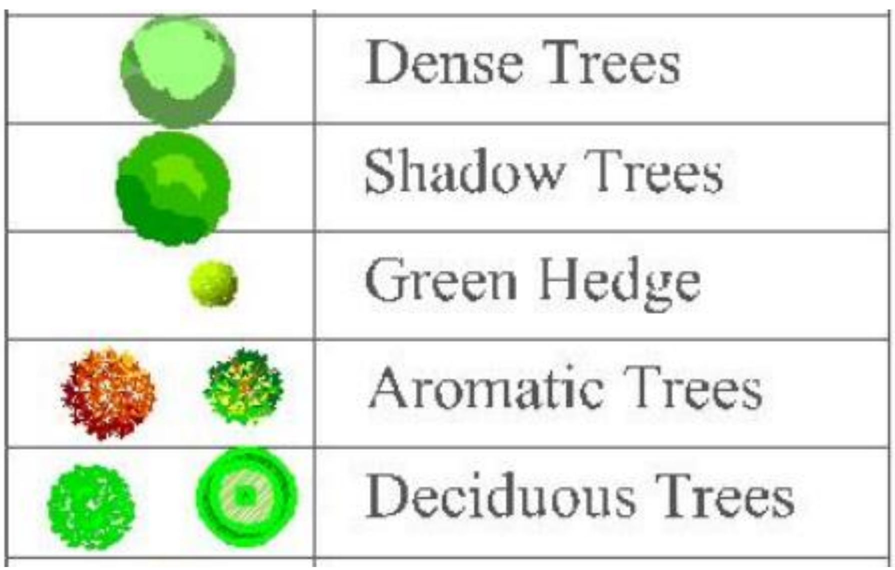
4.Vegetation

- **the trees should allow the solar access at winter and decrease the harmless solar rays at summer.**

I. at the main road: Trees should prevent the noise ant the pollution comes from the main road and the factory , (not drop full papers Shadow and Dense trees).

II. vegetation used at the power adapter buffer zone :a fence of streets that prevent the pollution of rays that can harm people at the site(**dense , Hedge trees).**

III. At the site it self, sidewalks , **Deciduous trees**, to allow solar access at winter



Fence streets at the power adapter zone

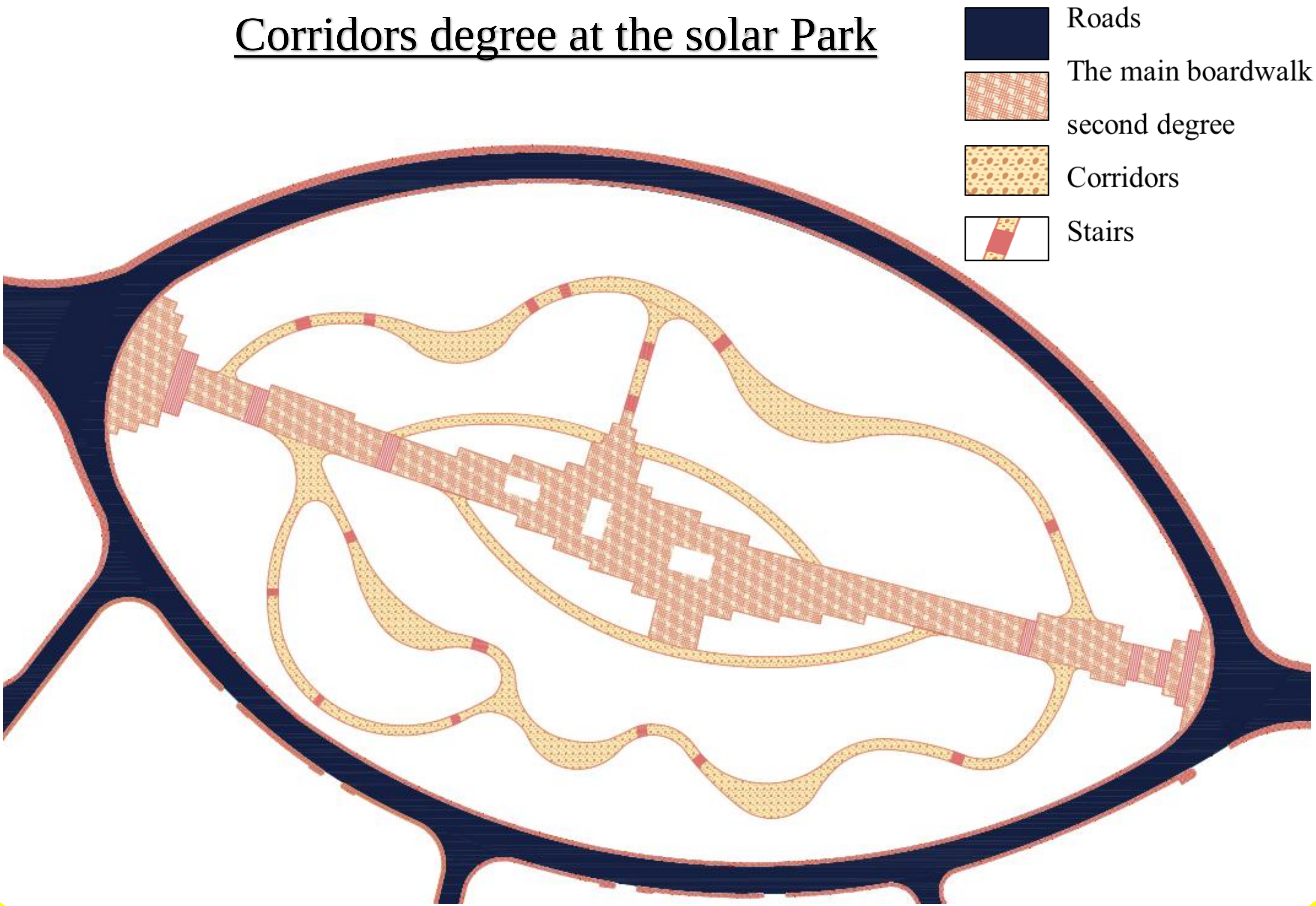
4.Vegetation

At boundaries and adapter, Fences

At sidewalks to allow sun access

At high radiation area’s

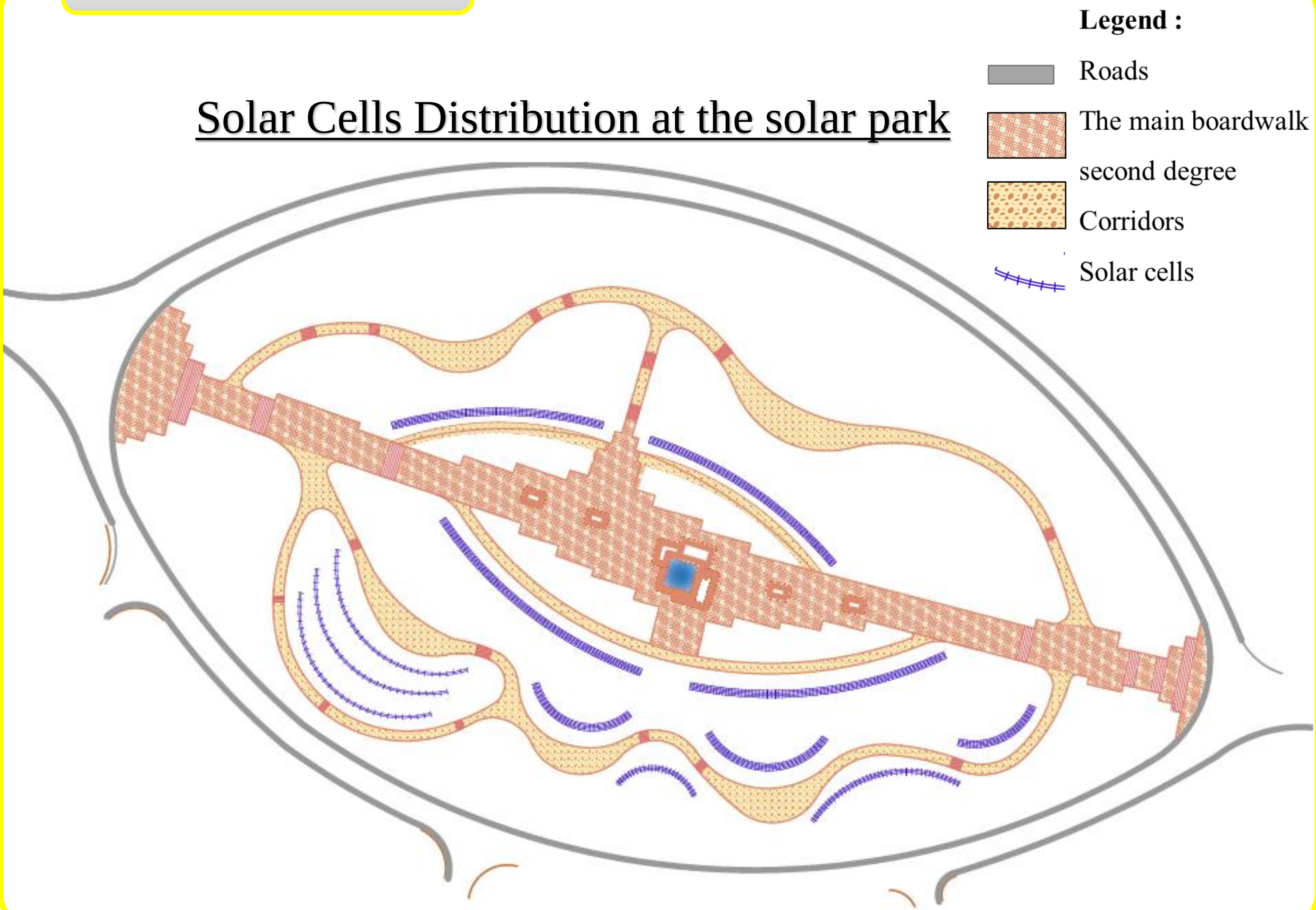
5.Solar Park



Corridors degree at the solar Park
Legend :
Roads
The main boardwalk
second degree
Corridors
Stairs

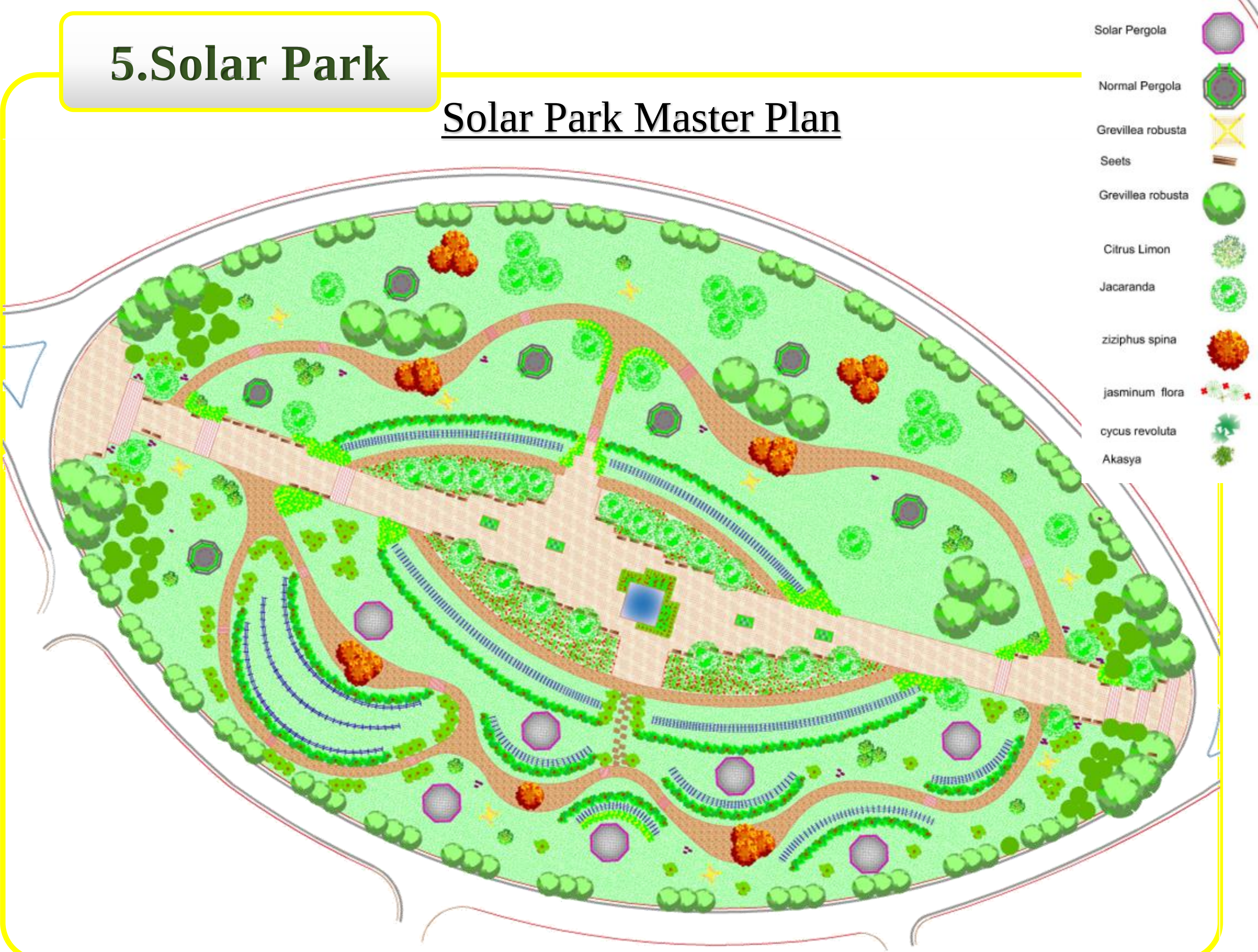
5.Solar Park

Solar Cells Distribution at the solar park



5.Solar Park

Solar Park Master Plan



5.Solar Park

Solar Energy Tree

Energy production and economical study:

produce energy used at the solar neighborhood :

1. **Building shading**
2. **lighting of streets**
3. **parking shading**
4. **solar park**
5. **solar area's**

Main Factors for the solar cells:

rating of 300 watt

Efficiency = 15.4 %

Voltage=35.95

Open cct voltage= 44.77

Short cc current=8.35

Energy production and economical study:

Energy Needed for the Neighborhood :

2 type of solar cells :

- **On Grid**

150 m2 300kw/month , 3600/year

Every 1600 kw need 1k solar cells , 1k solar cells = 10 m2

So , 150 need 3600/1600 need 2.25 k solar cells

- **Off Grid**

150m2 need 15 ampere need 2.5 k solar cells

Cost :

On grid for 1k solar cells = **1700 $** , Off grid for 1 k solar cells =**2200 $**

The project will use on grid solar cells

Energy production and economical study:

Energy Needed for the Neighborhood :

Total Residential area = 67.200 m2

Solar factor =0.4 , from electricity engineers

Total solar cells needed = (67200/150) * 2.25 *0.4 = 403.2k solar cells / year

Total cost every year = 403.2 * 1700$ = 685440 $ cost for supply the whole buildings

Total area requested for supply the buildings with energy
= 403.2 * 10 m2= 4032 m2

Energy production and economical study:

Solar Street Lighting :

Every street lighting need solar cell

Every solar = 1 m2 , 4-5 kw cover lighting

Area covered by building :

Every building used solar shading

Villa’s = 4m * 21 = 84 m2 , Buildings = 8m * 66 = 528 m2

Total area = 612 m2

Other area covered by parking's

Area used by parking's = 3000 m2 , 450 m2 used at solar area at the south

Energy production and economical study:

Public Buildings :

Total area = **2300 m2**

(2300 m2 /150) * 0.4 * 2.25 = **13.8 k solar cells**

area needed = 138 m2 , covered by solar cells at the **Solar Park** as showed at the Master plan

Energy production and economical study:

Total Solar Cells Area

Needed by residential buildings =4032 m2 , needed by Public Buildings= 138 m2

Total Area Used = 4170 m2

Total Energy Produced

Total Energy = 403.2k solar cells / year + 13.8 k solar cells / year

Total Energy = 417 k solar cells

Total solar cells Cost

1k solar cells cost 1700 $ (417 * 1700)

Total Cost = 708,900 $

Energy production and economical study:

Cost with out using solar cells :

150 m2 need 300 kw/month ,,

So , every 150m2 cost 200 Nis /month , 2400 kw/year ,

Total area =69500 m2

Total Cost per year =(69500/150) *2400 *0.27

Total Cost = 300540 $ / year

But !

By using sola Cells , **Total Cost = 708,900 $ per 20 years**

Time needed for Recovery of capital = 2.3 years

So , the project is Economically effective project

Project evaluation Results

- Maximizing the sun access
- Environmental importance, prevent Pollution,
- Warmth at winter, reduce temperature at summer
- Provide clean air in residential areas,
- Energy production , the profit is great

Recommendations

- Start new policy for planning neighborhoods depending on solar concepts
- Use solar regulations for designing and planning at large scale of cities
- Insert this kind of projects at the priorities of the local and Power ministry.
- Use programs that cants used at planning process like GIS, DIVA, Solar design ,,etc.
- Encourage investments in such as projects.

Solar Master Plan

This image cannot currently be displayed.

Legand

Symbol	Element Type
	Villa's
	2 Floor2 Building
	4 Floors Building
	Exixting Buildings
	Kinder Garden
	Health Center
	Shopping Center
	Mosque
	Power Adapter
	Buildings Intrances

Symbol	Element Type
	Roads
	Sidewalks
	Public Corridors
	FootPaths
	Main Park Corridor
	Islands
	Roandabout
	Parking
	Movment directions
	Cars

Symbol	Element Type
	Public Green Area
	Solar Park area
	Green buffer Zone
	Kids Playground
	Water Fountian
	Stairs
	Pergola
	Seats
	Dense Trees
	Shadow Trees
	Green Hedge
	Aromatic Trees
	Deciduous Trees
	Solar Cells