Planning Guideline Analysis & Development Strategies for the Village of Tundu

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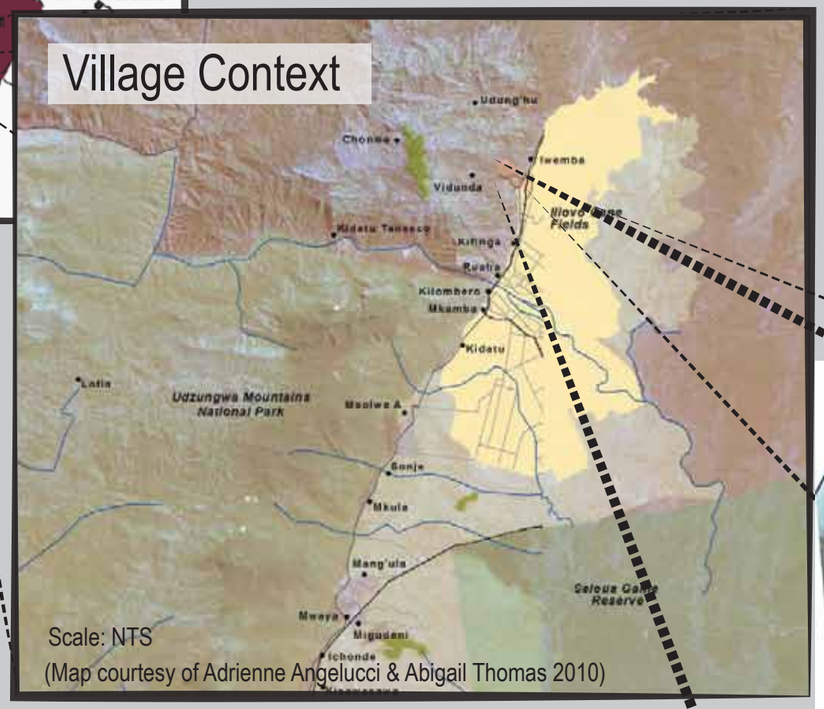
Project Background

The village of Tundu lies in close proximity to valuable conservation areas and National Parks including the Udzungwa Mountains National Park (UMNP) recognized world-wide as a valuable hotspot for biodiversity. The mountains also provide an incredible amount of valuable ecosystem services to the country and surrounding area; creating fresh air, preventing soil erosion and supplying fresh water for drinking, irrigation and general use to some 700,000 people living in the immediate area. However, there are growing concerns about the resilience of such ecosystem services if human pressures on the Udzungwa Mountains continue. Villages in the Kilombero and Kilosa districts, including Tundu, are experiencing rapid, unchecked growth from the presence of cash industries and arable land with supplies of fresh water. In a comprehensive study of the area, the Trento Museum of Natural Science noted that "The single greatest threat to the forests of the Udzungwa Mountains is the rapidly increasing human population," (Trento 2007).

Contributing to this rapid growth in places like Tundu, is a general lack of resources, funding and training for putting together comprehensive land use plans to deal with increasing population. With population growth showing no signs of stopping it will be essential to develop a model for ways in which villages can grow efficiently to minimize excessive land consumption and land conflicts. These issues are addressed in the following study in a three part process focusing on public infrastructure, transportation infrastructure, and residential development. This allows for a detailed investigation into the disparities between the current development pattern and the mandated guidelines under Tanzania's Town and Country Planning Regulations. The results of enforcing the planning guidelines on Tundu are illustrated along with methods for the reduction of negative consequences.

Scale: NTS

Village Context



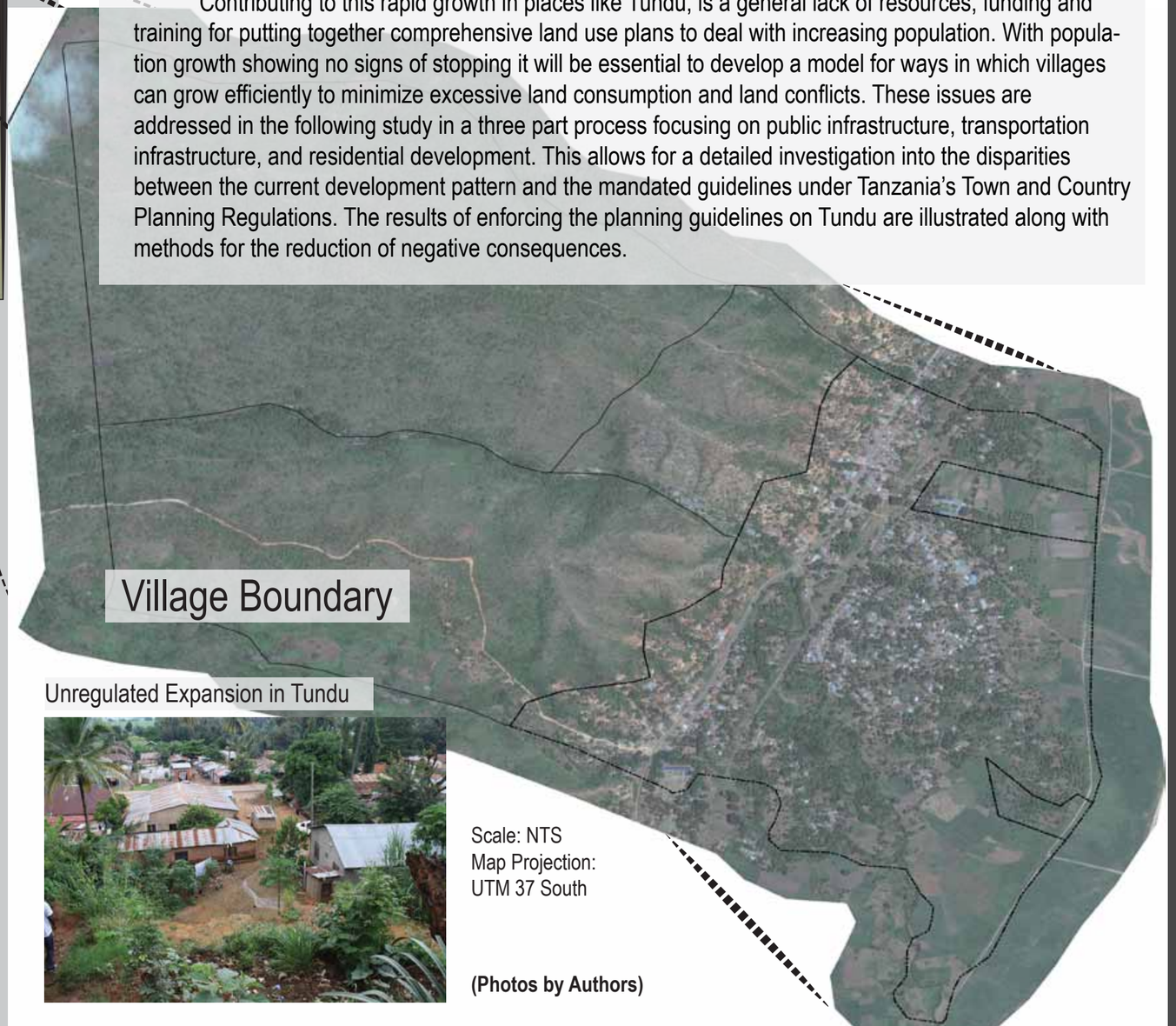
Scale: NTS
(Map courtesy of Adrienne Angelucci & Abigail Thomas 2010)

Udzungwa Mountains National Park

Park Encroachment

Kilombero Valley & Sugar Cane Fields

High Fertility Rates



Unregulated Expansion in Tundu

Scale: NTS
Map Projection:
UTM 37 South

(Photos by Authors)

Public Infrastructure Analysis

Utilizing the current Town and Country Planning Guidelines of Tanzania, this inventory focuses on existing public amenities and infrastructure within the village of Tundu. This serves to highlight the necessary measures that must be taken in order to correct the conflicts between existing public infrastructure and legal requirements. The Necessary Expansion column shows the shortcomings that exist if the village were to use the Planning Guidelines as a measure for modernization.

Population Data

Estimated Population: 3,437
Approximate Number of Children (0-18): 1,396

Public Facilities

Type of Facility	Gross area/person	Required for Tundu	Existing Conditions	Existing - Required	Impacted in ROW	Necessary Expansion
Market	0.4-0.5 sq.m	1374.8 sq.m	1179 sq.m	195.8	343 sq.m	538 sq.m
Shops	0.8-1.0 sq.m	2749.6 sq.m	3216 sq.m	466.4	2084 sq.m	1617.6 sq.m
Public Areas/Buildings	0.25-0.5 sq.m	859.25 sq.m	433 sq.m	426.25	40 sq.m	466.25 sq.m
Service Trade	0.4-1.0 sq.m	1374.8 sq.m	1453 sq.m	78.2	668 sq.m	589.8 sq.m
Religious Areas	0.3-0.4 sq.m	1031.1 sq.m	737 sq.m	294.1	475 sq.m	769.1 sq.m
Library	0.15-0.2 sq.m	515.5 sq.m	0	515.5	0	515.5 sq.m
Community Halls	0.2-0.4 sq.m	687.4 sq.m	999 sq.m	311.6	999 sq.m	687.4 sq.m

Active Recreation

Type of Activity	Gross area /1000 persons	Required for Tundu	Existing Conditions	Existing - Required	Impacted in ROW	Necessary Expansion
Children Play Area*	0.2-0.4 ha.	0.2 ha.	.1 ha.	.1 ha	0	.1 ha
Sports Fields	0.5-1.0 ha.	2 ha.	.76 ha.	1.24 ha	0	1.24 ha
Play fields	1.0-1.5 ha.	4 ha.	N/A	N/A	N/A	N/A

Recreational Facilities

Type of Facility	Gross area /person	Required for Tundu	Existing Conditions	Existing - Required	Impacted in ROW	Necessary Expansion
Open Spaces	5.0-10.0 sq.m	17185 sq.m	N/A	N/A	N/A	N/A
Neighborhood Park	2.0-5.0 sq.m	6874 sq.m	7038 sq.m	164	0	Sufficient

Educational Facilities

Type of Facility	Population/ unit (students)	Required for Tundu	Existing Conditions	Existing - Required	Impacted in ROW	Necessary Expansion
Nursery School	40-60	20	1	19	0	19
Primary School	280-1120	1	1	0	0	Sufficient
Secondary School	320-640	1	0	1	0	1


Tundu Primary School


Church


Market Place

Legend

- Public Area
- Service Trade
- Religious Area
- Market
- Shops
- Community Hall
- Recreation/Park
- School
- All Other Structures
- Village Boundary
- ROW
- Road/Path`

0 50 100 200 300 400
Meter

Map Projection:
UTM 37 South

Planning Guideline Analysis & Development Strategies for the village of Tundu

1.1 Analysis of Existing Public Infrastructure

Scenario 1

The first option would be to directly follow the recommended carriage and right-of-way (ROW) setbacks established by the Town and Country Planning Ordinance guidelines. Structures along the main road are already marked with red and green “x’s” indicating their interference with these predetermined ROW standards. This scenario is meant to show the implications and the extent of the negative impact on buildings should the guidelines be followed as is along the main road (Trunk Road), local feeder roads (Primary Distributor) and main pedestrian/bike paths (Pedestrian Access).

Structures marked with x’s

(Photos by author)

1

Market

2

Foundation & Shops

3

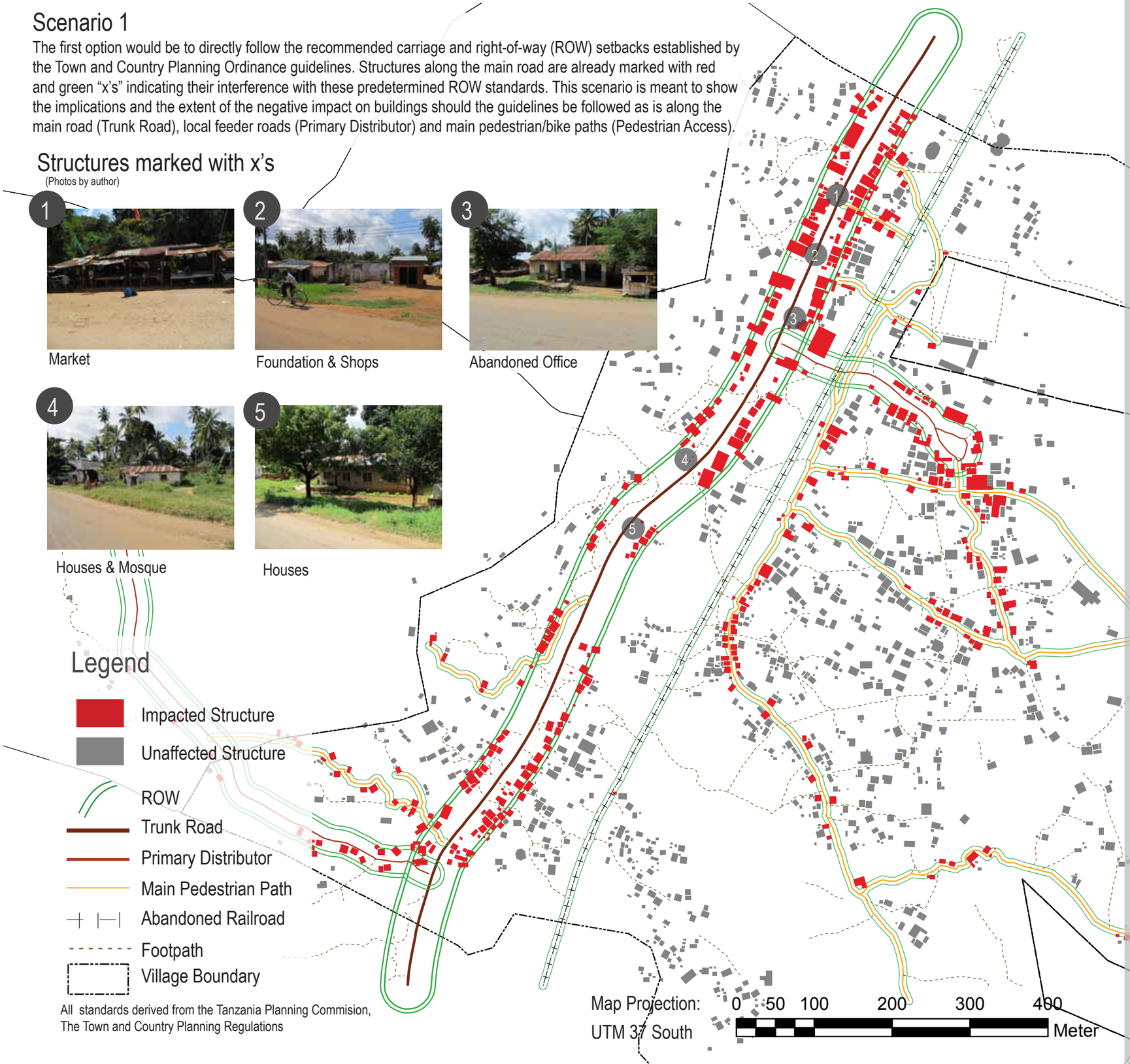
Abandoned Office

4

Houses & Mosque

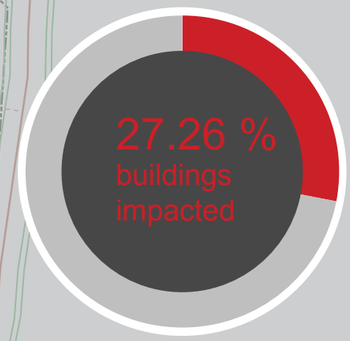
5

Houses



Impacts to Buildings Under Existing Planning Guidelines

Type of Road	ROW width	Buildings Impacted
Trunk Road	(60-70 m)	224
Primary Distributor	(30-40m)	52
Pedestrian Access	(10m)	147
	Total	423
	% of Tundu	27.26%



Distribution of Impacts

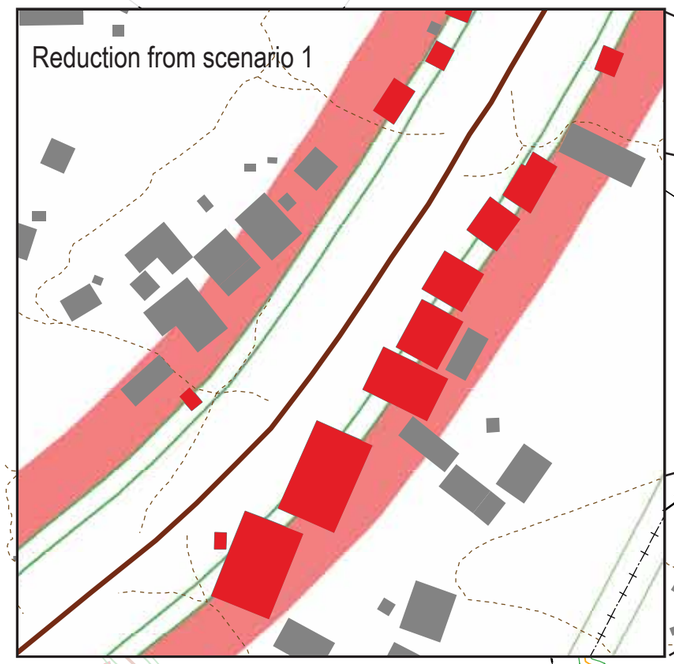
Building Type	Village Total	Trunk Road	Primary Distributor	Pedestrian Path
Abandoned	5	1	2	1
Animal Hut	56	3	1	0
Bar	9	3	0	4
Brick Kiln	6	0	0	1
Church	4	0	0	1
Food Stand	2	2	0	0
Foundation	111	9	4	11
Gathering	4	2	0	1
Graveyard	14	0	0	1
House	840	117	34	93
Kitchen	159	5	5	8
Latrine	217	11	4	9
Market	2	1	1	0
Mosque	2	2	0	0
Office	3	3	0	0
Restaurant	3	2	0	1
School	7	0	0	1
Shop	80	53	1	11
Storage	7	2	0	1
Workshop	7	0	0	1
Other	14	8	0	2
Total	**1552**	**224**	**52**	**147**

2.1 Scenario 1: Existing Planning Guidelines

Planning Guideline Analysis & Development Strategies for the village of Tundu

Scenario 2

The second scenario is meant to show the implications of imposing ROW setbacks along the same routes as in scenario 1 except in this instance, the recommended setback distances suggested for the village roads are relaxed by dropping them a category under the Town and Country Planning Ordinance guidelines. Instead of treating the main road as a trunk road it will be treated as a primary distributor and similarly the feeder roads would be treated as district distributors rather than primary distributors. The setback for paths in this scenario are kept the same to keep everything within the established set of planning guidelines to still achieve the desired level of traffic flow and safety but with reduced impact to buildings.



Legend

- Impacted Structure
- Unaffected Structure
- ROW
- Trunk Road
- Primary Distributor
- Main Pedestrian Path
- Abandoned Railroad
- Footpath
- Village Boundary

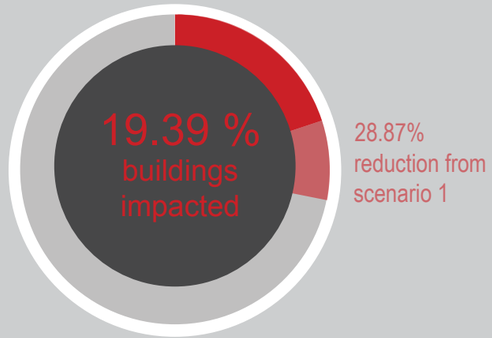
All standards derived from the Tanzania Planning Commision, The Town and Country Planning Regulations

Map Projection: UTM 37 South

0 50 100 200 300 400 Meter

Impacts to Buildings Under Relaxed Planning Guidelines

Type of Road	ROW width	Buildings Impacted
Primary Distributor	(30-40m)	112
District Distributor	(20-30m)	42
Pedestrian Access	(10m)	147
	Total	301
	% of Tundu	19.39%



Distribution of Impacts

Building Type	Village Total	Primary Distributor	District Distributor	Pedestrian Path
Abandoned	5	1	2	1
Animal Hut	56	0	1	0
Bar	9	3	0	4
Brick Kiln	6	0	0	1
Church	4	0	0	1
Food Stand	2	2	0	0
Foundation	111	5	2	11
Gathering	4	1	0	1
Graveyard	14	0	0	1
House	840	41	31	93
Kitchen	159	1	2	8
Latrine	217	2	2	9
Market	2	1	1	0
Mosque	2	2	0	0
Office	3	2	0	0
Restaurant	3	1	0	1
School	7	0	0	1
Shop	80	41	1	11
Storage	7	1	0	1
Workshop	7	0	0	1
Other	14	8	0	2
Total	**1552**	**112**	**42**	**147**

Planning Guideline Analysis & Development Strategies for the village of Tundu

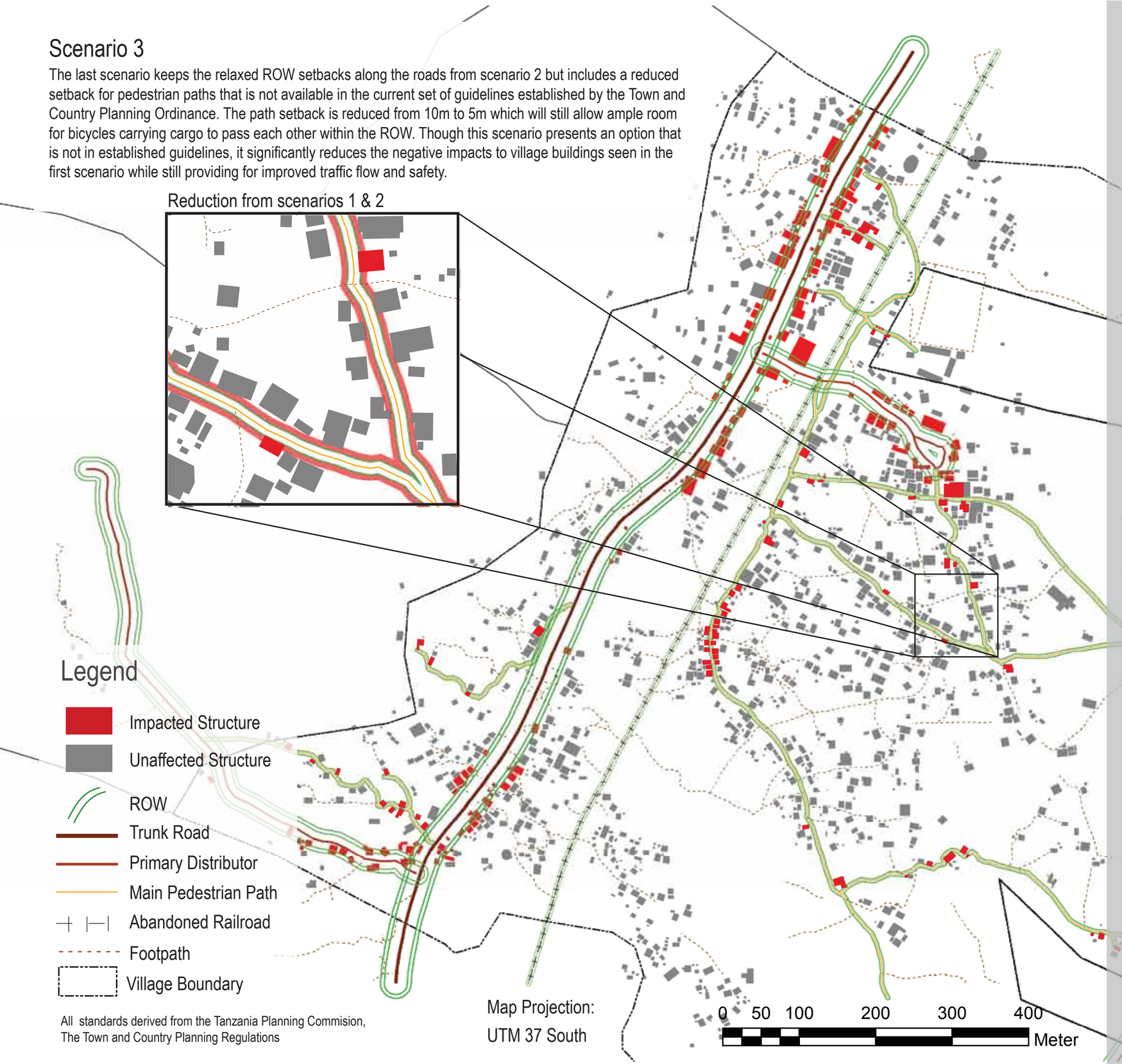
2.2 Scenario 2: Relaxed Planning Guidelines

Transportation Infrastructure

Scenario 3

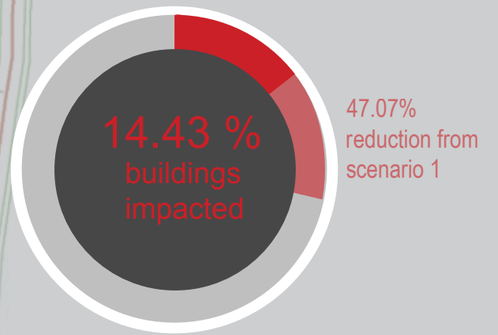
The last scenario keeps the relaxed ROW setbacks along the roads from scenario 2 but includes a reduced setback for pedestrian paths that is not available in the current set of guidelines established by the Town and Country Planning Ordinance. The path setback is reduced from 10m to 5m which will still allow ample room for bicycles carrying cargo to pass each other within the ROW. Though this scenario presents an option that is not in established guidelines, it significantly reduces the negative impacts to village buildings seen in the first scenario while still providing for improved traffic flow and safety.

Reduction from scenarios 1 & 2



Impacts to Buildings Under Relaxed Planning Guidelines

Type of Road	ROW width	Buildings Impacted
Primary Distributor	(30-40m)	112
District Distributor	(20-30m)	40
Pedestrian Access	(5m)	72
	Total	224
	% of Tundu	14.43%



Distribution of Impacts

Building Type	Village Total	Primary Distributor	District Distributor	Pedestrian Path (5m)
Abandoned	5	1	2	0
Animal Hut	56	0	1	0
Bar	9	3	0	3
Brick Kiln	6	0	0	0
Church	4	0	0	0
Food Stand	2	2	0	0
Foundation	111	5	2	5
Gathering	4	1	0	0
Graveyard	14	0	0	0
House	840	41	31	49
Kitchen	159	1	2	4
Latrine	217	2	2	4
Market	2	1	1	0
Mosque	2	2	0	0
Office	3	2	0	0
Restaurant	3	1	0	1
School	7	0	0	0
Shop	80	41	1	5
Storage	7	1	0	1
Workshop	7	0	0	0
Other	14	8	0	0
Total	**1552**	**112**	**42**	**72**

Proposed Routes: Cost- Benefit Analysis

As the village moves towards modernization and population continues to rise, expansion and improvements to existing transportation infrastructure will be necessary. The three proposed routes look at options for improving and expanding existing routes strategically to both have the minimum impact on structures and provide the benefits of an improved transportation network for the most people within a 50m distance of the road. These are meant only to show possible options and different combinations of these or alternative routes are encouraged as well as their gradual phasing as funding and resources permits.

Route 1: Residential Access Road (10-20m ROW)

Structure	Beneficiaries (50m)	Impacted by ROW	Net Benefit
Animal Hut	3	0	3
Bar	1	0	1
Church	1	1	0
Foundation	28	8	20
Homes	138	28	110
Restaurant/Shop	2	0	2
School	1	0	1
Storage/ Workshop/Kiln	5	1	4
Other/Negligable *	85	7	78

Pros
- High number of beneficiaries
- Connects to existing main and feeder roads
- Links the northern & southern parts of town
- Provides the most direct accecss to the center of the village
- Provides a stepping stone for future road expansion

Cons
- Impacts a high number of homes/ foundations
- Needs significant infrastructure improvements
- Little benefit to existing commercial enterprises

Route 2: District Distributor (20-30m ROW)

Structure	Beneficiaries (50m)	Impacted by ROW	Net Benefit
Animal Hut	9	0	9
Bar	5	0	5
Church	2	0	2
Foundation	14	0	14
Homes	118	1	117
Restaurant/Shop/Market	19	0	19
School	1	0	1
Storage/ Workshop/Kiln	8	1	7
Other/Negligable*	39	1	38

Pros
- Highest number of beneficiaries
- Incredibly low impact in ROW
- Utilizes old rail road bed
- Already exists as a major village circulation route
- Increases connectivity to outside of Tundu
- Ample space for building infill along route
- Links northern & southern parts of town

Cons
- Involves possible removal of existing railroad
- Eliminates opportunity for the return of a railroad

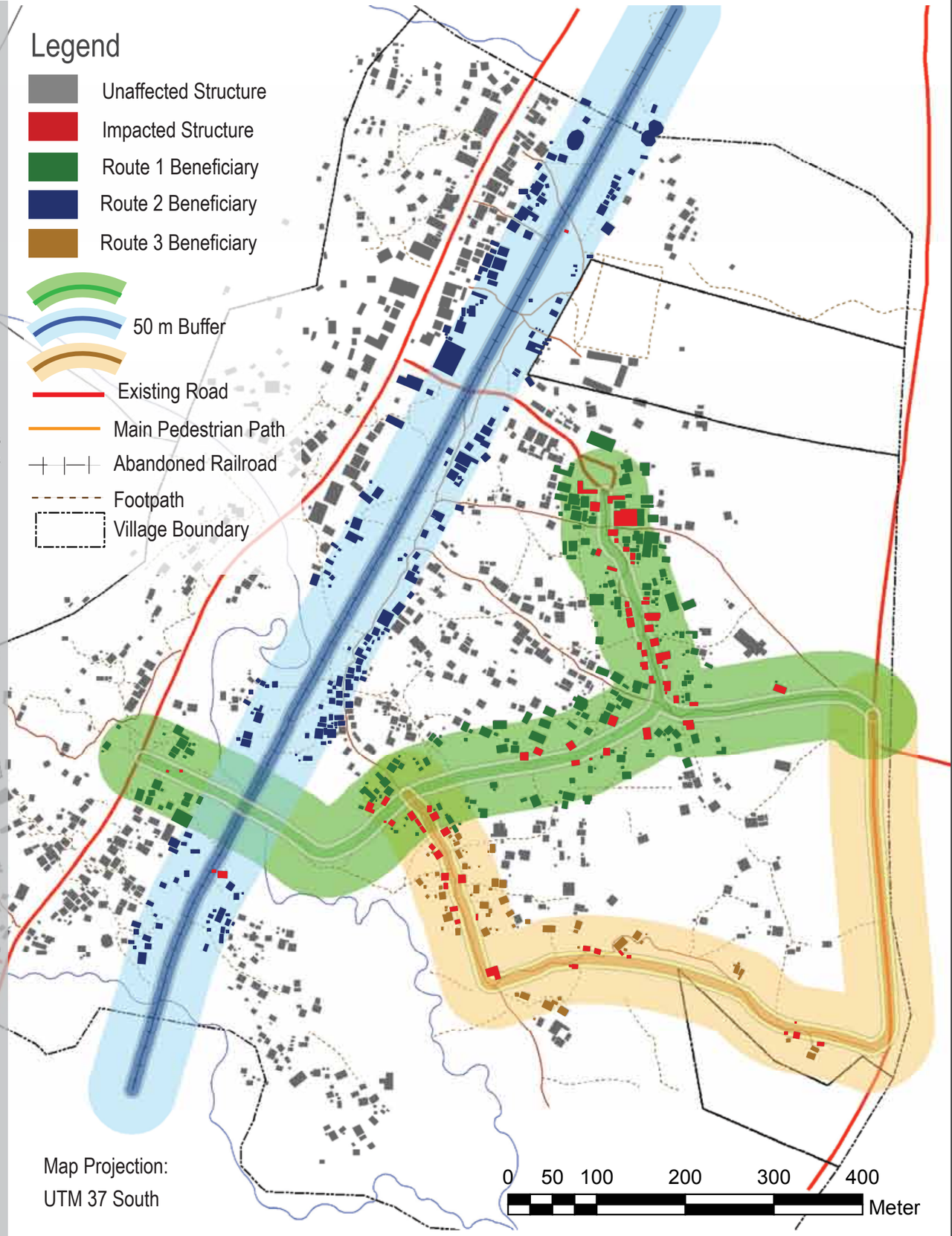
Route 3: Residential Access Road (10-20m ROW)

Structure	Beneficiaries (50m)	Impacted by ROW	Net Benefit
Animal Hut	4	1	3
Bar	0	0	0
Church	0	0	0
Foundation	8	1	7
Homes	59	17	42
Restaurant/Shop/Market	2	0	2
School	0	0	0
Storage/ Workshop/Kiln	1	0	1
Other/Negligable *	54	6	48

Pros
- Utilizes existing main paths & Illovo Sugar Cane Road
- Moves through low density area to provide for future development & expansion
- Relatively low amounts of impact

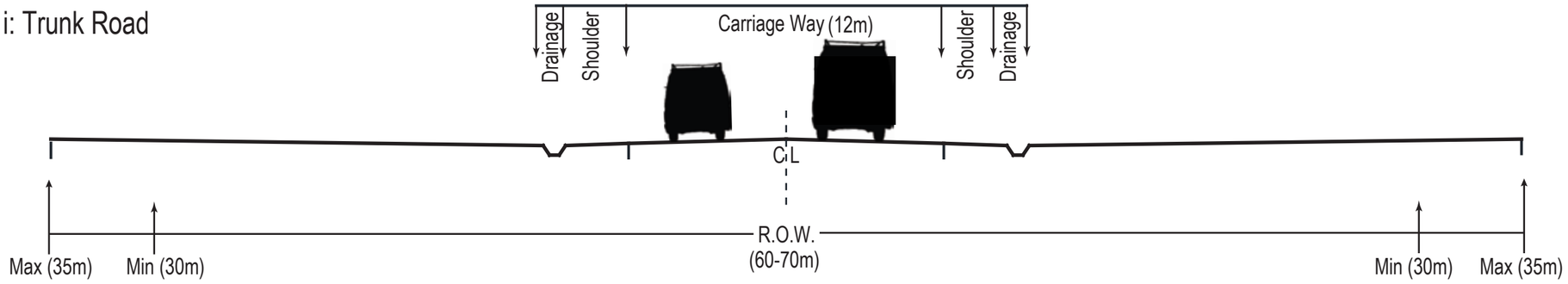
Cons
- Lowest number of existing beneficiaries
- Needs significant infrastructure improvement
- Most likely a later phase in expansion
- Impacts the most agriculture

* Negligable structures include kitchens, latrines, graveyards, abandoned and unknown structures that would otherwise not significantly benefit from a road.

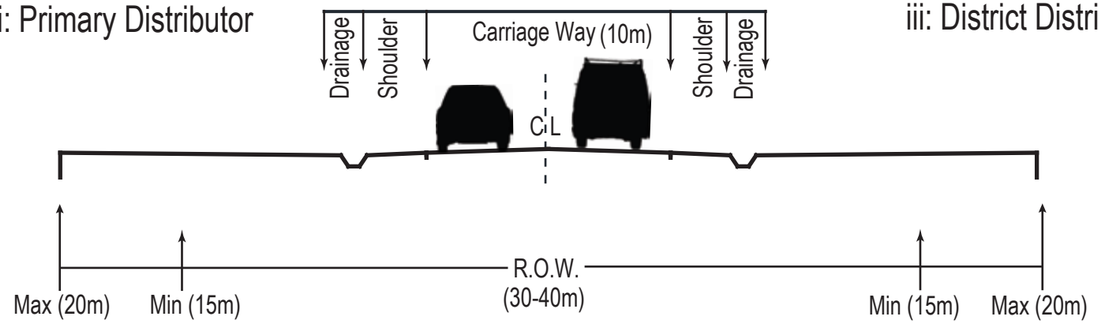


Road Types & Dimensioning

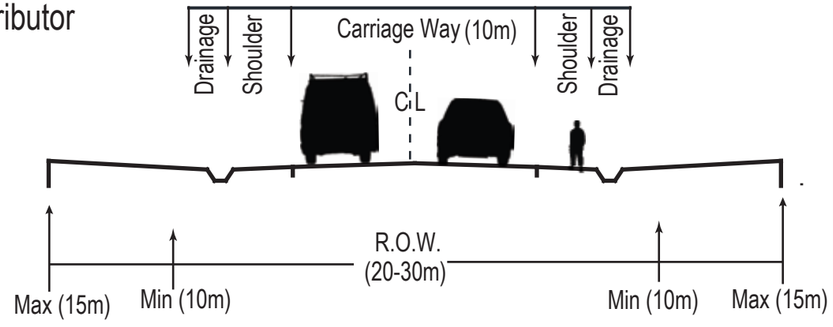
i: Trunk Road



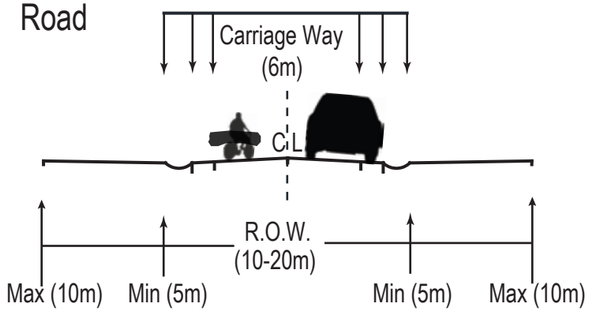
ii: Primary Distributor



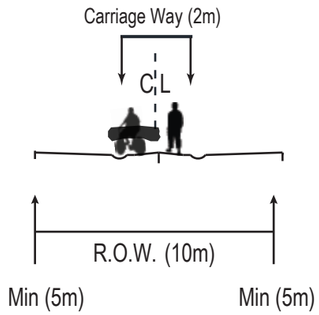
iii: District Distributor



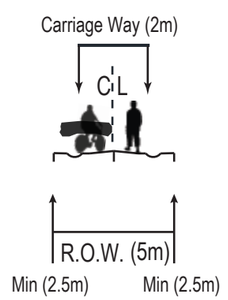
iv: Residential Access Road



v: Pedestrian Access (Current Guidelines)



vi: Pedestrian Access (Proposed Guidelines)

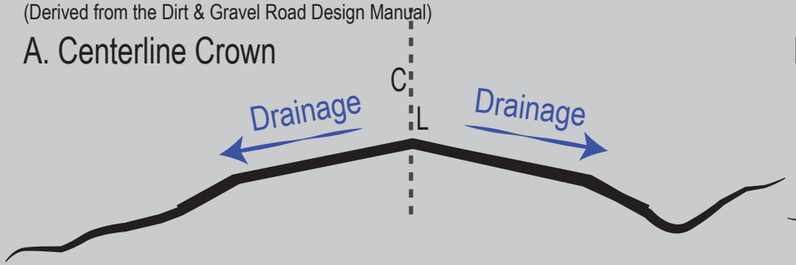


Road Crowning & Cross Slopes

**Road surfaces should be graded to have 4-6% slopes.

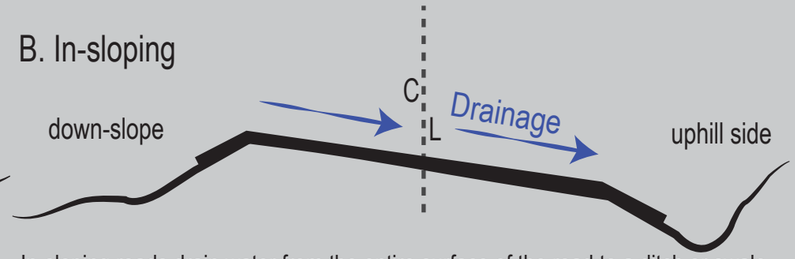
(Derived from the Dirt & Gravel Road Design Manual)

A. Centerline Crown



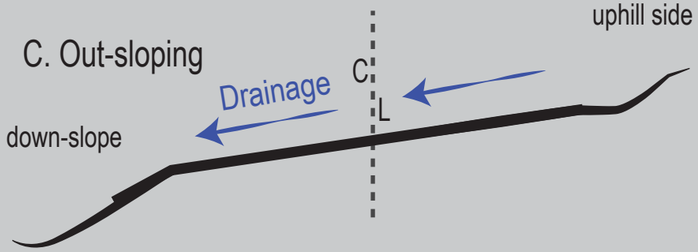
Creating a crowned high point on the road surface will shed water to both sides to prevent standing water, potholes and road surface erosion.

B. In-sloping



In-sloping roads drain water from the entire surface of the road to a ditch or swale. This configuration is most useful on steep hills along banked curves to prevent vehicles from sliding and roads from eroding down the hill side.

C. Out-sloping



This road is designed to shed water from the entire road surface to the downhill side. Most useful on roads with gentle side-slopes and ample space downhill of drainage. Ditches may not be necessary, avoiding concentrated channel flow.

Drainage Ditches

When used properly, drainage ditches can minimize damage to roads by collecting runoff from road surface and preventing erosion or flooding downhill. They should typically have a 'U' shape to them rather than 'V' shape to spread out water and slow it down as it flows.

Shallow Vegetated Ditch

In ditches with shallow slopes (>5%) grass and vegetation can slow water and control erosion.

Steep Reenforced Ditch

Ditches with steep slopes (<5%) should be reenforced with stone or a mix of stone and vegetation to control erosion and also serve as a barrier for traffic.

Road Repair & Construction

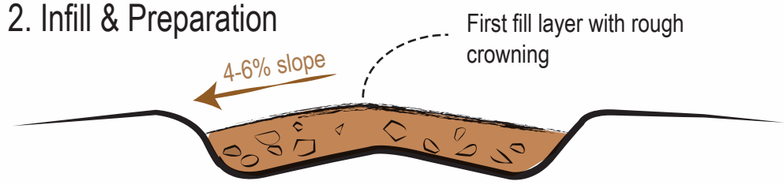
Poorly constructed roads with bad drainage are prone to holding water and quickly erode, significantly hindering traffic flow and need constant repair.

(Derived from the Penn State Center for Dir & Gravel Road Studies, Information/Technical Bulletins)

1. Existing Conditions

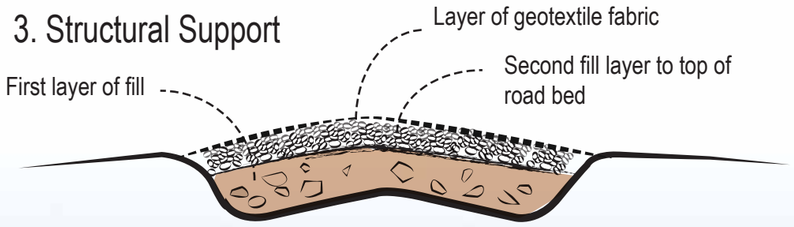
Sunken road trapping water, leading to tire rutting, erosion and constant maintenance. In order to properly repair these conditions, the road should be filled and properly constructed to avoid degredation.

2. Infill & Preparation

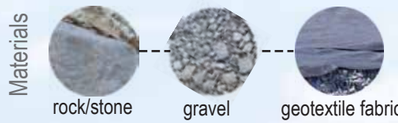


The first step in repair/ construction is regrading the existing road with a crown to establish proper form for drainage.Proceed to add a first base layer of fill material which can include a variety of recycled and locally available materials. Crown and compact once added.

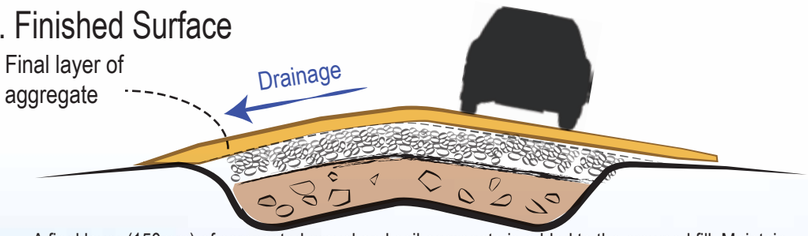
3. Structural Support



A second layer of fill should be added of various sized rock, stone and gravel then compacted and crowned. A layer of geotextile fabric can be added above to help with proper weight distribution, erosion control and support.

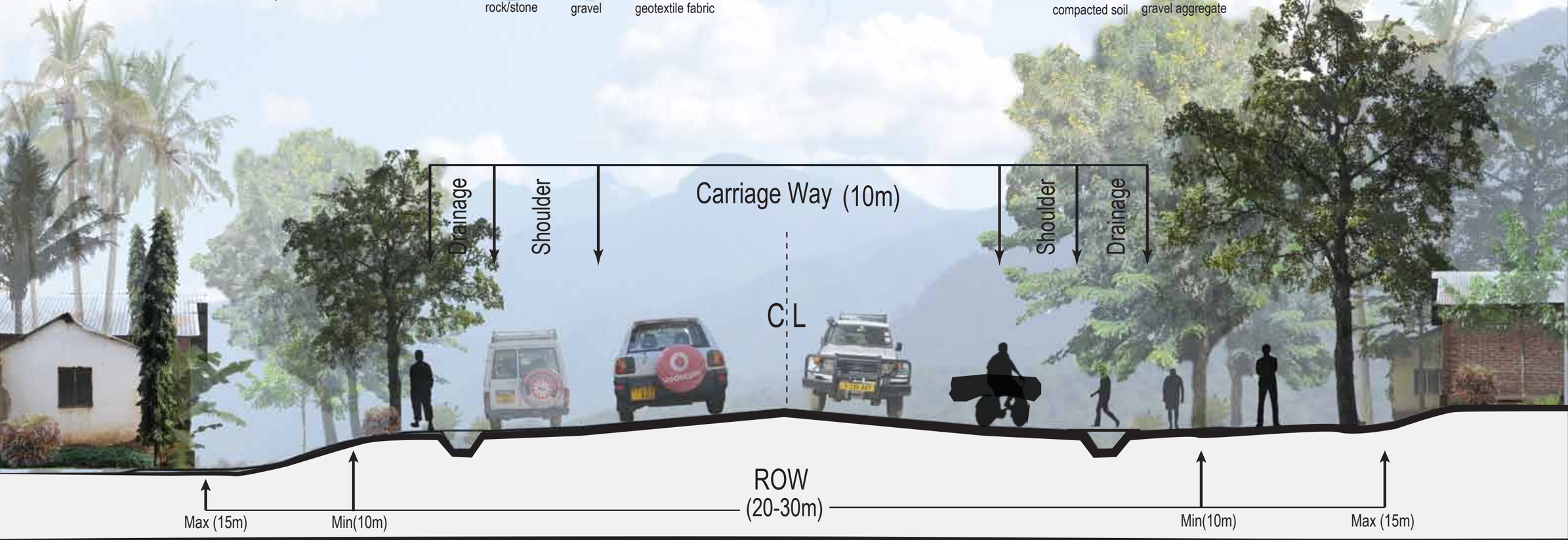


4. Finished Surface



A final layer (150mm) of compacted gravel and soil aggregate is added to the crowned fill. Maintain crown shape and a 4-6% slope for proper drainage.

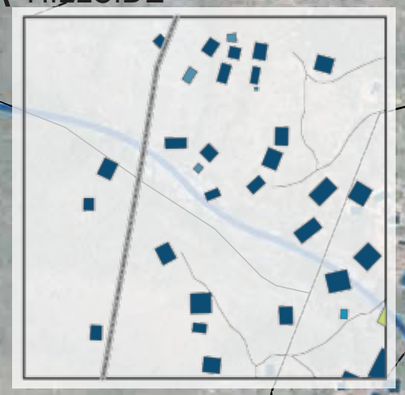
Sample Road Section
(iii: District Distributor)



Current Residential Arrangement

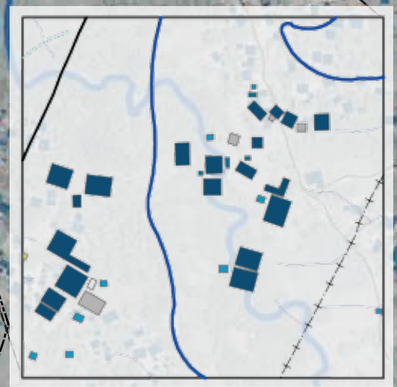
The town of Tundu is expanding upon a variety of geographic contexts. Split by the main road in the area, the village boundary extends into the valley and on the mountainside, with both high density and low density residential areas. Three streams intersect the town creating a series of columns within the village. Due to this variety of contexts four target areas have been chosen for development analysis and planning: on the hillside, in the valley, adjacent to a stream, and within a high density residential area. The development patterns of the village will be compared to the conditions dictated by the Town and Country Planning Regulations of Tanzania.

A HILLSIDE



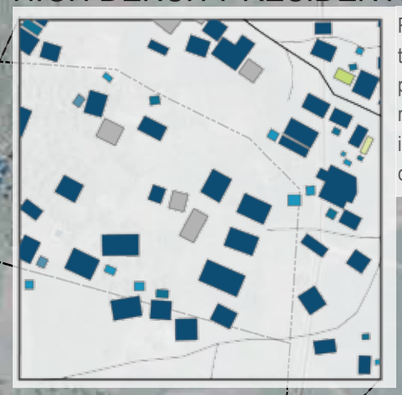
Currently, the mountains adjacent to Tundu have less forest cover than the mountains within UMNP. Residential development is extending up, with a pattern suggesting the formation of neighborhoods dependent on topography.

B STREAM ADJACENCY



This section of Tundu is within the valley and partially bounded by a stream. It is imperative that development does not encroach upon the stream to prevent effects human activities have on stream ecology. Due to the frequency of streams within Tundu it is necessary to highlight development within this context.

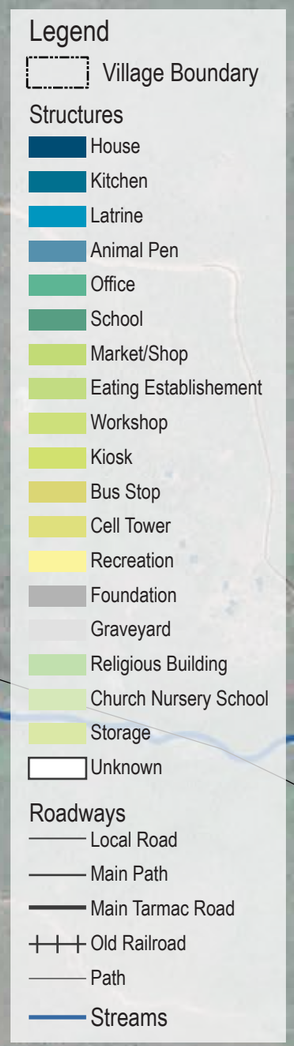
C HIGH DENSITY RESIDENTIAL

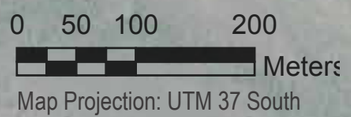


Residential infill can be used to reduce the amount of land consumed on the periphery of Tundu, so a high density residential area was chosen to illustrate how the interior of the town can grow in an organized manner

D VALLEY

The periphery of Tundu has the lowest density within the village. Within this context, development can both incorporate existing buildings and be cognizant of the amount of land consumed per residence. It is within this context that the largest opportunity to reduce land consumption lies.





Map Projection: UTM 37 South

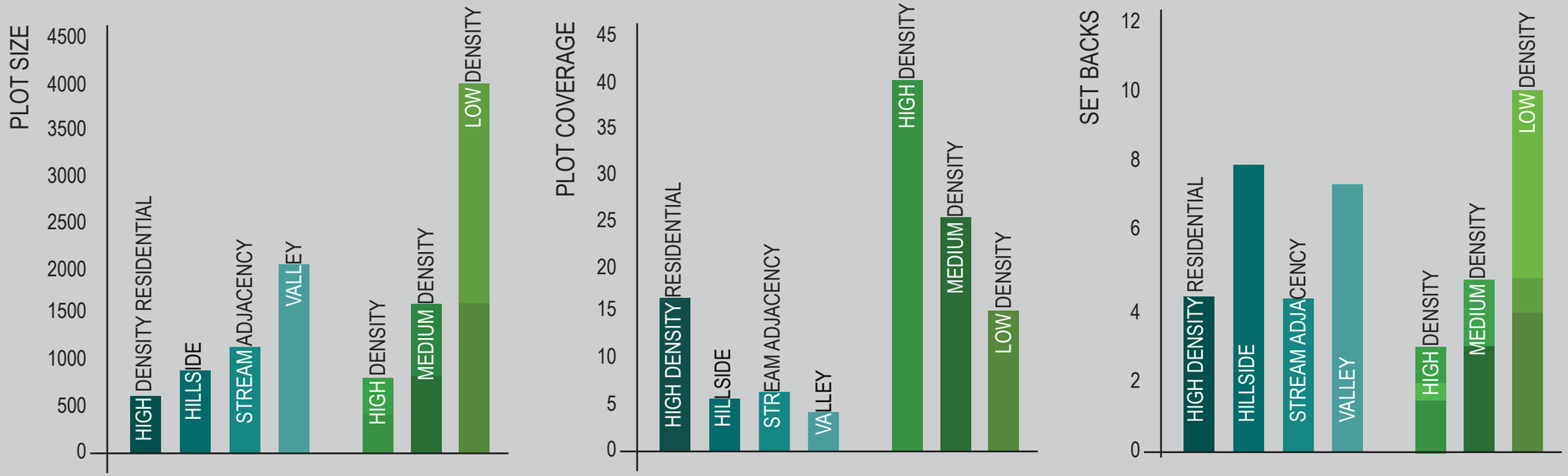
3.1 Residential Development Target Areas

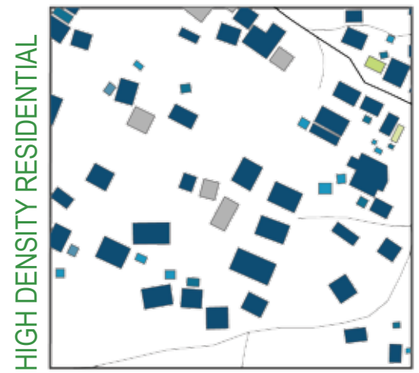
Residential Analysis

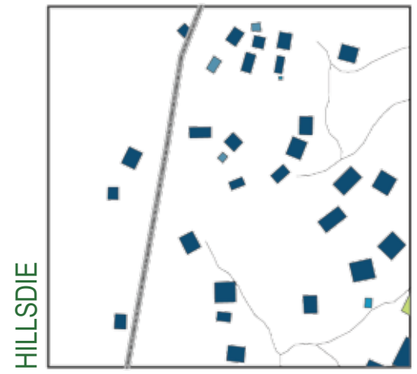
This analysis compares the current development patterns of Tundu to Tanzania's Planning Guidelines. The analysis serves to illustrate the disparities that have occurred between the guidelines and current development pattern.

Conclusions

All three development types are represented; high density development occurs in the high density residential target area, both the hillside and stream adjacency areas fall under the medium density category, while the valley remains low density. None of the target areas match the plot coverage requirements and the set back requirement is met with variable success. Due to the lack of property markers within the village it is difficult to determine property boundaries so this data was determined by measuring the distance between existing homes.







EXISTING CONDITIONS
Requirements have been displayed as averages due to property boundary inaccuracy resulting from a lack of ground markers

S/No.	Type	Avg. Plot Size (sq.m.)	Avg. Set Backs (m.)	Avg. Plot Coverage (%)
	Hillside	865.38	8.27	5.38
	Stream Adjacency	1125	4.44	6.17
	Valley	2045.45	7.69	4.02
	High Density Residential	608.12	4.47	16.44

PLANNING GUIDELINES
Tanzania's Town and Country Planning Regulations for residential areas have been condensed into one table for legibility

	Type	Recommended Plot Size	Set Backs			Plot Coverage
			Front	Sides	Back	
i.	High Density	400-800	3	1.5	2	40
ii.	Medium Density	801-1600	3	3	5	25
iii.	Low Density	1601-4000	5	4	10	15

Building footprints are accurate within one meter. Property boundaries are less accurate due to a lack of ground makers. Plans are intended to represent typical rather than existing conditions with respect to land allocation and development patterns.

0 25 50 100 Meters

Map Projection: UTM 37 South

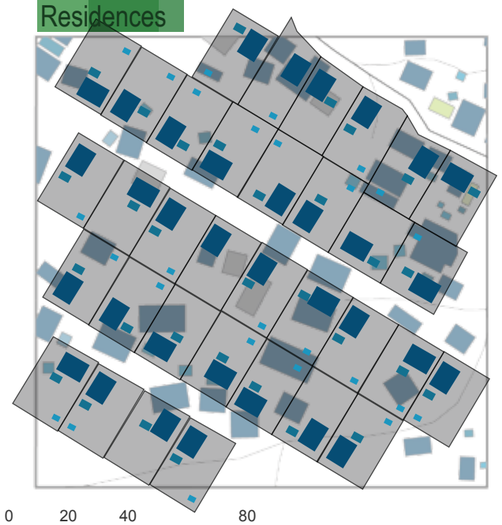
Introduction to Development Strategies

The current development pattern of Tundu does not match the regulations within the Town and Country Planning Guidelines of Tanzania. Utilizing the densities determined during the analysis phase each target area has been developed according to the Planning Guidelines, observing road setbacks and a 10 meter stream buffer. Each plot is accessible by either a land allotment for a pedestrian path or will follow the current access method of small dirt paths. The housing arrangement attempts to emulate the existing pattern and residences are given a **house**, **latrine**, **kitchen**, or **animal pen** depending on existing ratios present in each target area. The following pages follow this building ratio as well with a focus on residential infill within the current village arrangement.

HIGH DENSITY RESIDENTIAL

Regulated development in the high density residential area results in a number of homes comparable to existing conditions. Lots are rectangular in nature to maximize the number of lots in the given area. The pattern of development follows the existing flow of houses resulting in the angular grid with pedestrian paths providing access to each lot. The only constraints on this development pattern is the presence of existing access routes that result in a deviance from the rectangular lot imprinted across this target area.

37 existing
34 planned
Residences



HILLSIDE

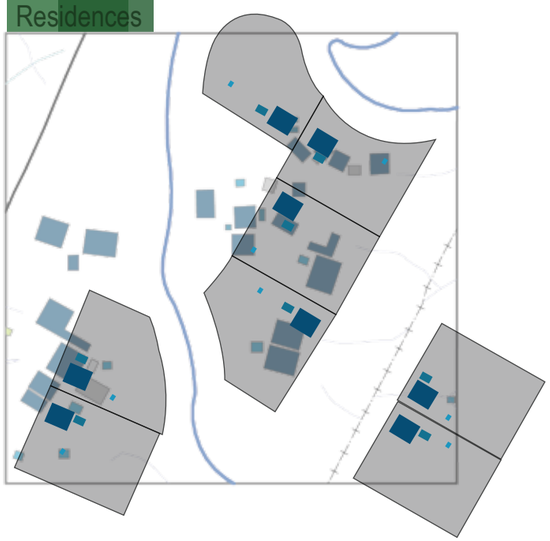
The existing number of homes exceeds the resulting number when the planning guidelines are followed. The regulations do not acknowledge topographical constraints so the grid pattern is imposed on the hillside in a fashion similar to high density development. Despite the disregard for topography, this type of development provides less residential plots than existing conditions. Regulated development does acknowledge the village boundary however, unlike the current arrangement.

26 existing
13 planned
Residences

STREAM ADJACENCY

There is a large difference between the amount of existing residences and proposed residences. Regulated development acknowledges the mandated setback for the nearby trunk road as well as a 10 meter buffer around the stream which partially accounts for this large difference. Not all land can be occupied with this type of development due to the limited amount of land available between the curving stream.

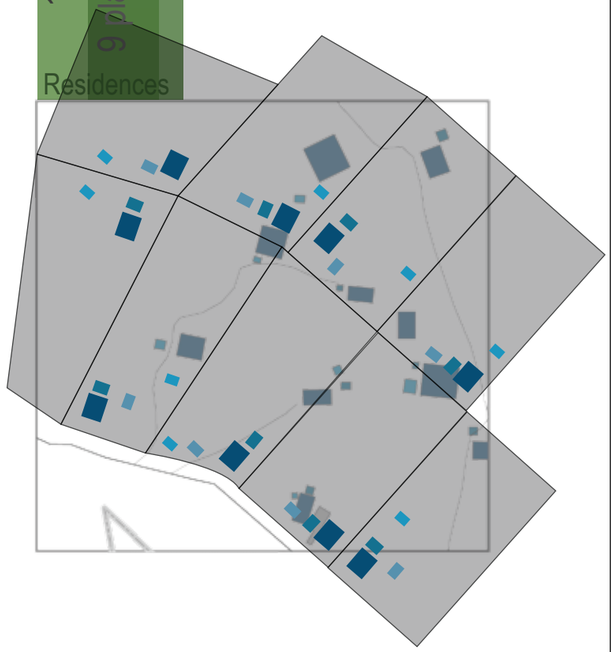
20 existing
8 planned
Residences



VALLEY

Development within the valley is comparable to existing conditions with respect to number of residences. The arrangement of homes across the landscape is vastly different however. The existing pattern involves a combination of clustered homes and isolated homes, while regulated development limits the formation of housing clusters. Development within both scenarios is responsive to the existence of the village cemetery in the lower right corner of the target area.

11 existing
9 planned
Residences

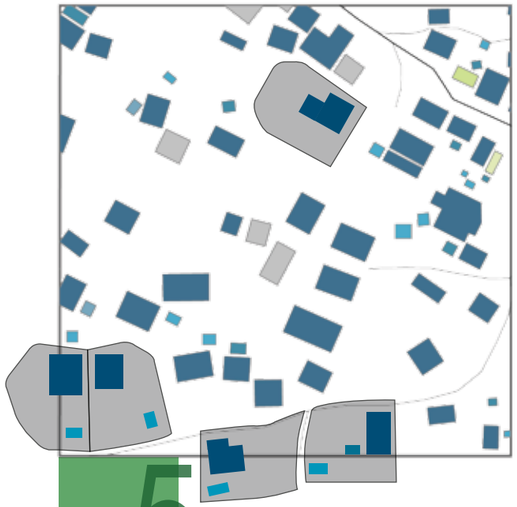


0 20 40 80
Meters

Map Projection: UTM 37 South

MAXIMUM LOT SIZE

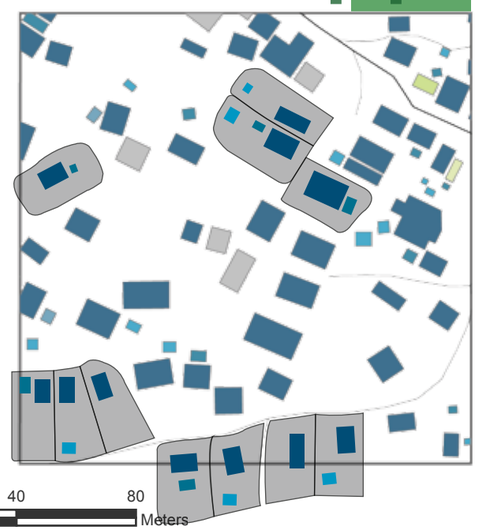
HIGH DENSITY RESIDENTIAL



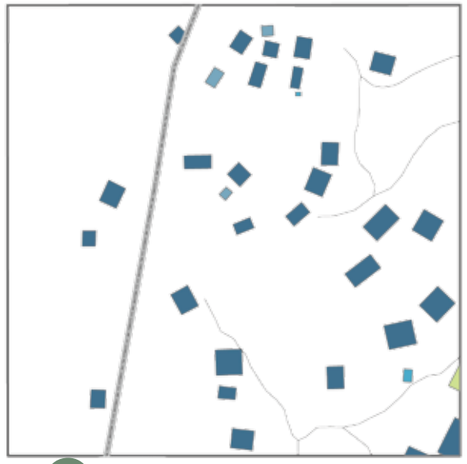
5 Residential Plots

Overall, there is little space within the high density residential area for additional residences. New **houses**, **kitchens**, and **latrines** emulate the current development pattern to maintain the sense of character present within the area. Both the **400 and 800 square meter plots** fill open land large enough to accommodate new residences. Not all available land is developed due to the organic nature of existing properties.

11 Residential Plots



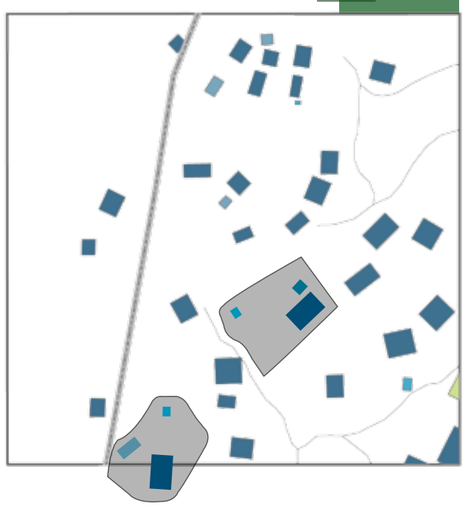
HILLSIDE



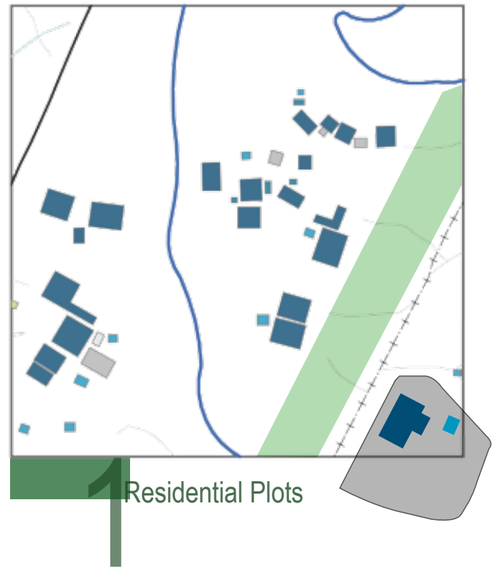
0 Residential Plots

The hillside target area has very few housing plots added to the current arrangement due to the village boundary and topographical obstructions. The two additional **800 square meter plots** follow the terraced nature of the hillside and serve to highlight the difficulties associated with development upon the steeper landform. **Houses**, **kitchens**, and **latrines** are placed dependent on landform rather than available space.

2 Residential Plots



STREAM ADJACENCY

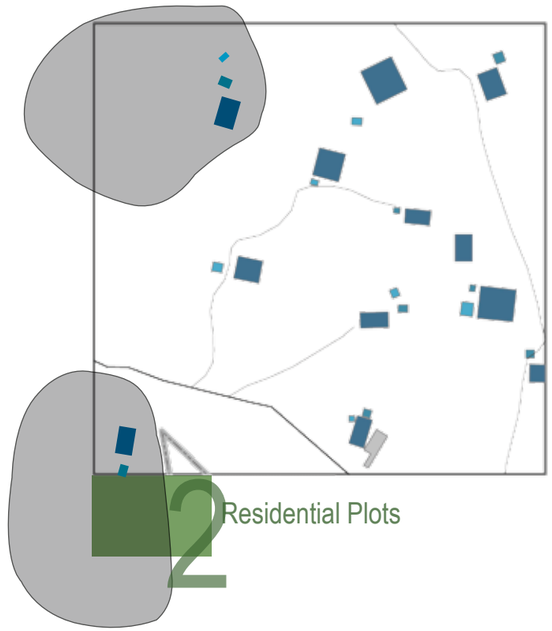


1 Residential Plots

Due to the trunk road in the upper left corner and the 10 meter buffer around the stream, few homes can be located within this context. In addition, a **steep hill** obstructs development on the northern side of the railroad, and organic development prevents the occurrence of large open tracts of land and few **800 or 1600 square meter plots** can be located here. **Latrines** are kept away from the stream, while **homes** and **kitchens** are placed near existing homes to maintain the character of development.

3 Residential Plots

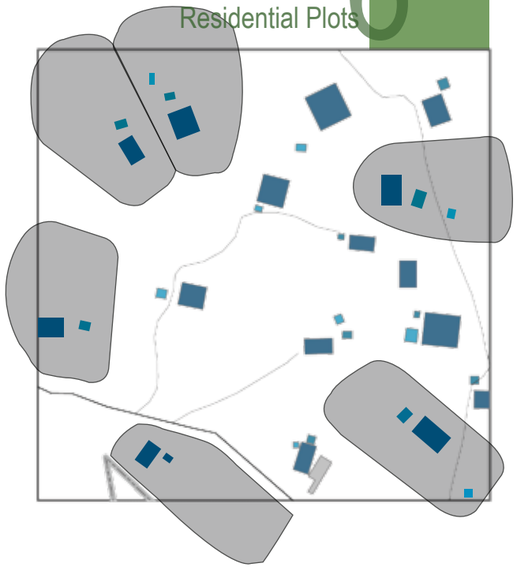
VALLEY



2 Residential Plots

The valley area incorporates **1600 and 4000 square meter plots** to match the low density of development. Located around existing paths and the cemetery border, these residences take advantage of the large amount of open land. **Houses**, **kitchens**, and **latrines** are sited within their lot to both create and integrate with existing housing clusters.

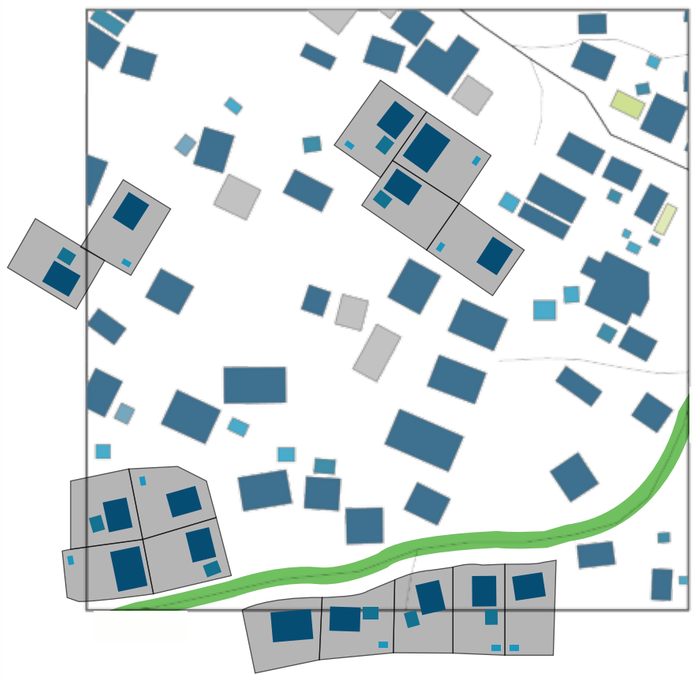
6 Residential Plots

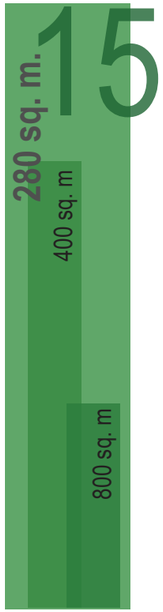


MINIMUM LOT SIZE

0 20 40 80
Meters

Map Projection: UTM 37 South





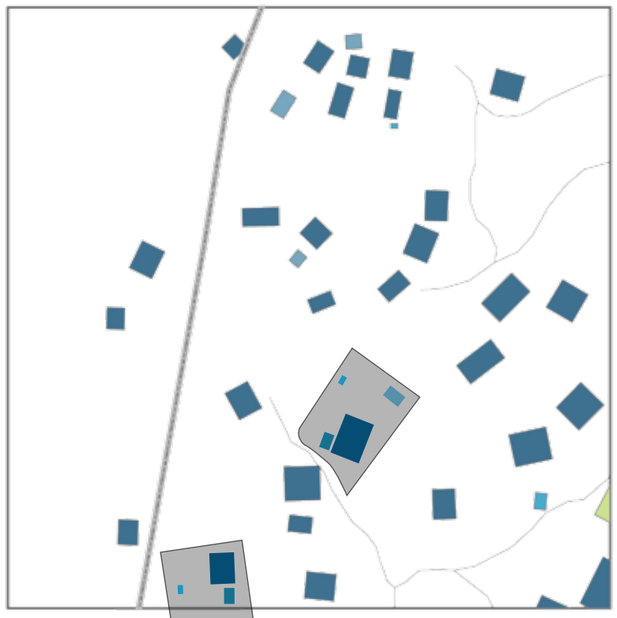
15 Residential Plots

This development plan utilizes a lot size that consumes 30% less land per lot than the smallest recommended plot size within the guidelines. The **280 sq.m. lot** arrangement incorporates with the current development pattern, including at most a **house**, **kitchen**, and **latrine**. Included in this plan is land allocation for a **new road** to increase access within the village, and lot arrangement attempts to remain geometric in order to increase efficiency. The smaller lots allow for more residences to fit into tighter spaces present in this context leading to the addition of 4 more lots to this plan compared to the smallest recommended plot size within the Planning Guidelines.

30% Reduction in land

High Density

Type	Plot Size	Set Backs			Plot Coverage
		Front	Side	Rear	
High Density	280 sq. m.	3 m	1.5 m	1.5 m	31%



0 15 30 60
Meters
Map Projection: UTM 37 South

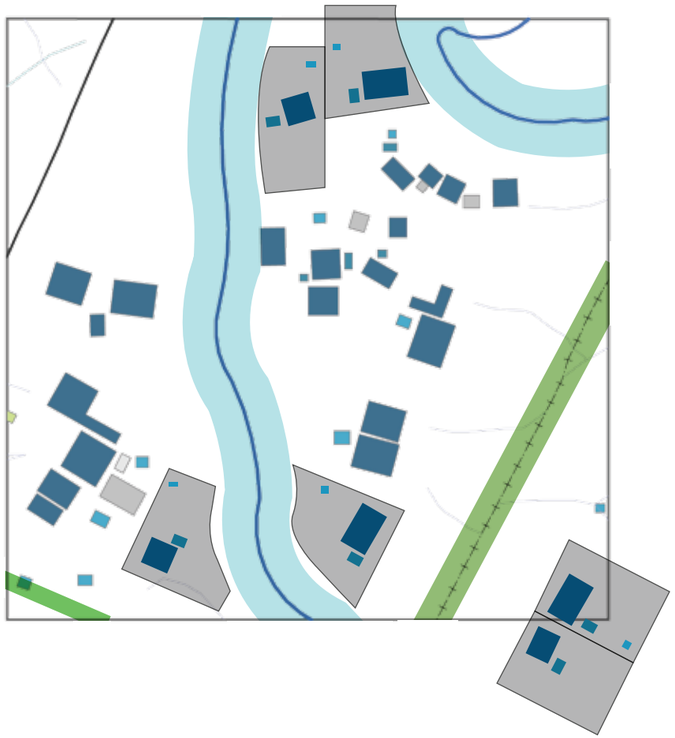
The forested site does not include a high percentage of residences due to topographical obstructions and the need to increase forest coverage upon the hillside. Reducing the amount of new residences allowed on the mountain provides space for the inclusion of native vegetation that will prevent soil erosion and have a positive impact on water quality. Utilizing a **560 sq. m. lot** as opposed to the medium density recommendations can reduce the amount of land consumed but only if paired with a development strategy that lowers the number of leaseholders allowed to live on the mountain. Due to the high frequency of animal pens on the mountain, these lots include a **house**, **kitchen**, **latrine**, and **animal pen**. Development patterns follow existing patterns of terracing to create enough flat land to build upon.

2 Residential Plots

Reduction in leased land, inclusion of forest

Medium Density

Type	Plot Size	Set Backs			Plot Coverage
		Front	Side	Rear	
Medium Density	560 sq. m.	3 m	1.5 m	2 m	17%



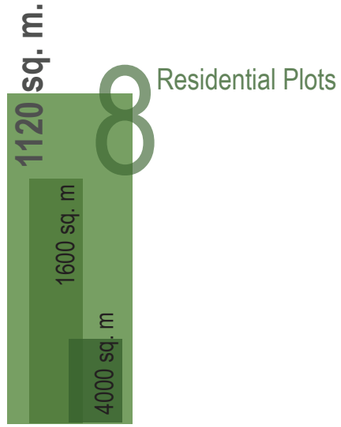
In order to maintain stream ecology and health, a **10 meter buffer** should be incorporated into development plans, with a 15 meter buffer for latrine placement. A 30% reduction in lot size (**560 sq. m**) allows for the inclusion of lots into the tighter spaces in this context. The **railroad** includes a buffer for the possibility of repurposing it for infrastructure improvements while a **proposed road** creates a buffer in the southern corner. The topographical barrier adjacent to the railroad is avoided while **houses**, **kitchens**, and **latrines** are located in the cluster arrangement seen within this development context.

10 m. stream buffer

Medium Density

Type	Plot Size	Set Backs			Plot Coverage
		Front	Side	Rear	
Medium Density	560 sq. m.	3 m	1.5 m	2 m	17%

Development within the valley incorporates residential lots into existing pockets of land and larger open tracts to illustrate the possibilities when using a lot size that is 30% smaller than the recommended size. Each **1120 sq. m. lot** in this plan includes a **house**, **kitchen**, and **latrine** yet only covers 5% of the lot, leaving 95% of the land available for food production. Building location is responsive to the existing context by creating housing clusters within lots that are adjacent. With this type of development it is possible to insert residences in amorphous tracts of land as well as open tracts more conducive to geometric lots.



95% land available for agriculture

Low Density

Type	Plot Size	Set Backs			Plot Coverage
		Front	Side	Rear	
Low Density	1120 sq. m.	3 m	2 m	3 m	5%

The development plan for Tundu includes 3 types of zoning targeting ares for future **public infrastructure** and **residential** development as well as **reduced** development. Reduced development occurs on the hillside and low density areas on the edges of the village to preserve ecosystems and maintain the productive agricultural lands within the village boundary. Public Infrastructure Development is targeted around existing and proposed access routes from section 2.4, acknowledging the ROW requirements. Residential development is relegated to infill areas towards the center of village land to maximize the number of residential plots while reducing land consumption on the periphery of town. This arrangement organizes public utilities around main transportation routes while residential neighborhoods form further from the throughway interface.

Example of Public Infrastructure Development

0 15 30 60 Meters

Legend

Village Boundary

Structures
- Impacted Structure*
- Residence
- Public Areas/Buildings
- Religious Areas
- Office
- School
- Shops
- Market
- Service Trade
- Negligible

Rivers

Roadways
- Local Road
- Main Path
- Main Tarmac Road
- Old Railroad
- Path

Development Target Areas
- Reduced Development
- Public Infrastructure Development
- Resdential Development

* Impacted structure is referenced from sections 2.2 & 2.3 (Scenarios 2 & 3) for minimum impact.

0 50 100 200 Meters

Map Projection: UTM 37 South

Goals

1 Public Infrastructure

• Take inventory of and acknowledge shortcomings of existing public amenities under the planning guideline recommendations
• Illustrate the impacts of modernization and target public infrastructure for expansion

2 Transportation Infrastructure

• Provide visualizations of the implications of imposing planning guidelines along current village transportation routes
• Offer alternative scenarios to minimize impacts while still abiding by planning guidelines
• Improve inter/intra-village circulation efficiency,quality and clarity
• Model possibilities for future transportation infrastructure expansion to best access public services, commercial areas and residential areas with minimum impact
• Influence and guide future village growth and expansion in more organized, efficient ways

3 Residential Development Patterns

• Provide short term solutions for a growing population
• Illustrate the benefits and drawbacks of development under the Planning Guidelines
• Offer solutions to the issue of land consumption and inefficient growth
• Highlight the issues associated with development on different contexts and propose ways to mitigate the negative effects
• Provide examples on how to integrate residential infill with the existing pattern of development

4 Development Plan

• Coordinate development and future growth between transportation, public services and residential expansion
• Begin to relocate structures impacted by planning guidelines
• Specify areas for targeted or reduced expansion
• Provide a model for future planning efforts

Conclusion & Implications

This project aims to both aid the village of Tundu and provide a model for informed growth in areas within the vicinity of Udzungwa Mountains National Park. By conducting an analysis of current conditions the design solutions are responsive to site context and the implications of modernization. It is our intention to not only highlight the implications of designing under the instruction of the Town and Country Planning Guidelines but provide ways to reduce the negative impacts of that result. We hope this project allows the village of Tundu to begin organized development in such a way that responds to both the government requirements and the current context of the village.

The focus on transportation infrastructure provides improved access throughout the village enabling the inclusion of public facilities that are not only lacking within the village, but those that are impacted by modernization. A guide to residential development within the variety of contexts present in the village will aid in mitigating the effects of unorganized growth associated with the current population increase so that Tundu can begin to develop in such a way that is conducive to modernization as Tanzania progresses.

Each portion of the project acknowledges the negative effects of future growth under the Planning Guidelines and aims to provide scenarios that minimize them so that development may be responsive to the current development pattern within the village. The project intends to help the village adopt a development plan that helps with both short term and long term issues that arise when population increases and is informed by the existing development pattern to create guidelines that allow the village to maintain the sense of character that currently exists while easing pressures on natural resources.

All development plans are only meant to serve as suggestions or possible models for analysis that can be used for further planning efforts. Future work should involve accepted participatory planning strategies involving village leadership and community members.

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Kilosa District, Tanzania

The World Wildlife Foundation
Dar es Salaam, Tanzania

References