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Health systems map and accessibility modelling to enhance routine immunisation microplanning

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AfriGIS Analysis Report – SHISELWENI REGION

WHERE is where it starts

Geospatial Information Scientists

Terms & Definitions

Term	Definition
UNICEF	United Nations Children's Fund
CMIS	Client Management Information Systems
CSO	Civil Society Organisations
GIS	Geographic Information System
HFML	Health Facility Master List
ID	Identifier
MOH	Ministry of Health
OSM	OpenStreetMap
POI	Points Of Interest
SISF	Spatial Information Strategy Framework
WHO	World Health Organisation

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EXECUTIVE SUMMARY

The government of Eswatini with the support of UNICEF and partners, aim to reach “Zero-Dose Communities” in the country with the purpose of expanding the immunisation footprint. To assist with the microplanning in identifying these locations, AfriGIS has been contracted to perform the analysis.

Shiselweni region currently has 32 existing immunisation centres, 7 facilities that have been closed, 8 with no link to HMIS/CMIS tables and 5 OSM facilities. These comprise 13.4% of the total number of existing and candidate facilities in the country.

Shiselweni II has the highest number of existing immunisation centres in the region. Shiselweni II and Maseyisini have the most existing and candidate facilities combined.

Existing immunisation centres provide access to approximately 210 463 people or 96.09% of the Shiselweni region’s population.

Population coverage within a 5km travel distance is 40.25% of the population, with 40.79% covered between 5-10km and 15.12% between 10-15km. The rest of the population is considered as not being covered due to the travel distance exceeding the maximum of 15km.

Maseyisini and Sigwe Tinkhundla have the best population coverage in the region with 99.97% and 99.94% respectively being covered. Kubuta and Somntongo has the worst coverage with only 86.54% and 73.07% respectively of the population covered with the existing facilities.

The average travel distance for individuals in Hhohho region is 6.08km with people in Maseyisini having the lowest average travel distance of 4.37km and residents of Nkwene needing to travel on average the furthest at 7.31km.

It is proposed that 1 additional fixed facility be implemented as immunisation centres. It is a facility that was previously in use but has been closed. The facility is in Sigwe Tinkhundla. Addition of this facility will reduce the population that is not covered to 3.11% or 6 812 individuals.

The addition of 30 mobile locations is also proposed, which will assist to provide coverage in areas where accessibility is low and there are no candidate facilities. Mobile locations will reduce the population not covered to a further extent, with a potential of 99.05% of the population being covered.

Demand on existing facilities have also been reduced and is now better distributed.

1 Introduction

The government of Eswatini with the support of UNICEF aim to reach “Zero-Dose Communities” in the country with the purpose of expanding the immunisation footprint. To assist with the microplanning in identifying these locations, AfriGIS has been contracted to perform the analysis.

An extensive analysis study was conducted using Eswatini 2017 Census data provided on a Tinkhundla level, Kontur population grid, Government Immunisation facilities, OSM road network and points of interest and topology layers such as a digital elevation model, rivers and waterbodies.

The detailed methodology followed is described in this document. Findings are reported on a National and Regional level.

2 Objectives and scope of the study

The overall objective of the study was to evaluate the levels of access to immunisation facilities and elicit recommendations for the optimum provisioning and location of immunisation facilities. The intention is to increase the population coverage while minimising the need for establishment of new facilities.

This study assessed the current availability and accessibility of immunisation facilities in relation to actual distances travelled and in relation to the present location of other government services. It also identified specific areas where accessibility needs to be improved.

Key services which are considered in the study include those that are provided by the Ministry of Home Affairs, Ministry of Labour and Social Security and selected services of the Royal Eswatini Police Service. These are services which people require to transact their daily lives.

This study also highlights the demand that is placed on each facility. Demand is calculated by distributing population within 15km of a facility using the percentage of the inverse distance to the related facility. The newly proposed immunisation facilities would therefore serve two purposes firstly to increase the coverage of population within 15km of an immunisation facility and secondly to relieve existing immunisation facilities with the demand placed on them.

3 Methodology and approach

The overall objective of the study was to evaluate the levels of access to immunisation facilities and elicit recommendations for the location of immunisation facilities. The intention is to increase the population coverage while minimising the need for establishment of new facilities.

This study assessed the current availability and accessibility of immunisation facilities in relation to actual distances travelled. It also identified specific areas where accessibility needs to be improved.

3.1 Datasets used

Some datasets were received from the Eswatini Ministry of Health, and some were sourced by AfriGIS. A list of datasets, their source and comments are shown below:

Table 1 Datasets used

Dataset description	Dataset detailed name	Source	Format	Date/Version	Comment
Population data	Census 2017 - Tinkhundla level	MOH	Spatial	2017	Actual numbers used
Kontur population	Kontur hexagon population	Kontur	Spatial	20231101	Used to distribute Census 2017 population data to smaller Kontur boundaries
Immunisation facilities	CMIS and HMIS tables	MOH	Data tables	2023	Data joined to spatial data where possible using facility name
Immunisation facilities	Location of existing immunisation facilities	MOH	Spatial	2023	Location data used in conjunction with data tables provided
OSM Points of Interest	Health facilities and key services	OSM	Spatial	2023/11/14 - downloaded date	Location data used
Rivers and dams	Location and size of water bodies	MOH	Spatial	2023	Used due as it was more accurate and had river order attribute
Rivers and dams	Location and size of water bodies	OSM	Spatial	2023/11/14 - downloaded date	not used - MOH data was more accurate and had river order attribute
Road network	Routable road network	OSM	Spatial	2023/11/14 - downloaded date	Most accurate routable road network available
Digital elevation model	Digital elevation model	Shuttle Radar Topography Mission	Spatial	17/04/2015	Used to determine terrain and create contour polygons

3.2 Factors used

The table below shows the factors used when calculating coverage and demand.

Table 2 Factors included

Factor description	Dataset detailed name
Population data	Entire population considered
Existing Immunisation facilities	Facilities classified as "Open" on CMIS and HMIS tables were used as current facilities
Candidate Immunisation facilities	"Closed" facilities on CMIS and HMIS tables, and OSM POI were used as potential facilities
Travel distances	Distances of 5, 10 and 15km travel were used
Rivers and dams	River order of 0-4 to classify magnitude of the river
Road network	Routable road network
Digital elevation model	Steep terrain was defined as a slope of 15 degrees or more

3.3 Analysis approach

The Geographic accessibility analysis considers factors such as population size and density, the distance for people to travel to clinics, the availability of roads as well as population thresholds around clinics. The analysis used a movement network to determine travel distance, hence actual travel distances were used.

The approach of this study was to optimise the provisioning and location of different types of immunisation facilities to achieve a 15 km coverage across Eswatini. To reduce the cost involved in establishing additional infrastructure, optimum locations were identified to achieve the maximum possible population coverage with the least number of additional facilities.

3.3.1 Population

The Kontur population dataset was used to measure population within 400-meter resolution. The Kontur data was however not accurate enough and Census 2017 data was distributed to the Kontur grids. Kontur population does not indicate age groups, so the study makes use of the entire population.

The average centroid of buildings falling inside the grid was used to create the origin point for a journey. The assumption was made that building footprints indicate where most of the people stay within a grid block and therefore the average building centroid will cover more population than the actual centroid of the Kontur population grid block.

3.3.2 Facilities

Destination facilities were classified and weighted as in the below table:

Table 3 Facility classification

Facility	Description	Location-Allocation Type
Open Immunisation Facility	Permanent immunisation facility that has a track record of immunisations done in 2023 and had a status indicating that the facility is still open.	Required
Open Facility Without Immunisation Records	Permanent immunisation facility without track records of immunisations done in 2023 and had a status indicating that the facility is still open.	Candidate (strong weight)
Closed Immunisation Facility	Previously permanent immunisation facility with a status indicating that the facility has been closed.	Candidate (strong weight)
OSM Health Facility	OSM points of interest classified as doctors, hospitals or pharmacies	Candidate (strong weight)
OSM Key Services	OSM points of interest classified as fire stations, libraries or schools	Candidate (weak weight)

If some of these points are in the same location as an existing facility, the analysis will disregard these, as that area will be covered by existing facilities.

3.3.3 Natural barriers

Natural barriers were considered affecting travel between origin population points and facilities. Rivers with an order of one and above, water bodies and steep terrain were considered as natural barriers.

3.3.4 Road network

Rout-based calculations were done from community centroids to immunisation facilities. Rout-based analysis requires a routable road network created from road segments and connection points. The OSM road network formed the base of the routable road network.

To route to a community, links were created from the centroid of a Kontur population grid block to the closest OSM road.

To further establish interconnectivity between communities, straight lines were created between the centroids of the Kontur population grids using Triangular Irregular Networks (TIN). Road networks generally suggest that people traveling on the ground can freely move from one point to another following the road network, by walking, cycling, driving or other modes of transport. The new links created assume that movement is possible along the line, so natural barriers were considered to delete links deemed to be impossible or difficult to cross.

3.3.5 Coverage analysis

Road based calculations and algorithms were used to determine existing immunisation coverage as well as to locate new immunisation facilities.

Accessibility modelling was done to determine the current population coverage of immunisation centres and clinics. To quantify the demand on each centre and to identify areas that are under-, over- or poorly served, catchment area analysis was done.

Population coverage was calculated on a 15km routable road-based distance from a community centre to an existing immunisation facility. Population counts were also used to estimate the amount of people that are likely to visit the immunisation facility.

The assumption was made that the closer the immunisation facility is to a community centre the more likely people from the community will travel to the respective immunisation facility. Population was therefore proportionally assigned to immunisation facilities based on inverse travel distance.

Origin points (community centroids) that could not be connected to the road network represents disconnected community centroids without travel links to the network dataset. The population associated with the disconnected centroids were added to the not covered population but classified as inaccessible. The road network or links to the road network needs improvement to gain access to the inaccessible population.

A cutoff of 15km ensure that a community centroid (origin points) is only linked to existing immunisation facilities (destination points) within a road distance of 15km. The covered communities were further divided into three categories namely covered within 5km, 10km.

This study assumed that the closer a facility is to a community, the more likely the community will visit the respective immunisation centre. Population belonging to community centroids that have more than one immunisation facility within 15km were proportionally divided between facilities. A shorter travel distance should therefore carry more weight than a farther distance, hence the proportion of population per facility were calculated using the inverse distance weight.

Demand points were represented by the community centroids. The assumption was made that people would travel from the community centroid to an immunisation facility rather than an immunisation facility sending healthcare workers to a community centroid, hence the direction of travel was chosen as toward facilities.

The output chosen and required facilities from the Location-Allocation analysis were used to determine the hypothetical population coverage as if the proposed facilities existed. The coverage calculations were done in the same manner as the assessment of the current provisioning and location of facilities with the added proposed locations as the only difference. The result shows the coverage that is possible if the proposed facilities were available for immunisations. It also gives an indication of the distribution in demand, with more people being serviced within a 5km and 10km radius and demand being distributed to other facilities.

Community Centroids located outside the 15km route-based threshold of existing and proposed immunisation facilities was considered as possible base locations for mobile clinics. Using the analysis methods, the most ideal locations for these mobile facilities were determined.

The analysis was done on a national level and then for each region, with results in the region reported on Tinkhundla level.

4 Shiselweni Region - Overview

The general overview describes the characteristics of the region to from the background for the study.

4.1 Geographic overview

Shiselweni region is in the most Southern part of Eswatini. Its northern and most of the eastern boundary borders the south of Lubombo and Manzini regions. A part of the eastern, the entire southern and western region borders South Africa.

It covers an area of approximately 4 005,18 km², or 23.06% of the entire country. It is the second largest region in the country Lubombo as the largest at 5 856.04 km² or 33.72% and slightly larger than Manzini with 3 914.62 km² or 22.54%.

The cities in Shiselweni, listed from the most northern city and proceeding clockwise, are Hlatikulu, Kentucky, Zibe, Hluti, Nhlangano and Gege. The administrative centre is Nhlangano.

Figure 1 Shiselweni Location in Eswatini

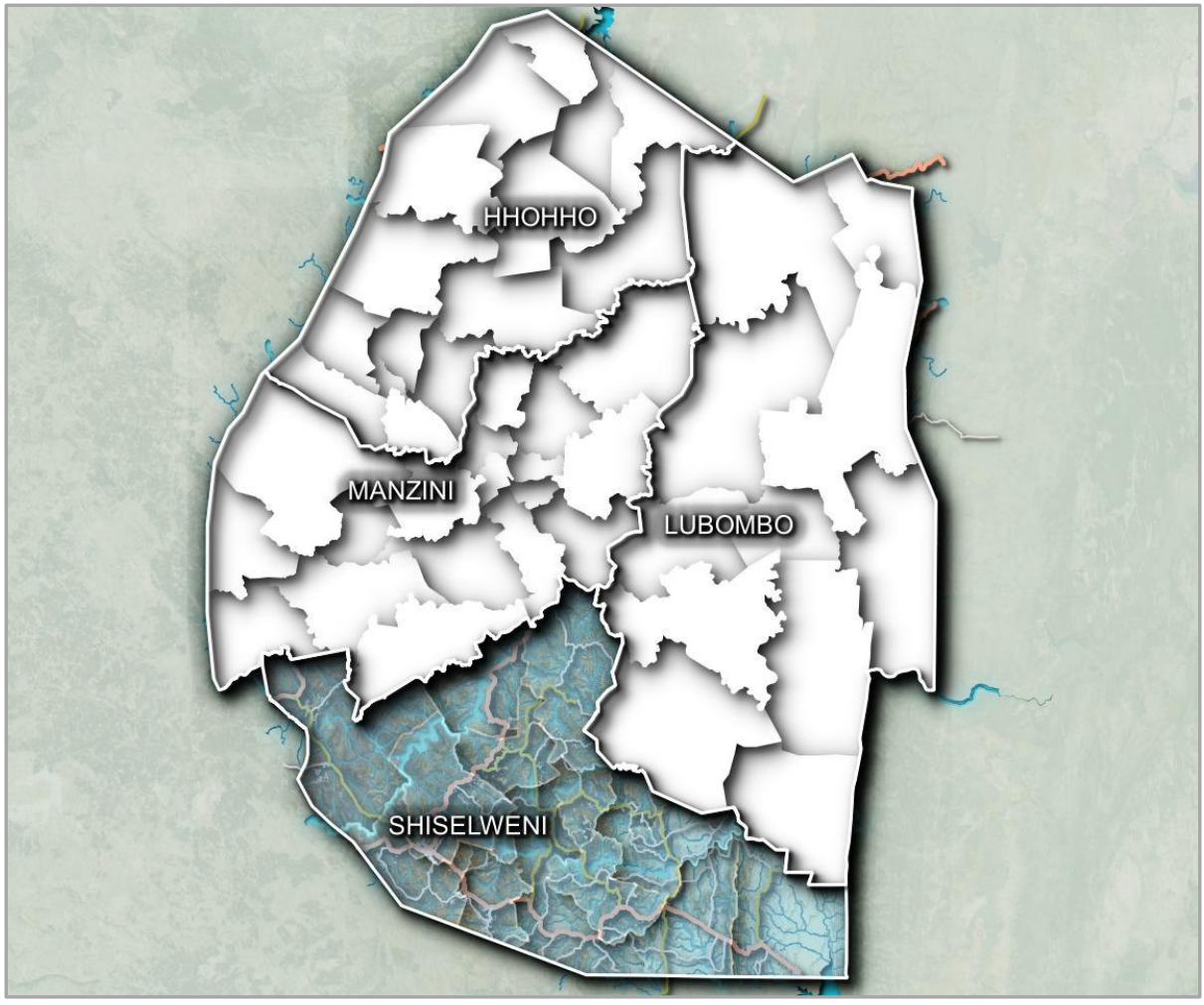
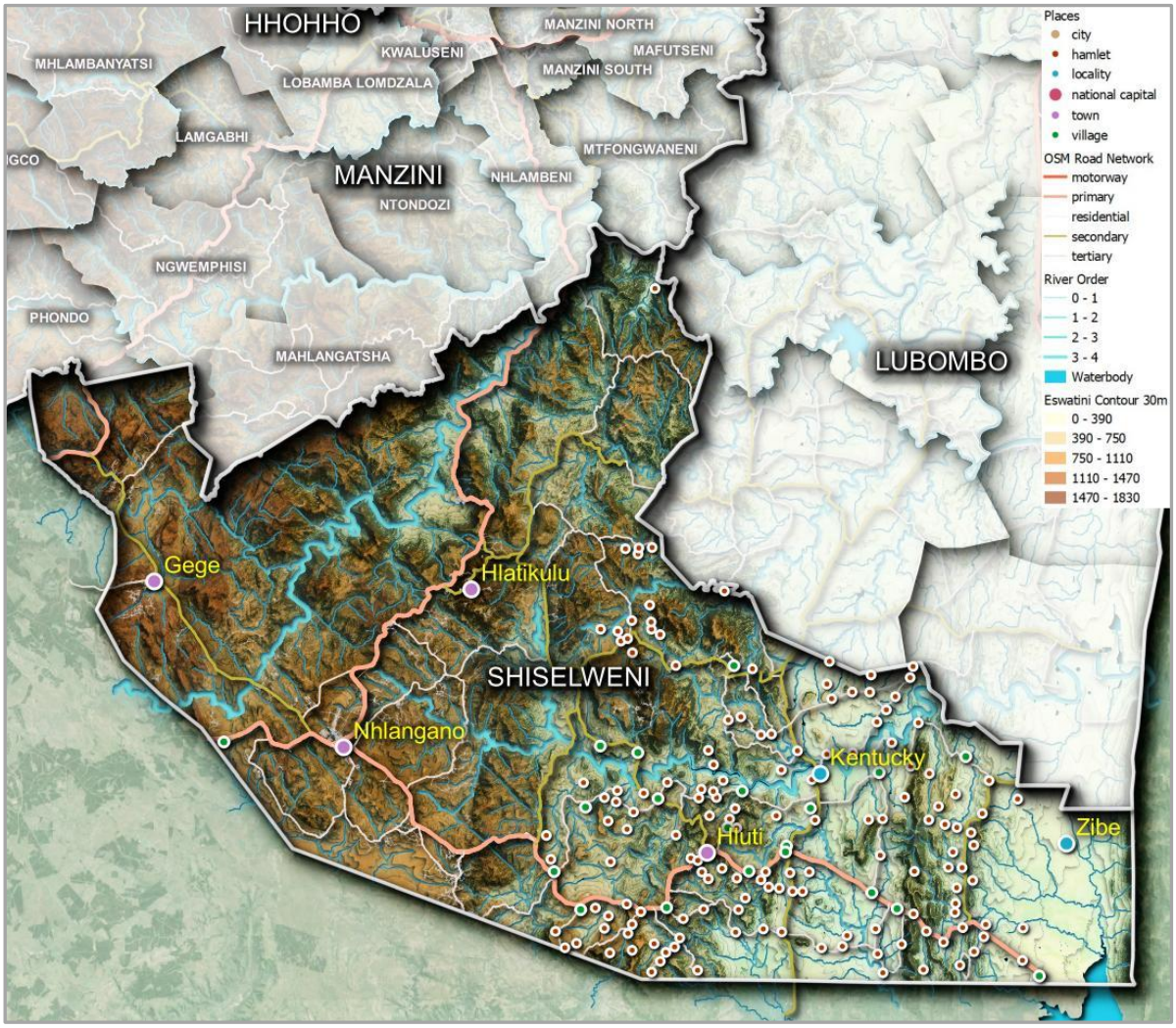


Figure 2 Shiselweni Geographic Overview



The region is divided into 15 Tinkhundla areas of which Gege covers the most area and Ngudzeni and Kumethula the least.

Table 4 Shiselweni Land Area

Tinkhundla	Area (km2)	Percentage of Total Eswatini Area
GEGE	570.92	3.29%
HOSEA	216.19	1.24%
KUBUTA	400.01	2.30%
KUMETHULA	115.94	0.67%
MASEYISINI	242.98	1.40%
MATSANJENI SOUTH	323.19	1.86%
MTSAMBAMA	193.28	1.11%

Tinkhundla	Area (km2)	Percentage of Total Eswatini Area
NGUDZENI	114.88	0.66%
NKWENE	255.51	1.47%
SANDLENI	163.98	0.94%
SHISELWENI I	225.10	1.30%
SHISELWENI II	363.29	2.09%
SIGWE	217.62	1.25%
SOMNTONGO	440.53	2.54%
ZOMBODZE EMUVA	161.76	0.93%

4.2 Economic drivers

Shiselweni has a strong history in the timber industry. Agriculture also shapes the economic landscape in this region.

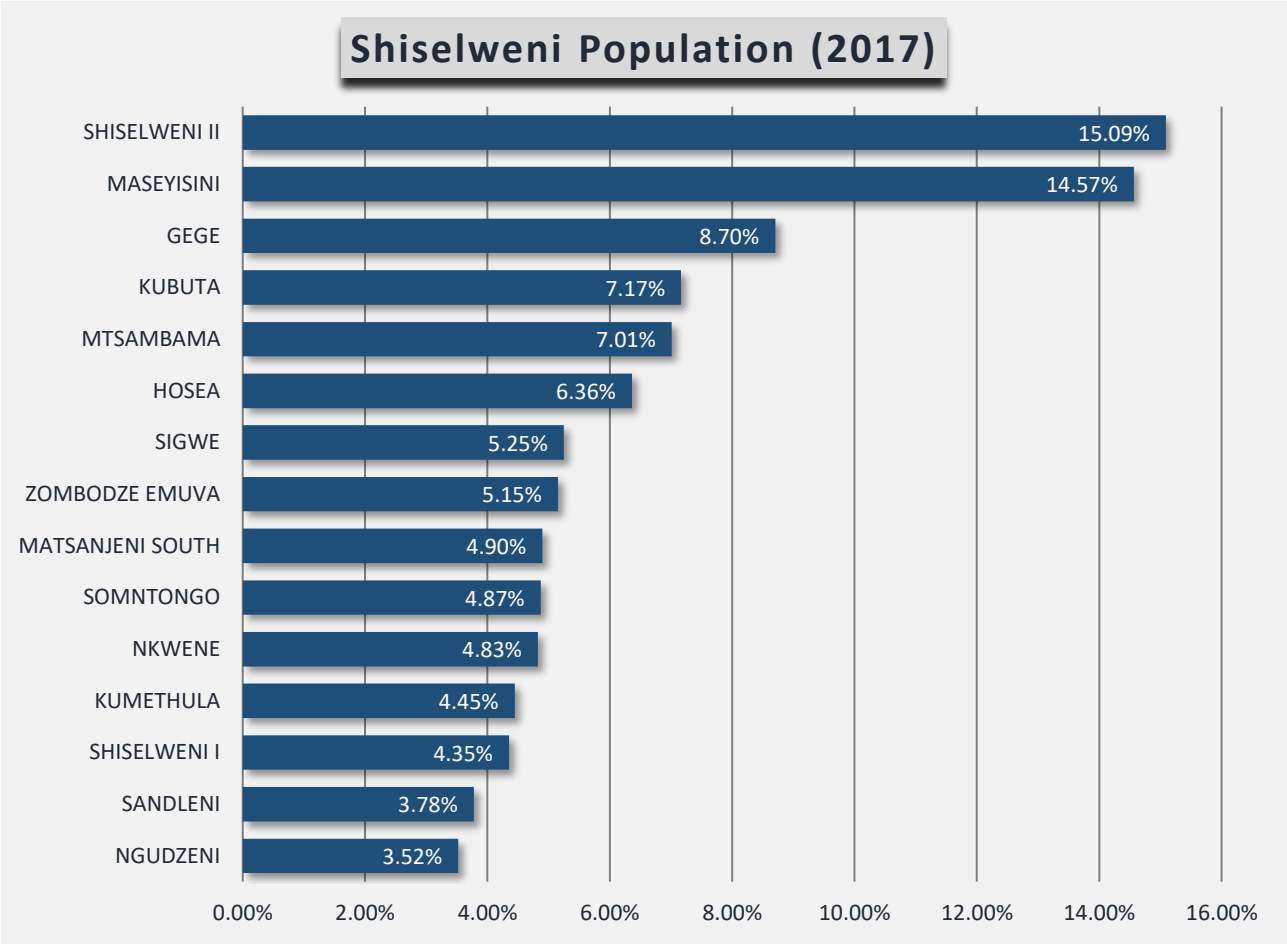
4.3 Demographic profile

According to the 2017 census data, Shiselweni has the second lowest population, out of the 4 regions in Eswatini. There are 219 017 people residing within the Shiselweni borders which makes up 20.03% of Eswatini's total population.

Shiselweni region's settlement topology encompasses a blend of urban centres, rural villages, and many hamlets concentrated in the northern and eastern part.

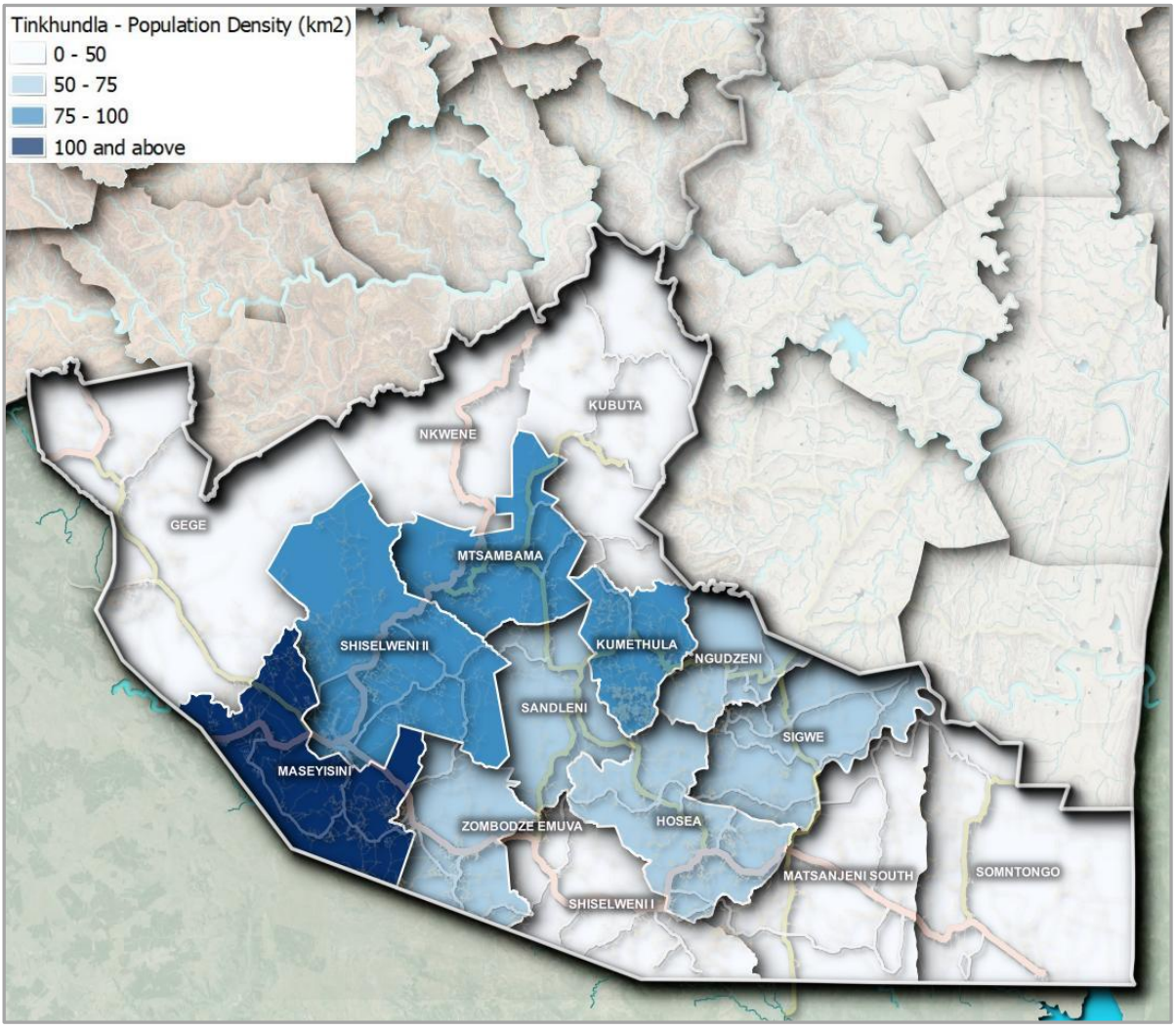
The largest part of the population resides in Shiselweni II with 33 050 or 15.09% of the population residing there but is closely followed by Maseyisini with a population of 31 911. The smallest number of people, with only 3.52% of the total, live in Ngudzeni.

Figure 3 Shiselweni Census Population (2017)



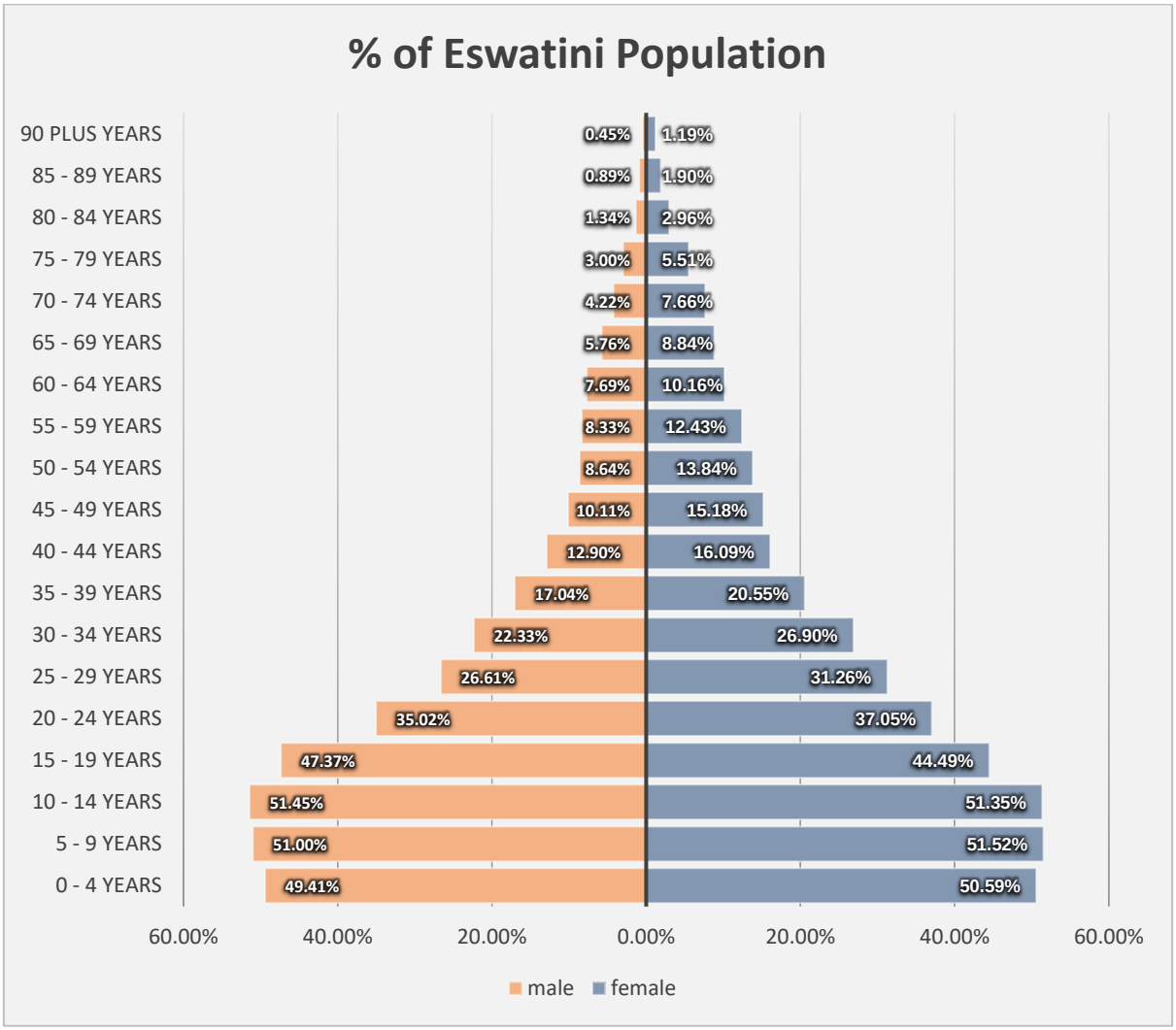
The map below gives an indication of the population density distribution and is clear to see that the Tinkhundla regions within Shiselweni is not highly densified with only Maseyisini with a population density above 100. Shiselweni II, Mtsambama and Kuvmethula with slightly higher populations density of 75 to 100 individuals per square kilometre.

Figure 4 Shiselweni Tinkhundla Census Population Density (2017)



The male to female population distribution is quite close for this region, but unlike other regions where there are slightly more males than females, this region has only the age bracket 12-14 years where there are more males. In all the other brackets there are more females than males.

Figure 5 Shiselweni Census Male and Female Population Percentage (2017)



5 Shiselweni Region – Current Scenario of Immunisation Facilities

Using the methodology proposed, the national analysis on immunisation facilities were expanded into more detailed analysis for Shiselweni region and the Tinkhundla within it.

5.1 Shiselweni - geographic distribution of immunisation facilities

There are currently 52 health or key facilities within Shiselweni consisting of 32 existing and functioning immunisation facilities, 7 immunisation facilities that are closed and 8 immunisation facilities that did not have HMIS or CMIS information. There is only 1 OSM health facility and 4 OSM key service points. Combined, these facilities contribute to 13.40 % of the total facilities within Eswatini.

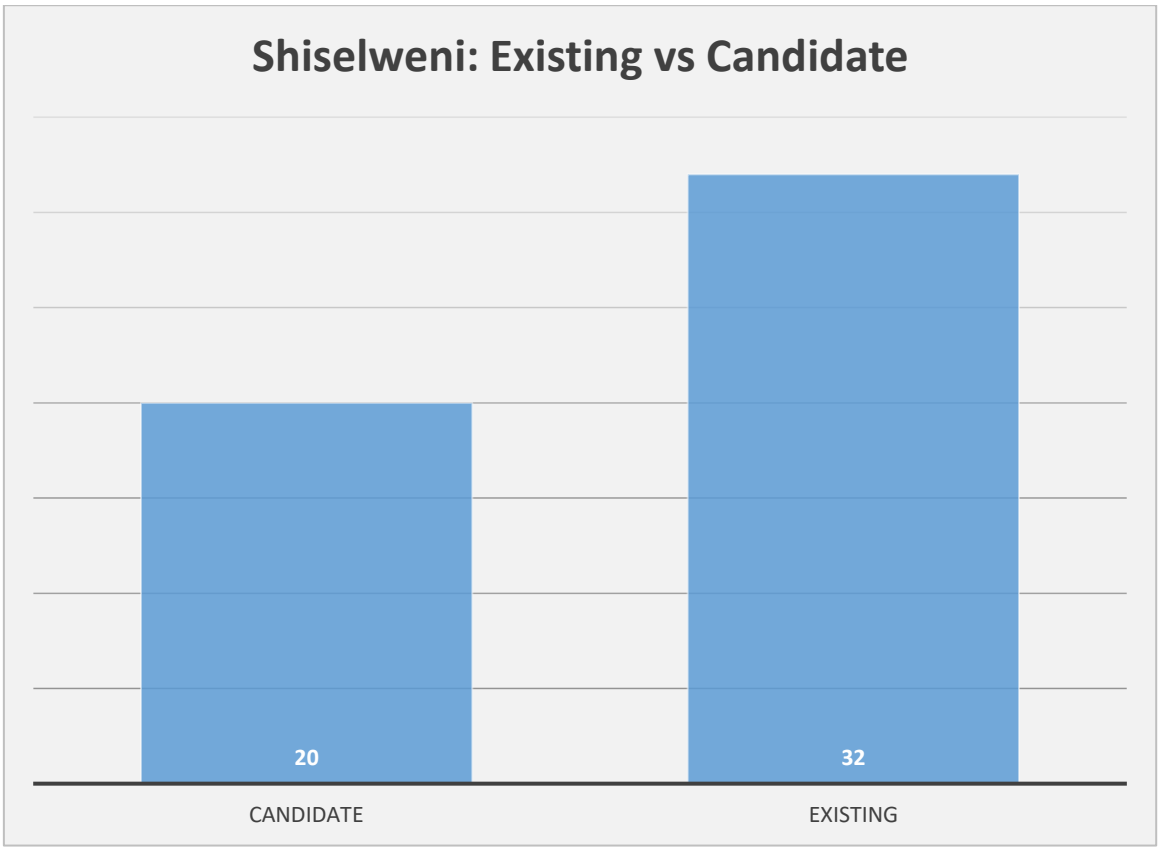
Table 5 Shiselweni Facility Count

Facility Type	Count	Percentage Per Facility Type	Percentage Per Facility Category (Candidate/Existing)	Percentage Of Eswatini Facilities
Facility closed	7	10.61%	3.41%	1.80%
Facility existing	32	17.49%	17.49%	8.25%
Facility no link	8	11.11%	3.90%	2.06%
OSM Health facility	1	5.26%	0.49%	0.26%
OSM Key service	4	8.33%	1.95%	1.03%
Grand Total	52	13.40%	13.40%	13.40%

Shiselweni has the least number of existing facilities, with only 32. This adds up to 8.25% of the total existing immunisation facilities in Eswatini while the region also contains 20 or 9.76% of the candidate facilities in the country. The candidate facilities consist out of 7 closed facilities, 8 facilities that are open but had no link to HMIS/CMIS values, 1 OSM health facilities and 4 OSM key service points.

The 20 candidate facilities to choose proposed facilities from are far less than the 104 and 63 facilities in Manzini and Hhohho respectively.

Figure 6 Shiselweni Existing vs Candidate Facilities



5.1.1 Shiselweni - immunisation facilities per Tinkhundla

The analysis split the facilities, per type and indicated the number for each Tinkhundla with a total for all available facilities, irrespective of that facility currently providing immunisations.

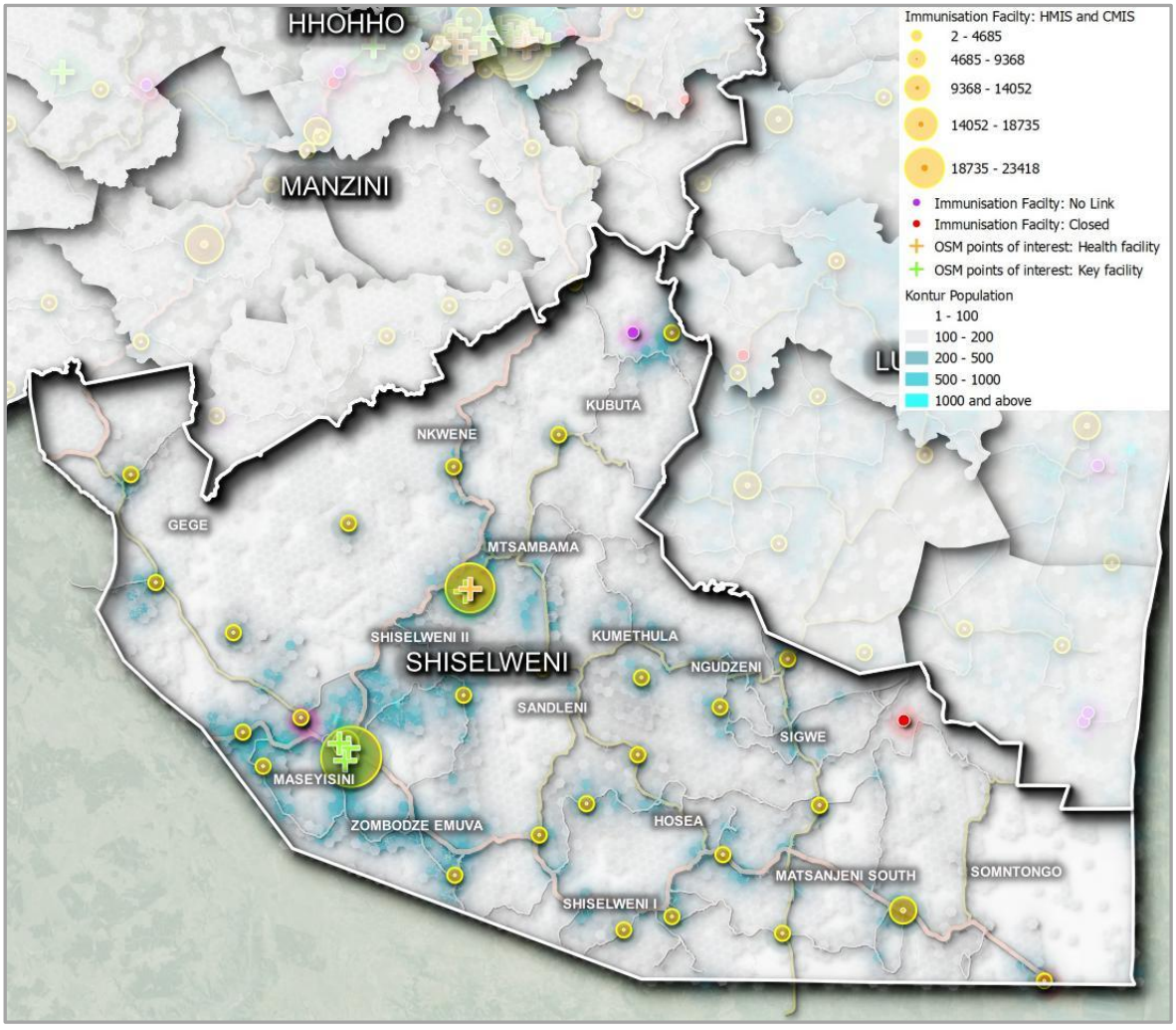
Table 6 Shiselweni Facilities per Tinkhundla

Tinkhundla	Facility closed	Facility existing	Facility no link	OSM Health facility	OSM Key service	Grand Total
GEGE		3				3
HOSEA		3				3
KUBUTA		3				3
KUMETHULA		1				1
MASEYISINI	1	3	2		1	7
MATSANJENI SOUTH		3				3
MTSAMBAMA	1	1	1	1	1	5
NGUDZENI		2				2
NKWENE		1				1

Tinkhundla	Facility closed	Facility existing	Facility no link	OSM Health facility	OSM Key service	Grand Total
SANDLENI		1				1
SHISELWENI I		3				3
SHISELWENI II	3	6	5		2	16
SIGWE	1					1
SOMNTONGO	1	1				2
ZOMBODZE EMUVA		1				1
Grand Total	7	32	8	1	4	52

Shiselweni II Tinkhundla has the highest total count of facilities in Shiselweni. It is important to note that 10 of the Tinkhundla in this region do not have any candidate facilities to propose additional location from. The total count is therefore valuable as it will be used when identifying proposed additional locations for immunisation facilities.

Figure 7 Shiselweni Facility Location



5.2 Shiselweni - current population coverage

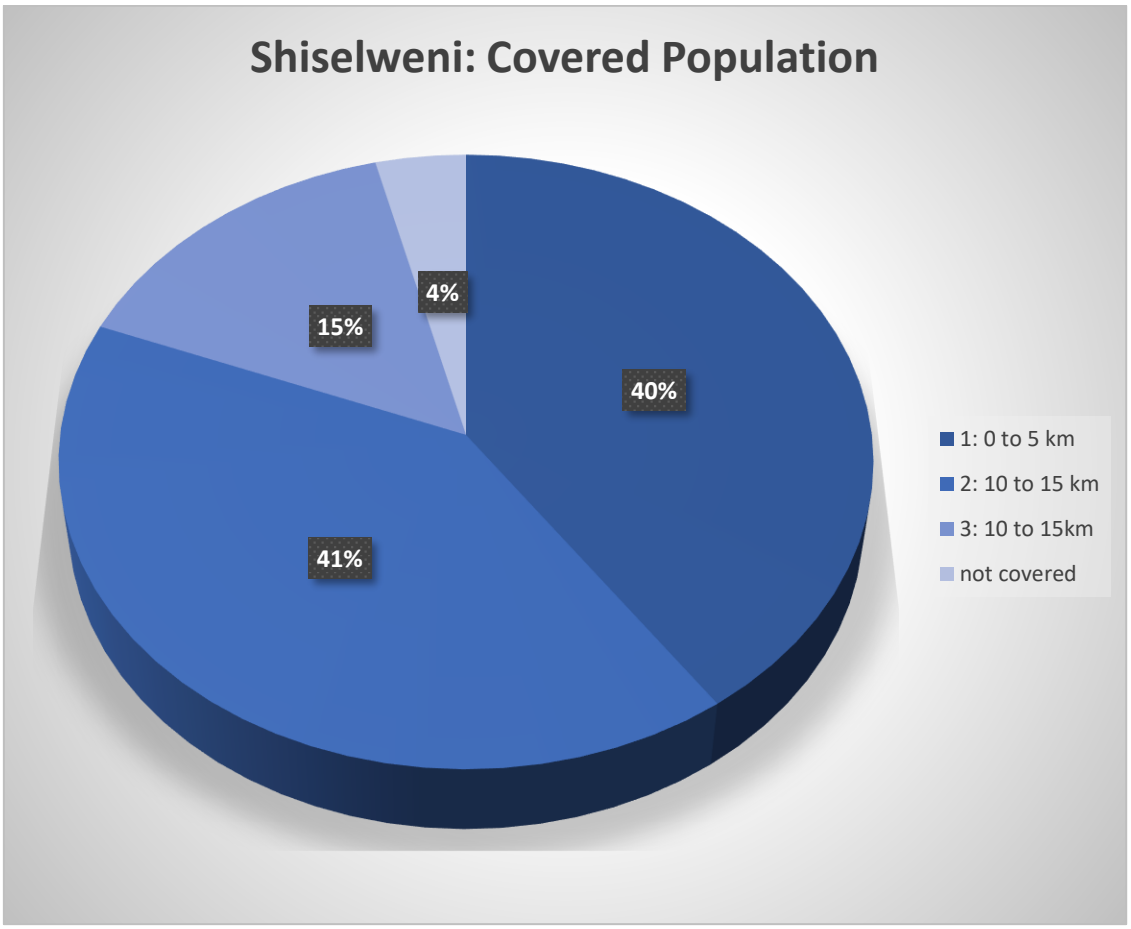
The results of the accessibility analysis show that 210 463 people or 96.09% of the population in the Shiselweni region currently have access to an immunisation centre. The remaining 8 554 people or 3.91% in the region are not covered.

Table 7 Shiselweni Population Coverage per Distance – Existing Facilities

Distributed Census Population (2017)	Number of people
1: 0 to 5 km	88 163
2: 10 to 15 km	89 181
3: 10 to 15km	33 119
Not covered	8 554
Percentage not covered	3.91%
Total population	219 017

These percentages are illustrated in the pie chart in Figure 8

Figure 8 Shiselweni Covered Population Pie chart



Shiselweni consists of 15 Tinkhundla regions. Table 8 highlights the current population coverage provided by immunisation facilities in each Tinkhundla distributed between distance brackets.

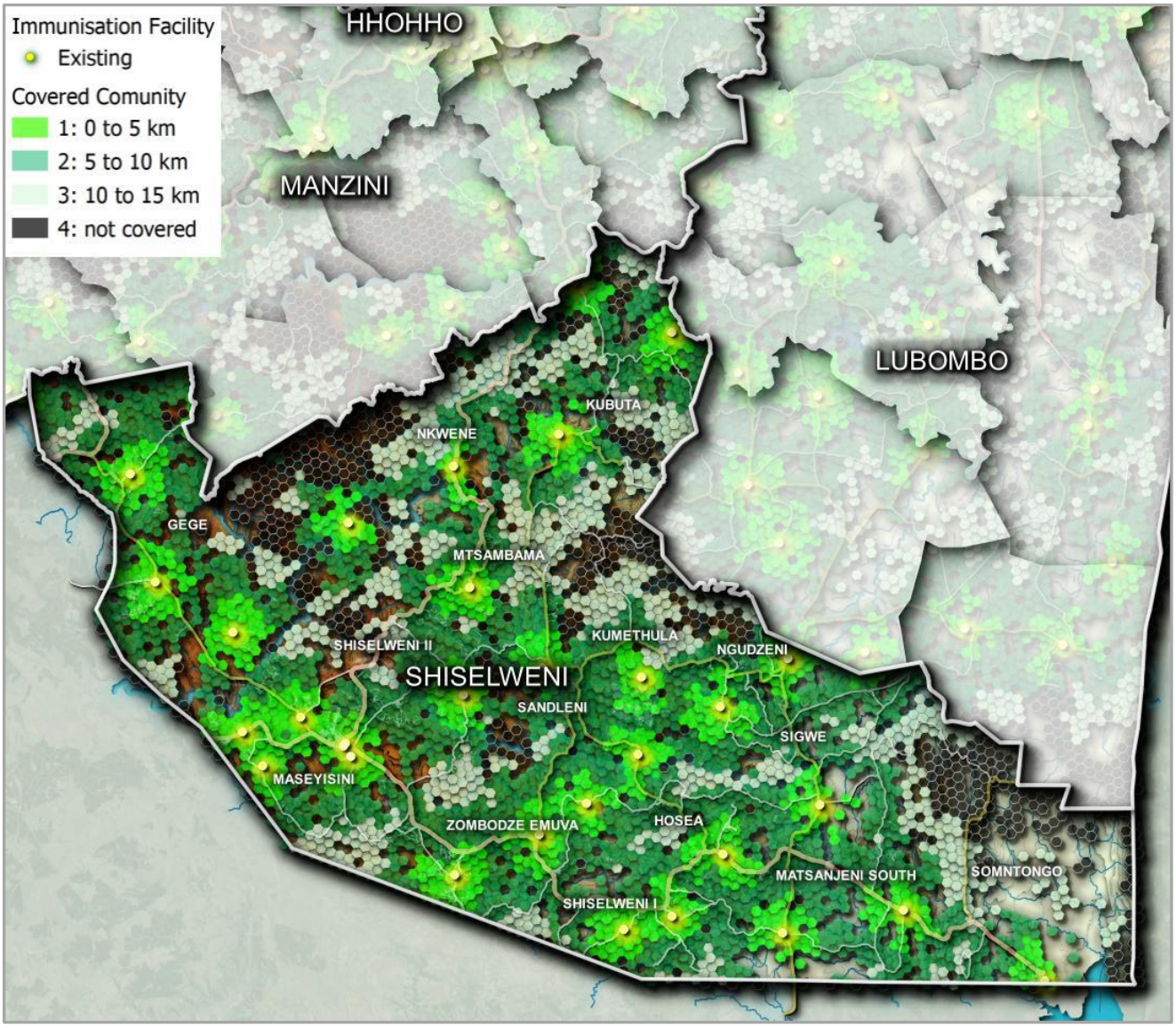
Table 8 Shiselweni Tinkhundla population coverage

	Distributed Census Population (2017)				Total Percentage Not Covered	Total Distributed Census Population (2017)
Covered Distance	1: 0 to 5 km	2: 5 to 10 km	3: 10 to 15 km	4: not covered		
GEGE	9 863	6 261	1 687	1 254	6.57%	19 065
HOSEA	7 688	5 621	503	124	0.89%	13 936
KUBUTA	5 618	4 667	3 296	2 112	13.46%	15 693
KUMETHULA	2 456	4 419	2 721	141	1.45%	9 737
MASEYISINI	17 470	9 272	5 149	10	0.03%	31 901
MATSANJENI SOUTH	3 629	5 878	1 136	79	0.73%	10 722
MTSAMBAMA	5 510	5 675	4 069	108	0.70%	15 361
NGUDZENI	3 222	3 600	782	111	1.44%	7 715
NKWENE	2 505	3 779	3 463	824	7.79%	10 571
SANDLENI	2 967	5 085	151	74	0.89%	8 278
SHISELWENI I	4 756	4 020	737	22	0.23%	9 535
SHISELWENI II	14 139	15 224	2 885	805	2.43%	33 053
SIGWE	2 698	7 172	1 618	7	0.06%	11 495
SOMNTONGO	2 143	2 501	3 152	2 873	26.93%	10 669
ZOMBODZE EMUVA	3 498	6 007	1 769	12	0.10%	11 286
Grand Total	88 163	89 181	33 119	8 554	3.91%	219 017

Maseyisini and Sigwe Tinkhundla has the best percentage coverage with more than 99.90% of individuals being covered. Maseyisini and Shiselweni II has the most covered population of 17 470 and 14 139 respectively within 5 kilometres. Maseyisini and Sigwe has a low not covered percentage of 0.03% and 0.06% respectively not covered. Somntongo is by far the worst covered Tinkhundla with 10 669 or 26.93% of its population not being covered.

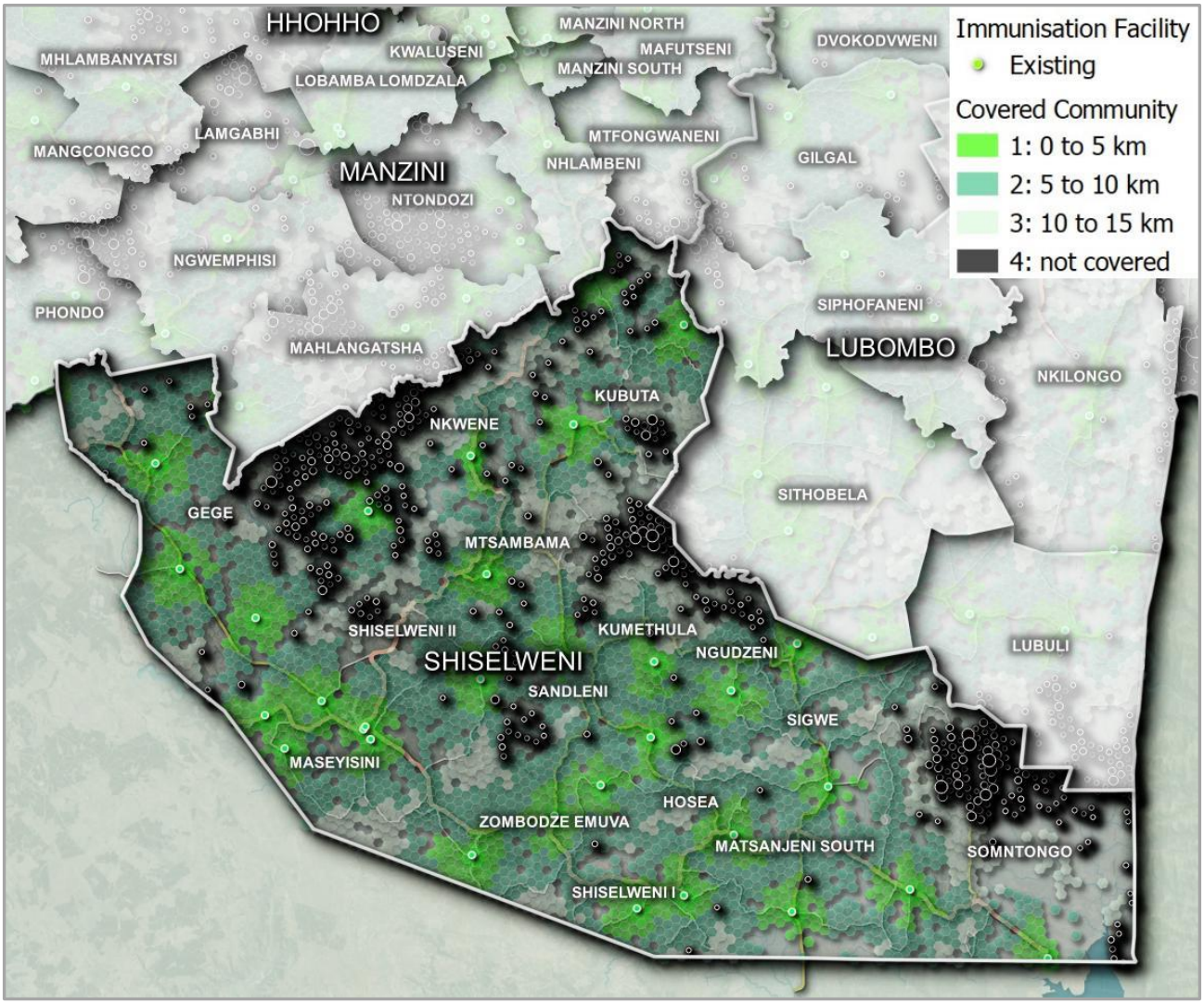
All Tinkhundla show a moderate degree of coverage for population within a 5km distance of an immunisation facility at 40.25% of the population.

Figure 9 Shiselweni – Existing Immunisation Facility Population Coverage



Some communities are deemed inaccessible because the community centroid could not be linked to the existing OSM road layer but would have had access if the spatial data resembled the actual ground network.

Figure 10 Shiselweni Existing Immunisation Facility Population Not Covered



There is 1 facility in Shiselweni that does not contribute to population being covered, meaning that there are other existing immunisation facilities closer to the community centroids in the area. This facility does however assist with the demand that is placed on other facilities, as it is in densely populated areas and help to distribute the population, relieving strain on the other facilities in the area.

Nhlangano PHU contributes 8 029 people to the demand in the area.

Table 9 Shiselweni Over-Provisioning Facilities

Facility Name	Tinkhundla	Covered Population	Population Demand
Nhlangano PHU	SHISELWENI II	0	8 029

5.3 Shiselweni - current travel distances to immunisation facilities

The average travel distance for the covered population of Shiselweni to the nearest immunisation facility is 6.172 km, see Table 10. The Tinkhundla Hosea has an average travel distance below 5km to the nearest immunisation facility while the Nkwene Tinkhundla has the highest average travel distance of 8.297km.

Table 10: Shiselweni Covered Population Average Travel Distance

Tinkhundla	Average Distance to Facility in meters	Covered Census Population (2017)
HOSEA	4 932	13 812
GEGE	5 309	17 811
SHISELWENI I	5 441	9 513
MASEYISINI	5 564	31 891
SHISELWENI II	5 618	32 248
NGUDZENI	5 766	7 604
SANDLENI	5 803	8 204
MATSANJENI SOUTH	6 203	10 643
ZOMBODZE EMUVA	6 645	11 274
KUBUTA	6 698	13 581
MTSAMBAMA	6 921	15 253
SIGWE	7 029	11 488
KUMETHULA	7 459	9 596
SOMNTONGO	8 194	7 796
NKWENE	8 297	9 747
Grand Total	6 172	210 463

Some communities covered in the table below show a total of 206 089 individuals covered by Shiselweni facilities, of which 2 587 are individuals that travel across a regional border to make use of the facility.

Table 11 Community Traveling to a Shiselweni Facility

Region	1: 0 to 5 km	2: 5 to 10 km	3: 10 to 15 km	Grand Total
LUBOMBO	751	567	703	2 022
MANZINI	7	533	25	565
SHISELWENI	87 748	85 641	30 113	203 502
Grand Total	88 507	86 741	30 841	206 089

A breakdown of the origin regions of these individuals are given below with an indication by which Tinkhundla they are covered for services.

Table 12 Shiselweni Facility Population Origin per Region

Region	LUBOMBO	MANZINI	SHISELWENI	Grand Total
SHISELWENI II			39 155	39 155
MASEYISINI			23 366	23 366
MATSANJENI SOUTH			18 763	18 763
KUBUTA	1 769	549	15 554	17 873
HOSEA			15 877	15 877
GEGE		16	15 512	15 527
MTSAMBAMA			13 091	13 091
NGUDZENI	252		12 540	12 792
SHISELWENI I			11 933	11 933
ZOMBODZE EMUVA			10 747	10 747
SANDLENI			8 838	8 838
KUMETHULA			8 107	8 107
NKWENE			6 824	6 824
SOMNTONGO			3 197	3 197
Grand Total	2 022	565	203 502	206 089

A total of 1 990 of Shiselweni region's population is covered by other regions, of which the vast majority is being covered by facilities in Shiselweni.

Table 13 Shiselweni Population Covered by Facilities in Other Regions

Region	LUBOMBO	MANZINI	Grand Total
SITHOBELA	3 986		3 986
MAHLANGATSHA		1 390	1 390
PHONDO		577	577
NGWEMPHISI		495	495
LUBULI	351		351
SIPHOFANENI	162		162
Grand Total	4 499	2 462	6 961

5.4 Shiselweni – current demand

The table below shows the demand calculated for each existing facility with the average distance individuals travel to the respective facility. This table provides more insight on the facility itself, giving information such as if the facility serves communities in close proximity or act as a facility for individuals travelling from the general area.

Table 14 Demand and Average Travel Distance per Facility in Shiselweni

Facility Name	Tinkhundla	Demand Travel Distance (m)	Facility Demand
Tfokotani Clinic	MASEYISINI	5 487	5 946
Lavumisa Clinic	SOMNTONGO	5 931	3 445
Kaphunga Nazarene Clinic	KUBUTA	6 190	8 036
Gege Clinic	GEGE	6 218	5 995
Magubheleni Clinic	GEGE	6 304	5 484
Zombodze Clinic (Shiselweni)	ZOMBODZE EMUVA	6 665	7 574
Mashobeni Clinic	GEGE	6 849	4 187
Mahlandle Clinic	MASEYISINI	6 932	5 391
Dwaleni Clinic	SHISELWENI II	7 001	9 622
Hlathikhulu Maternity,Hlathikhulu Wellness Clinic,Hlatikhulu Public Health Unit,Hlathikhulu Government hospital	MTSAMBAMA	7 235	13 040
Jericho Clinic	HOSEA	7 278	4 884

Facility Name	Tinkhundla	Demand Travel Distance (m)	Facility Demand
Mgazini Nazarene Clinic	SHISELWENI I	7 304	3 978
Ntshanini Clinic	NGUDZENI	7 494	7 357
Hluti Clinic	HOSEA	7 518	5 508
Mkhitsini Clinic	SHISELWENI II	7 615	3 623
FTM Clinic / Community and Textile clinic	MASEYISINI	7 882	7 012
Matsanjeni Health Centre,Matsanjeni Public Health Unit	MATSANJENI SOUTH	7 940	7 582
Our Lady of Sorrows Clinic	SHISELWENI I	8 079	4 164
Philani Clinic (Nhlangano)	SHISELWENI II	8 189	8 133
Silele Red Cross Clinic	HOSEA	8 241	5 402
Nsalitje Clinic	MATSANJENI SOUTH	8 371	3 595
SOS Clinic (Nhlangano)	SHISELWENI II	8 375	7 910
Nkwene Clinic	NKWENE	8 506	7 749
New Haven Clinic	KUMETHULA	8 559	7 871
Nhlangunjani Clinic	NGUDZENI	8 572	5 483
Moti Clinic	KUBUTA	8 636	3 817
Nhletsheni Clinic	SANDLENI	8 650	8 688
Nhlangano Health Center	SHISELWENI II	8 759	8 032
Nhlangano PHU	SHISELWENI II	8 762	8 029
Mhlosheni Clinic	SHISELWENI I	8 830	5 197
JCI (Mphelandzaba) Clinic	MATSANJENI SOUTH	9 180	7 011
KaMfishane (KaNdlovu) Clinic	KUBUTA	9 255	5 936
Grand Total		7 742	205 678

6 Shiselweni Region – Recommendations and Considerations

Based on the findings in the analysis phase, additional locations for immunisation centres were identified. Some locations are fixed facilities and other will be mobile clinics. The aim was to make use of existing infrastructure and, where possible, and aim towards full coverage of the population.

6.1 Shiselweni - distribution of proposed locations

The accessibility analysis identified 1 additional location in Shiselweni where access to services needs to be improved to meet the population demand. The location is a facility that was previously in use but has since been closed. The provisioning of services at this location would increase the total number of immunisation centres in Shiselweni from 32 to 33.

Table 15 Shiselweni Proposed Facilities

Facility Type	Facility Name	Tinkhundla
facility closed	Ancher Clinic	SIGWE

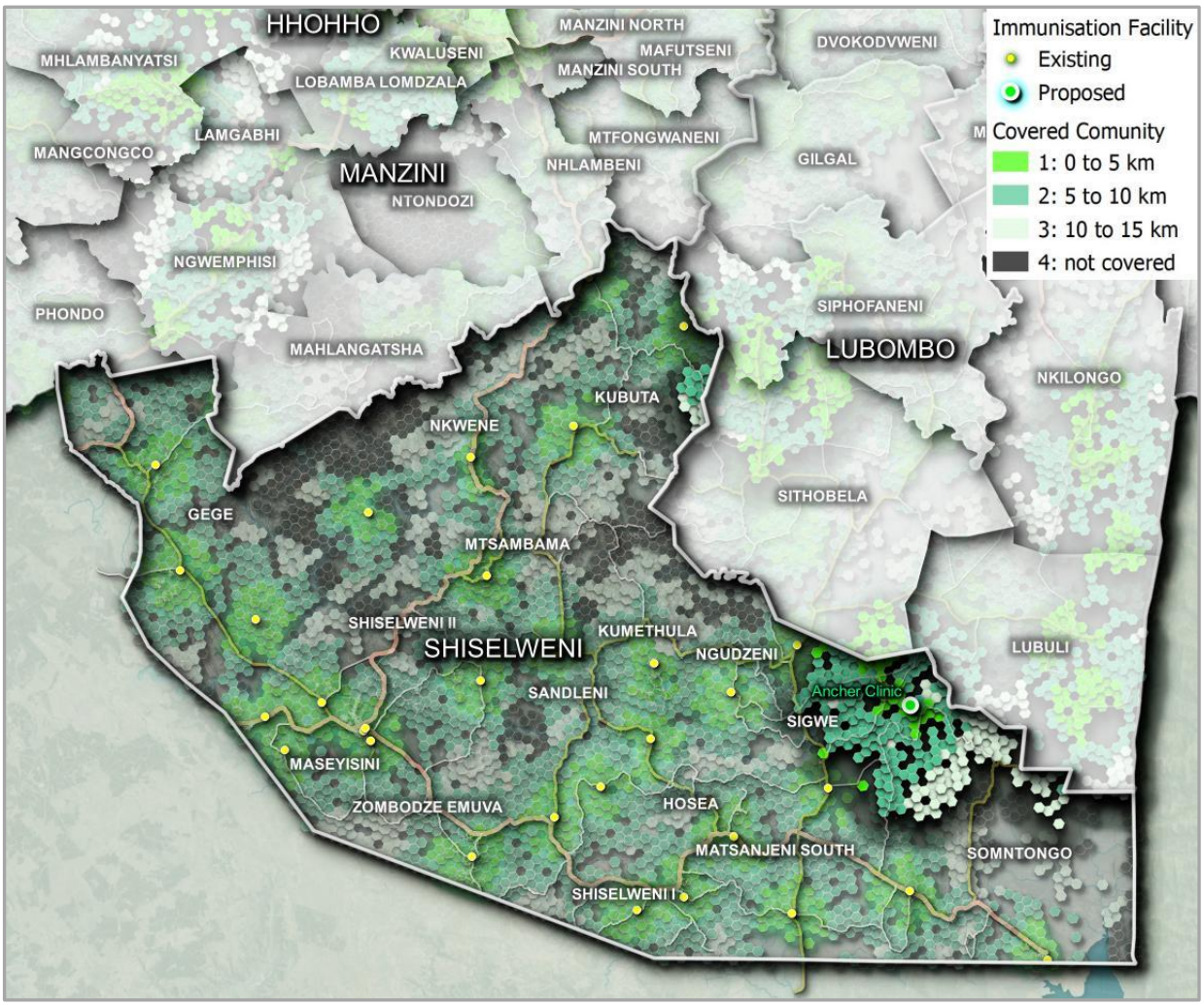
The 1 proposed location was positioned to cover the maximum number of people with the least number of additional facilities, while taking into consideration the current geographic footprint. With the proposed additional location Shiselweni covered population is 212 205 or 96.89%.

Table 16 Shiselweni New Coverage Distance

	Distributed Census Population (2017)				Total Percentage Not Covered	Total Distributed Census Population (2017)
Tinkhundla	1: 0 to 5 km	2: 5 to 10 km	3: 10 to 15 km	4: not covered		
GEGE	9 863	6 261	1 687	1 254	6.57%	19 065
HOSEA	7 688	5 621	503	124	0.89%	13 936
KUBUTA	5 618	4 667	3 296	2 112	13.46%	15 693
KUMETHULA	2 456	4 419	2 721	141	1.45%	9 737
MASEYISINI	17 470	9 272	5 149	10	0.03%	31 901
MATSANJENI SOUTH	3 894	6 496	315	17	0.16%	10 722
MTSAMBAMA	5 510	5 675	4 069	108	0.70%	15 361
NGUDZENI	3 222	3 600	782	111	1.44%	7 715
NKWENE	2 505	3 779	3 463	824	7.79%	10 571
SANDLENI	2 967	5 085	151	74	0.89%	8 278

	Distributed Census Population (2017)				Total Percentage Not Covered	Total Distributed Census Population (2017)
Tinkhundla	1: 0 to 5 km	2: 5 to 10 km	3: 10 to 15 km	4: not covered		
SHISELWENI I	4 756	4 020	737	22	0.23%	9 535
SHISELWENI II	14 139	15 224	2 885	805	2.43%	33 053
SIGWE	3 565	6 899	1 024	7	0.06%	11 495
SOMNTONGO	2 153	3 128	4 195	1 193	11.18%	10 669
ZOMBODZE EMUVA	3 498	6 007	1 769	12	0.10%	11 286
Grand Total	89 307	90 153	32 746	6 812	3.11%	219 017

Figure 11 Shiselweni Proposed Immunisation Facility Coverage - Distance



6.2 Shiselweni - distribution of mobile locations

In addition to the 1 proposed immunisation facility, 30 locations were identified as possible mobile clinic locations. Community centroids farther than 15 kilometres from an existing or newly proposed immunisation facility were used to identify possible mobile clinic locations and therefore the mobile clinic location is mostly situated in the more rural areas.

Table 17 Shiselweni Mobile Locations

Tinkhundla	Count of Mobile Locations
GEGE	4
KUBUTA	9
KUMETHULA	1
MTSAMBAMA	2
NGUDZENI	1
NKWENE	3
SHISELWENI II	2
SOMNTONGO	8
Grand Total	30

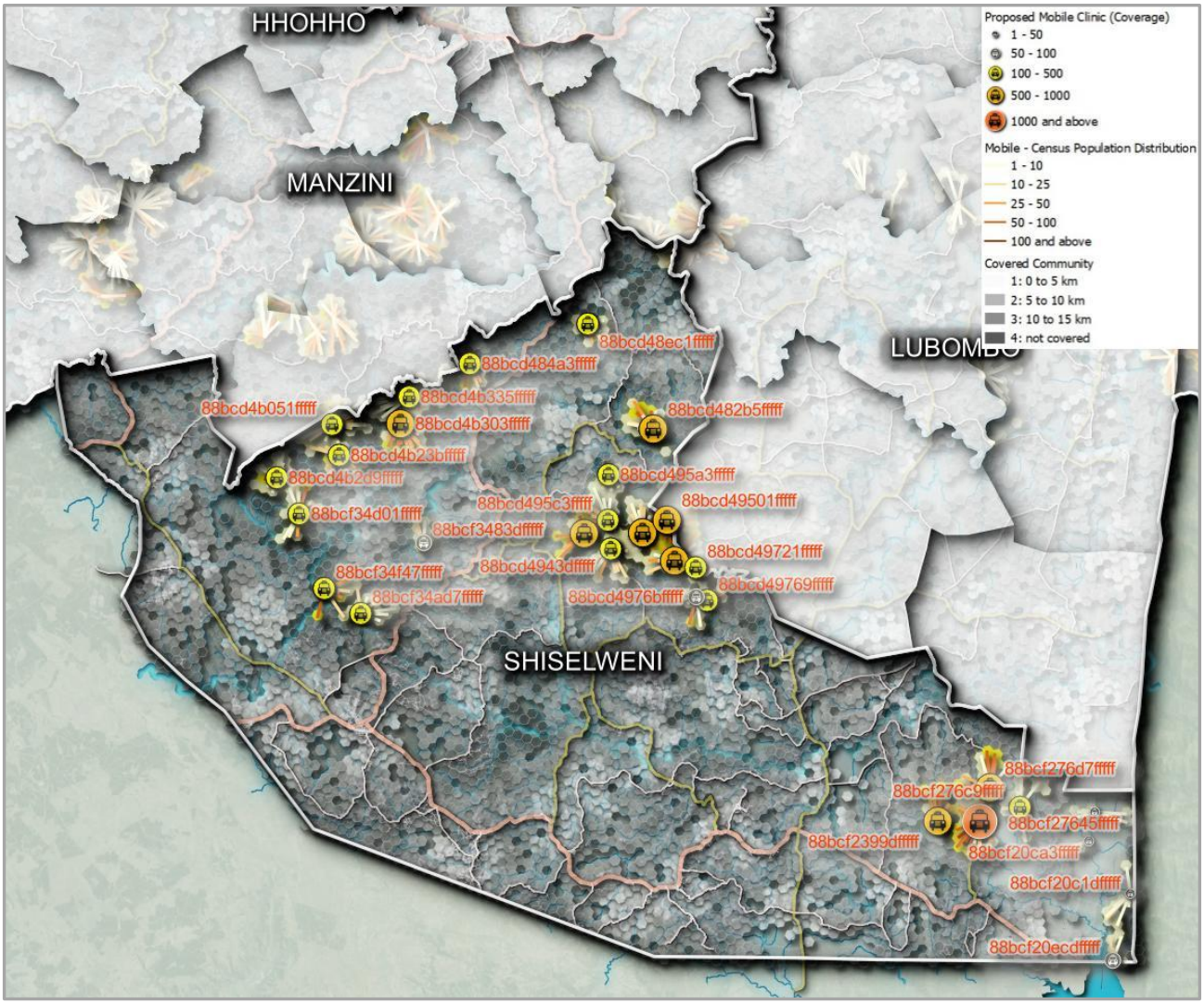
The additional mobile locations will cover an additional 4 734 individuals bringing the total covered population percentage in Shiselweni to 99.05%. The mobile clinic locations will also overlap 5 692 individuals that currently has access within 10 to 15km. Currently there is no road network and or links to calculate coverage for the rest of the 0.95% population in Shiselweni.

Table 18 Shiselweni Mobile Coverage

Mobile Coverage (5km)	Distributed Census Population (2017)
1: New	4 734
2: overlap	5 692
Grand Total	10 426

From the map below it is evident that the mobile clinic locations are distributed in the more rural areas of Shiselweni and are not all distributed in close proximity to each other and therefore the mobile clinics might need to travel large distances to reach individuals requiring immunisations.

Figure 12 Shiselweni Mobile Facility Proposed Location and Coverage



Six mobile clinic locations have a covered population of 100 or more individuals. If these locations are not on a logistical driving route from each other, it might not be beneficial to drive to these areas on a regular basis. Scheduling might be required to visit each of these areas individually as specified times.

Table 19 Shiselweni Mobile Clinic Locations and Coverage

Mobile Clinic Location (H3 ID)	Tinkhundla	New Population Covered (5km)	Overlap in Population Covered (5km)	Total Population covered (5km)
88bcf20ca3fffff	SOMNTONGO	2	3	6
88bcf27645fffff	SOMNTONGO	21	2	23
88bcf20c1dfffff	SOMNTONGO	19	30	49
88bcf20ecdfffff	SOMNTONGO	67		67
88bcf3483dfffff	MTSAMBAMA	9	70	79
88bcd4976bfffff	KUMETHULA	1	96	97
88bcf34ad7fffff	SHISELWENI II	65	43	108
88bcd49769fffff	NGUDZENI	22	99	121
88bcf276c9fffff	SOMNTONGO	54	91	146
88bcd495a3fffff	KUBUTA	1	158	159
88bcd49721fffff	KUBUTA	26	200	226
88bcd48ec1fffff	KUBUTA	36	224	260
88bcf34d01fffff	GEGE	194	68	262
88bcf34f47fffff	SHISELWENI II	56	211	268
88bcd4b2d9fffff	GEGE	92	87	279
88bcd4943dfffff	KUBUTA	22	79	301
88bcd4b335fffff	NKWENE	27	110	337
88bcd4b23bfffff	GEGE	71		371
88bcd484a3fffff	NKWENE	53	362	414
88bcd495c3fffff	KUBUTA	76	341	417
88bcd4b051fffff	GEGE	89	303	492
88bcd482b5fffff	KUBUTA	19	218	537
88bcf2399dfffff	SOMNTONGO	2	564	567
88bcd49735fffff	KUBUTA	52	369	622
88bcd494e5fffff	MTSAMBAMA	33	610	643
88bcd49519fffff	KUBUTA	652	2	654
88bcd4b303fffff	NKWENE	84	439	722
88bcf276d7fffff	SOMNTONGO	39	239	978
88bcd49501fffff	KUBUTA	23	476	1 000
88bcf239e1fffff	SOMNTONGO	29	871	1 100

Mobile Clinic Location (H3 ID)	Tinkhundla	New Population Covered (5km)	Overlap in Population Covered (5km)	Total Population covered (5km)
Total Population covered (5km)		4 939	6 365	11 304

6.3 Shiselweni - potential improvement in population coverage

The addition of 1 proposed location to the existing 32 immunisation facilities in the region could potentially increase the population coverage provided by immunisation centres from 96.09% to 96.89%. The 30 mobile clinic locations in Shiselweni will further aid with an additional 2.16% increasing the total to 99.05%.

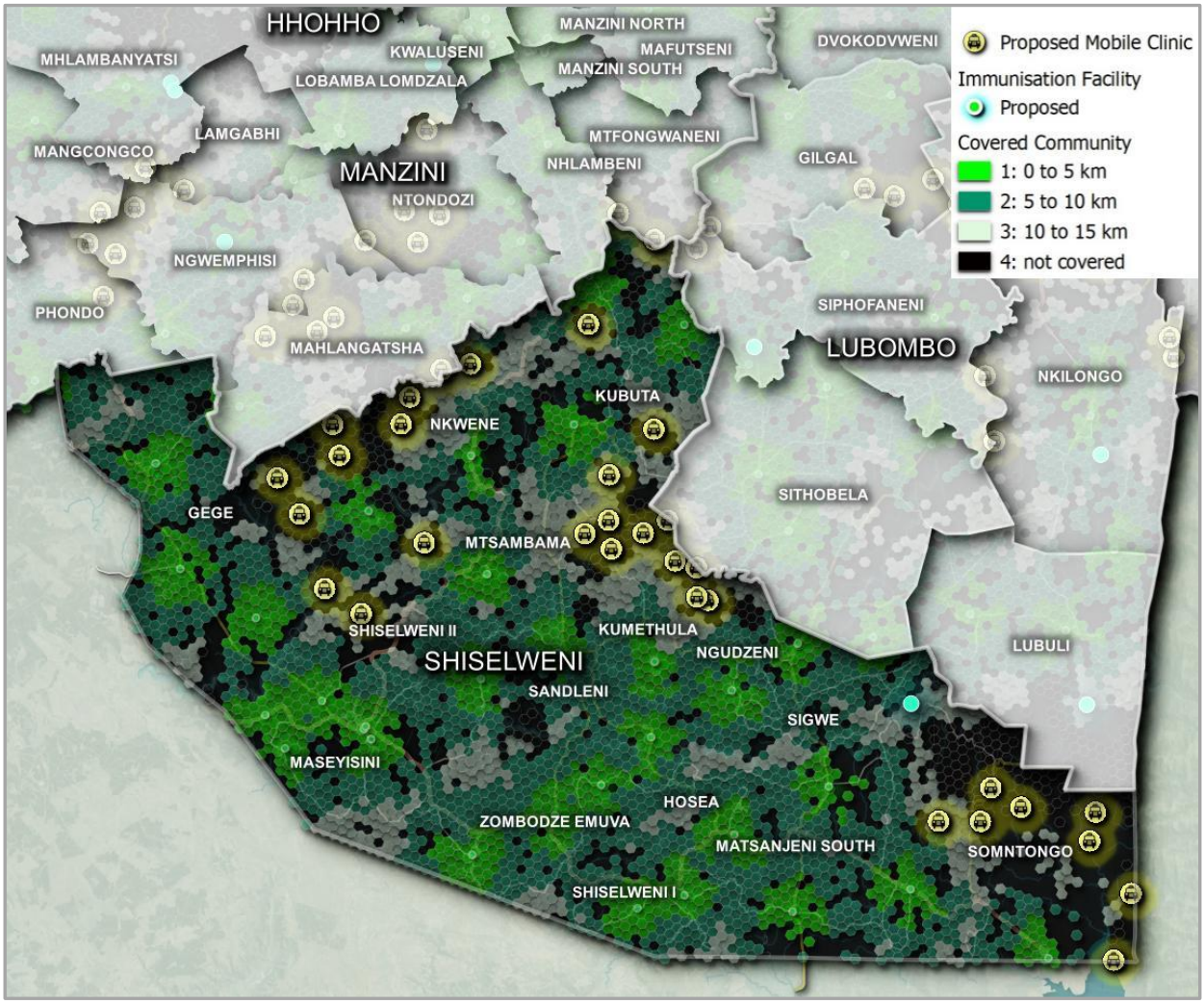
Somntongo has the lowest existing coverage of 73.07% which increases with 26.36% bringing the total to 99.45% with the proposed immunisation facilities and mobile clinics.

Nkwene has the lowest coverage after additional facilities have been added with 97.61% coverage. Only five Tinkhundla is left with a coverage below 99%, with coverage between 97.60-98.40%. After the proposed facilities and mobile clinics have been added to the calculation, Maseyisini has the best coverage at 99.97%.

Table 20 Shiselweni Coverage Increase per Tinkhundla

Tinkhundla	Distributed Census Population (2017)	Existing Coverage	Existing and Proposed Coverage	Coverage Increase (Proposed Facility)	Total Coverage (including mobile clinics)	Coverage Increase (Mobile Clinics)	Total Coverage Increase
SOMNTONGO	10 669	73.07%	88.82%	15.75%	99.45%	10.63%	26.38%
KUBUTA	15 693	86.54%	86.54%	0.00%	98.38%	11.83%	11.83%
NKWENE	10 571	92.21%	92.21%	0.00%	97.61%	5.40%	5.40%
GEGE	19 065	93.43%	93.43%	0.00%	98.33%	4.91%	4.91%
SHISELWENI II	33 053	97.57%	97.57%	0.00%	97.93%	0.37%	0.37%
KUMETHULA	9 737	98.55%	98.55%	0.00%	99.05%	0.50%	0.50%
NGUDZENI	7 715	98.56%	98.56%	0.00%	98.85%	0.29%	0.29%
SANDLENI	8 278	99.11%	99.11%	0.00%	99.11%	0.00%	0.00%
HOSEA	13 936	99.11%	99.11%	0.00%	99.11%	0.00%	0.00%
MATSANJENI SOUTH	10 722	99.27%	99.84%	0.58%	99.84%	0.00%	0.58%
MTSAMBAMA	15 361	99.30%	99.30%	0.00%	99.58%	0.28%	0.28%
SHISELWENI I	9 535	99.77%	99.77%	0.00%	99.77%	0.00%	0.00%
ZOMBODZE EMUVA	11 286	99.90%	99.90%	0.00%	99.90%	0.00%	0.00%
SIGWE	11 495	99.94%	99.94%	0.00%	99.94%	0.00%	0.00%
MASEYISINI	31 901	99.97%	99.97%	0.00%	99.97%	0.00%	0.00%
Grand Total	219 017	96.09%	96.89%	0.80%	99.05%	2.16%	2.96%

Figure 13 Shiselweni Proposed and Mobile Immunisation Facility Locations



6.4 Shiselweni – potential distribution of demand

Table 21 shows the change in demand per Shiselweni facility by adding the proposed facilities and mobile clinics.

Table 21 Shiselweni Immunisation Facility Demand Change

Facility Name	Tinkhundla	Existing Demand	Proposed Demand	Demand Change
JCI (Mphelandzaba) Clinic	MATSANJENI SOUTH	7 011	5 948	-1 063
Kaphunga Nazarene Clinic	KUBUTA	8 036	7 708	-328
Nhlangunjani Clinic	NGUDZENI	5 483	5 203	-280
Matsanjeni Health Centre,Matsanjeni Public Health Unit	MATSANJENI SOUTH	7 582	7 454	-127

Facility Name	Tinkhundla	Existing Demand	Proposed Demand	Demand Change
Ntshanini Clinic	NGUDZENI	7 357	7 332	-25
New Haven Clinic	KUMETHULA	7 871	7 871	-0
Nhlangano Health Center	SHISELWENI II	8 032	8 032	-0
Hlathikhulu Maternity,Hlathikhulu Wellness Clinic,Hlatikhulu Public Health Unit,Hlathikhulu Government hospital	MTSAMBAMA	13 040	13 040	-0
Zombodze Clinic (Shiselweni)	ZOMBODZE EMUVA	7 574	7 574	-0
Magubheleni Clinic	GEGE	5 484	5 484	-0
Moti Clinic	KUBUTA	3 817	3 817	-0
Jericho Clinic	HOSEA	4 884	4 884	-0
Our Lady of Sorrows Clinic	SHISELWENI I	4 164	4 164	-0
Gege Clinic	GEGE	5 995	5 995	-0
Silele Red Cross Clinic	HOSEA	5 402	5 402	-0
Mahlandle Clinic	MASEYISINI	5 391	5 391	-0
Tfokotani Clinic	MASEYISINI	5 946	5 946	-0
Mhlosheni Clinic	SHISELWENI I	5 197	5 197	0
Nsalitje Clinic	MATSANJENI SOUTH	3 595	3 595	0
Hluti Clinic	HOSEA	5 508	5 508	0
Mashobeni Clinic	GEGE	4 187	4 187	0
Dwaleni Clinic	SHISELWENI II	9 622	9 622	0
KaMfishane (KaNdlovu) Clinic	KUBUTA	5 936	5 936	0
FTM Clinic / Community and Textile clinic	MASEYISINI	7 012	7 012	0
Philani Clinic (Nhlangano)	SHISELWENI II	8 133	8 133	0
Nkwene Clinic	NKWENE	7 749	7 749	0
Mgazini Nazarene Clinic	SHISELWENI I	3 978	3 978	0
Nhlangano PHU	SHISELWENI II	8 029	8 029	0
SOS Clinic (Nhlangano)	SHISELWENI II	7 910	7 910	0
Lavumisa Clinic	SOMNTONGO	3 445	3 445	0
Ancher Clinic	SIGWE		4 800	0
Nhletsheni Clinic	SANDLENI	8 688	8 688	0
Mkhitsini Clinic	SHISELWENI II	3 623	3 623	0
Grand Total		205 678	208 655	-1 823

The additional facility increased the facilities with a demand between 0-2 000 people with one more.

Table 22 Shiselweni Demand Change with Additional Facilities

Demand bracket	32 Facilities	33 Facilities
2 000-5 000	8	9
5 000-10 000	23	23
10 000+	1	1
Grand Total	32	33

6.5 Shiselweni - potential reduction in travel distances

Table 23 Shiselweni Proposed vs Current Coverage Distance shows the change and number of individuals that would be covered by the existing and proposed immunisation facilities by distance category. Currently there are 161 456 which will increase to 164 736 individuals that are being covered within a 5km distance. The increase of 3 280 individuals in the 0 to 5km bracket consist out of 3 048 individuals previously being covered within 5 to 10 km and 231 within 10 to 15 km. There are 508 individuals less being covered in the 5 to 10km bracket and 1 942 less in the 10 to 15km bracket. Individuals not being covered within a 15km distance decreased by 829 of which 795 will fall in the 10 to 15 km bracket and 34 in the 5 to 10km.

Table 23 Shiselweni Proposed vs Current Coverage Distance

Covered Distance	Current	Current & Proposed	With mobile	Difference
1: 0 to 5 km	88 163	89 307	99 732	11 570
2: 5 to 10 km	89 181	90 153	90 153	971
3: 10 to 15 km	33 119	32 746	27 054	-6 065
4: not covered	8 554	6 812	2 078	-6 476
Grand Total	219 017	219 017	219 017	0

7 Shiselweni Region - Conclusions

There are currently 32 immunisation facilities that cover 96.09% of people in Shiselweni. Of these 40.79% are covered within 5km, 40.79% in 10 km, 15.12% in 15km which leaves 3.6% of individuals currently not being covered. Maseyisini and Sigwe Tinkhundla have the most coverage of 99.97% and 99.94% respectively. Kubuta and Somntongo Tinkhundla have the lowest coverage of 86.54% and 73.07% respectively.

The accessibility study has identified 1 proposed health facility in Eswatini, which falls within Sigwe. This facility will increase the population covered to 96.89% in the region and relieve existing facilities of 10 426 individuals.

Along with the permanent health facilities, the implementation of 30 Satellite/Mobile clinics should be considered in Shiselweni where there is a lack of presence of permanent health facilities. This will increase the population covered to an even higher percentage of 99.05%. It will also reduce the demand on some of the existing facilities or the distance of travel that is required from individuals to reach an immunisation centre.

The implementation of the proposed measures could potentially provide access to an additional 4 734 people and improved the distance needed to travel for 12 541 individuals. Of the improved individuals 11 570 fall within the 0 to 5km travel distance bracket.

In Shiselweni the most impact for providing services to individuals will be accomplished by adding mobile immunisation facilities. This will assist in providing access to the utmost rural communities. It will also and improve the distance individuals need to travel to reach an immunisation facility.

It is however important to note that these proposed measures are recommendations and considerations with the aim to reach “Zero-Dose Communities” and therefore some proposed facilities might not be feasible due to the cost of reaching rural communities with a very low population estimation such as the 6 mobile locations with a coverage of 100 or less individuals which includes overlap population.