Smart facility location planning using GIS technology & facility provision standards for pro-active planning of social facilities

Cheri Green

BRICS Smart Cites, Jaipur India

17-19 August 2016

CSIR

our future through science

Council for Scientific and Industrial Research
SOUTH AFRICA

Structure of presentation

- Key informants & objectives
- Linking Accessibility planning; Planning Support Systems and the Smart City concept
- Approach & provision principles
  - Accessibility analysis
  - Provision standards and guidelines
- Library case study
- Impact, value for capacity building & resource allocation
- Truth behind the successful application

Smart City concept in planning

Geertman (2015) two main discourses in smart city concept:

- Smart growth leading to environmental & financial sustainability

- How ICT can contribute to more efficient planning & management of cities

Context

Smart Cities emerge "when investments in human and social capital and traditional (transport) and modern (ICTs) communication infrastructure fuel sustainable economic growth and high quality of life, with a wise management of natural resources, through participatory governance"

Caragllui 2011

Planning Support Systems (PSS) can be defined as geo-information technology-based instruments that are dedicated to supporting those involved in planning in the performance of their specific planning tasks. .....provides an approach **where ICT is combined with geo-spatial analysis** capabilities to provide smart planning support solutions to inform and guide sustainable development and management of cities.
Geertman 2006/ 2015

www.csir.co.za

our future through science

Key informants

- Access to services is a basic right
- Need to eliminate service backlogs
- Plan for equity /fairness
- Support sustainable & efficient city growth
- Optimal resource allocation
- Standards used to inform decision making; and
- Provide benchmarks for monitoring

Inaccuracy of "Island" based planning

Unit area data ie. ward or local municipality indicators of service demand & *available* facilities per local area unit - Island approach

Inaccurate basis for assessing *accessibility of* facilities.

Ignores distance & may ignore capacity, density and facilities just across border

Potentially accessible "cross-border" services

Available services per local area
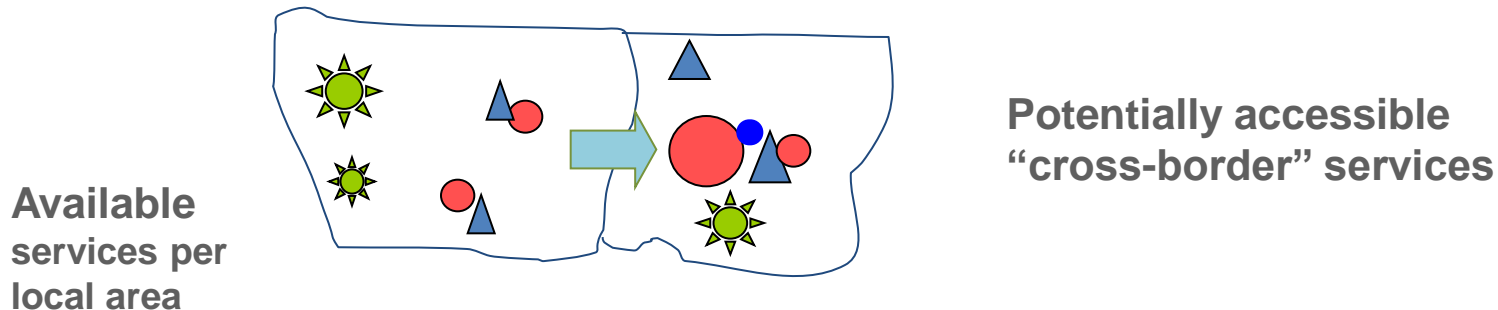
Context and complexities

- Different density & settlement types within same management area.

- Need to constantly play catch-up.

- Young inexperienced planners versus developers & development pressures.

- Restricted budgets.

- Pressure for investment to have greatest impact on backlog reduction.

Solution?

To support capacity building through informed decisions

Use GIS (ICT) based accessibility analysis **&** apply provision standards

- Accessibility analysis provides good spatial evaluation tool which is a-political & empirical

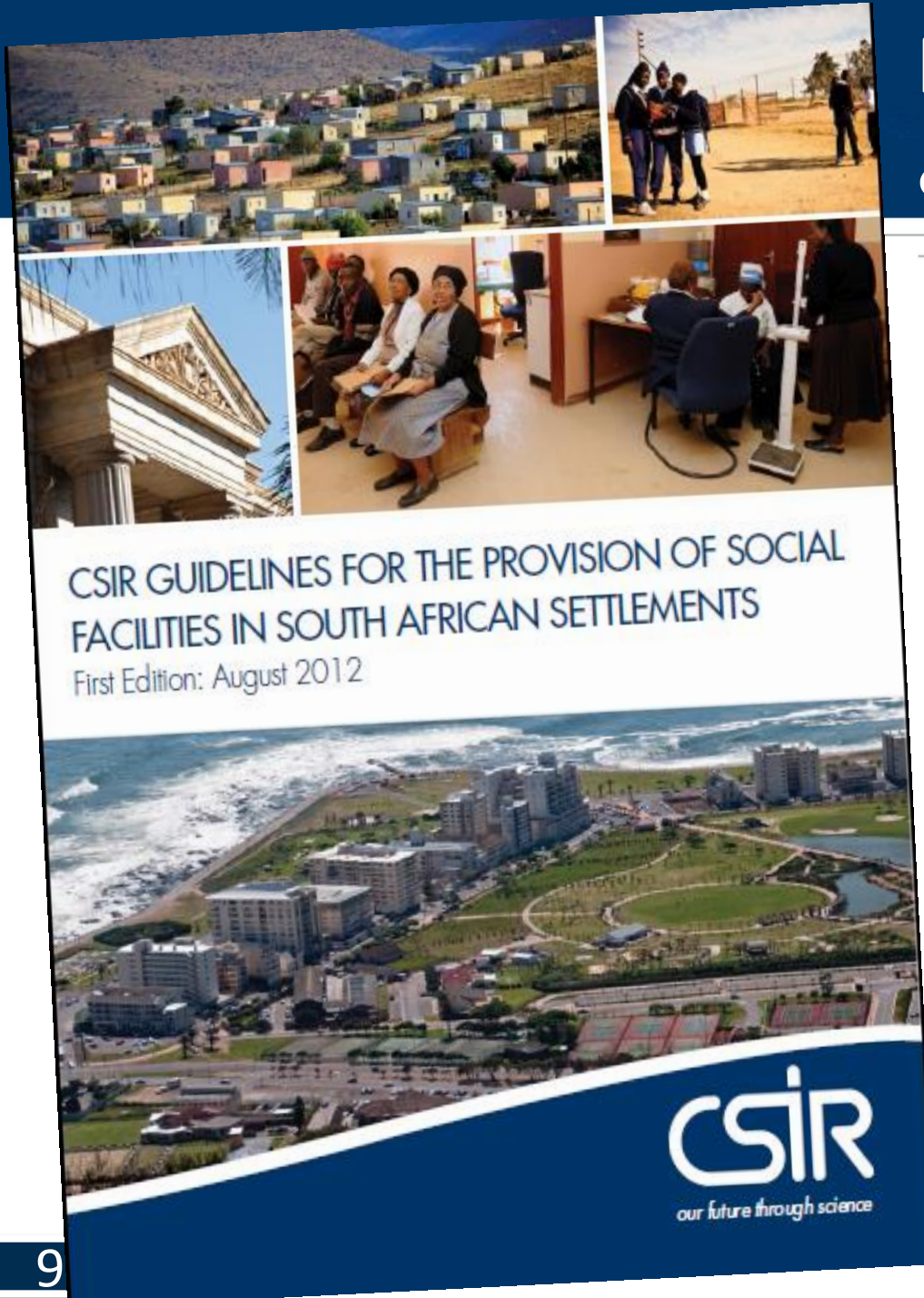- Standards enable measurement, benchmarking & target setting

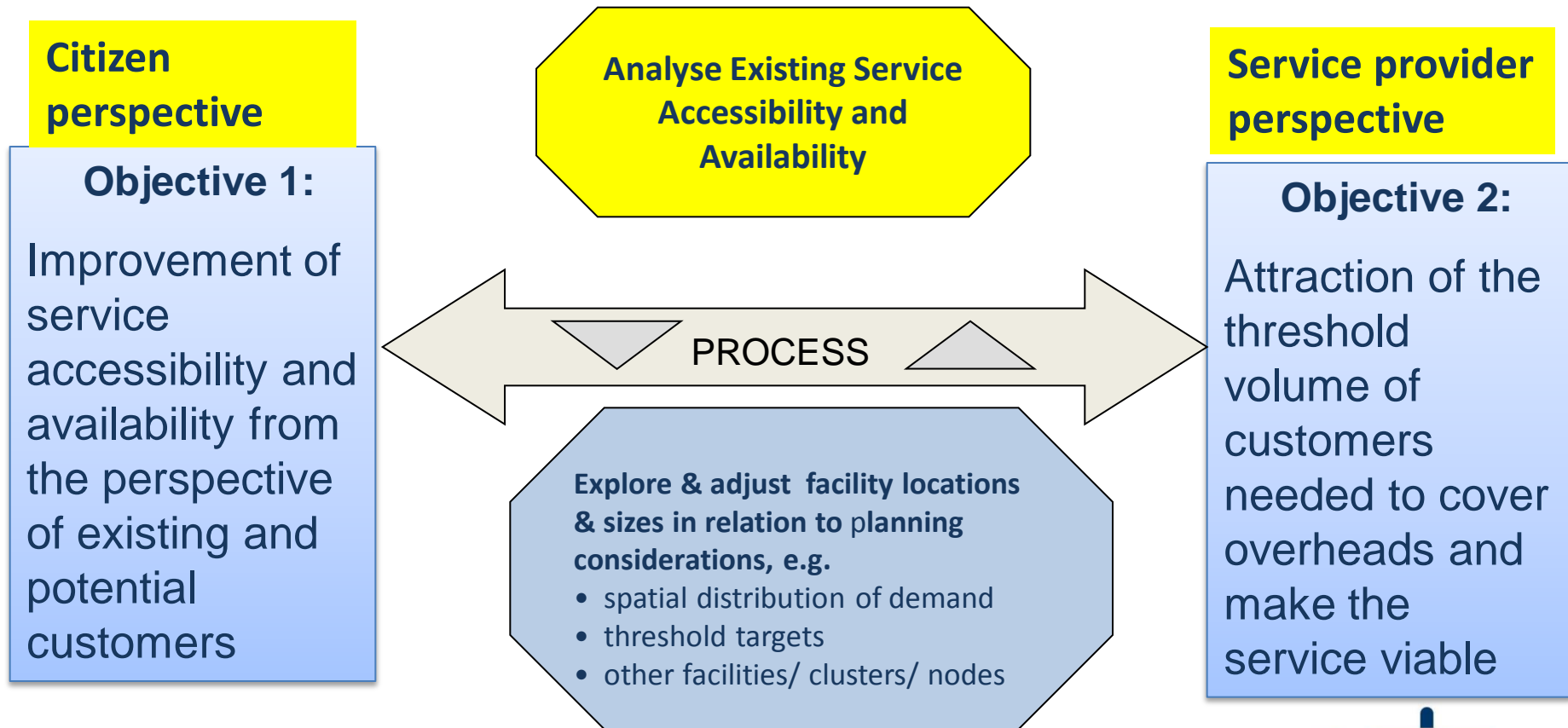CSIR GUIDELINES FOR THE PROVISION OF SOCIAL FACILITIES IN SOUTH AFRICAN SETTLEMENTS

First Edition: August 2012

Main variables

- **THRESHOLD CAPACITY**
- **DISTANCE**

Available at:

http://www.csir.co.za/Built_environment/pdfs/CSIR_Guidelines.pdf

# Basic principles of facility location planning: WHO gets WHAT, WHERE and HOW MUCH

Citizen perspective

Objective 1:

Improvement of service accessibility and availability from the perspective of existing and potential customers

Analyse Existing Service Accessibility and Availability

PROCESS

Explore & adjust facility locations & sizes in relation to planning considerations, e.g.
- spatial distribution of demand
- threshold targets
- other facilities/ clusters/ nodes

Service provider perspective

Objective 2:

Attraction of the threshold volume of customers needed to cover overheads and make the service viable

CSIR

our future through science

www.csir.co.za

Accessibility analysis

- Analyse the service provision distribution & capacity in relation to demand

- Measured in terms of maximum distances people will travel - facility service capacity and minimum viable service thresholds within service catchments and BASED ON AGREED STANDARDS.

- Model access based on rational choice – to nearest facility.

- When access distance and facility size/capacity considered in combination over a wide area can show whether provision is both **sufficient and equitable.**

- Analysis of only distance or only capacity is not adequate.

# Data layers used for accessibility analysis

- Road network used to calculate travel distance

- Facility locations with capacity - i.e. classroom/ staff or size

- Population distribution
  - disaggregated to hexagon layer
  - hexagon = 20ha

2016   www.csir.co.za
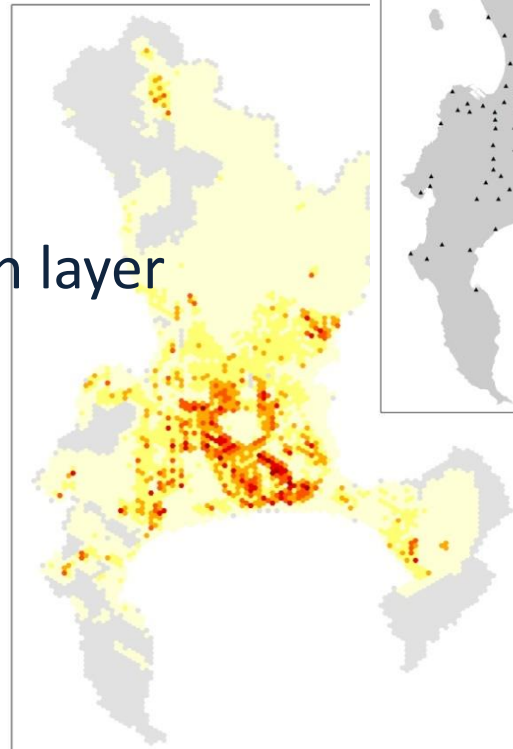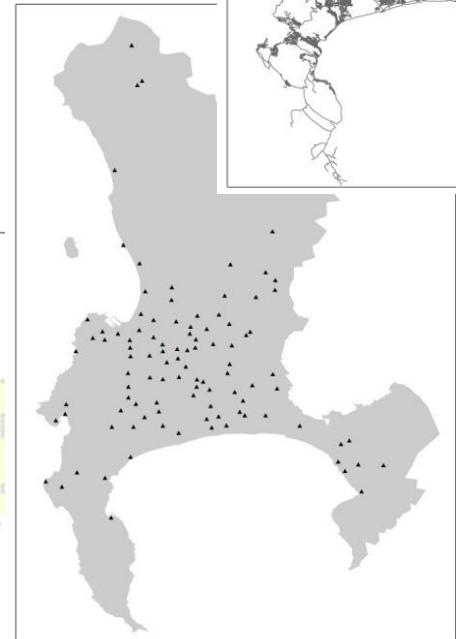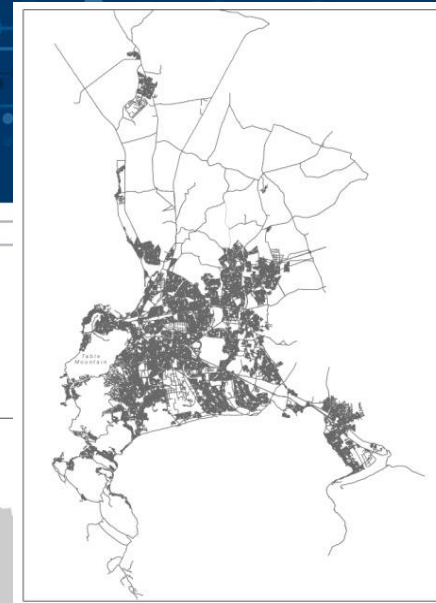
Accessibility analysis

All three layers interact within set standards to determine:

- Which part of **population;**

- Will travel **how far;**

- To a **facility** with set capacity.
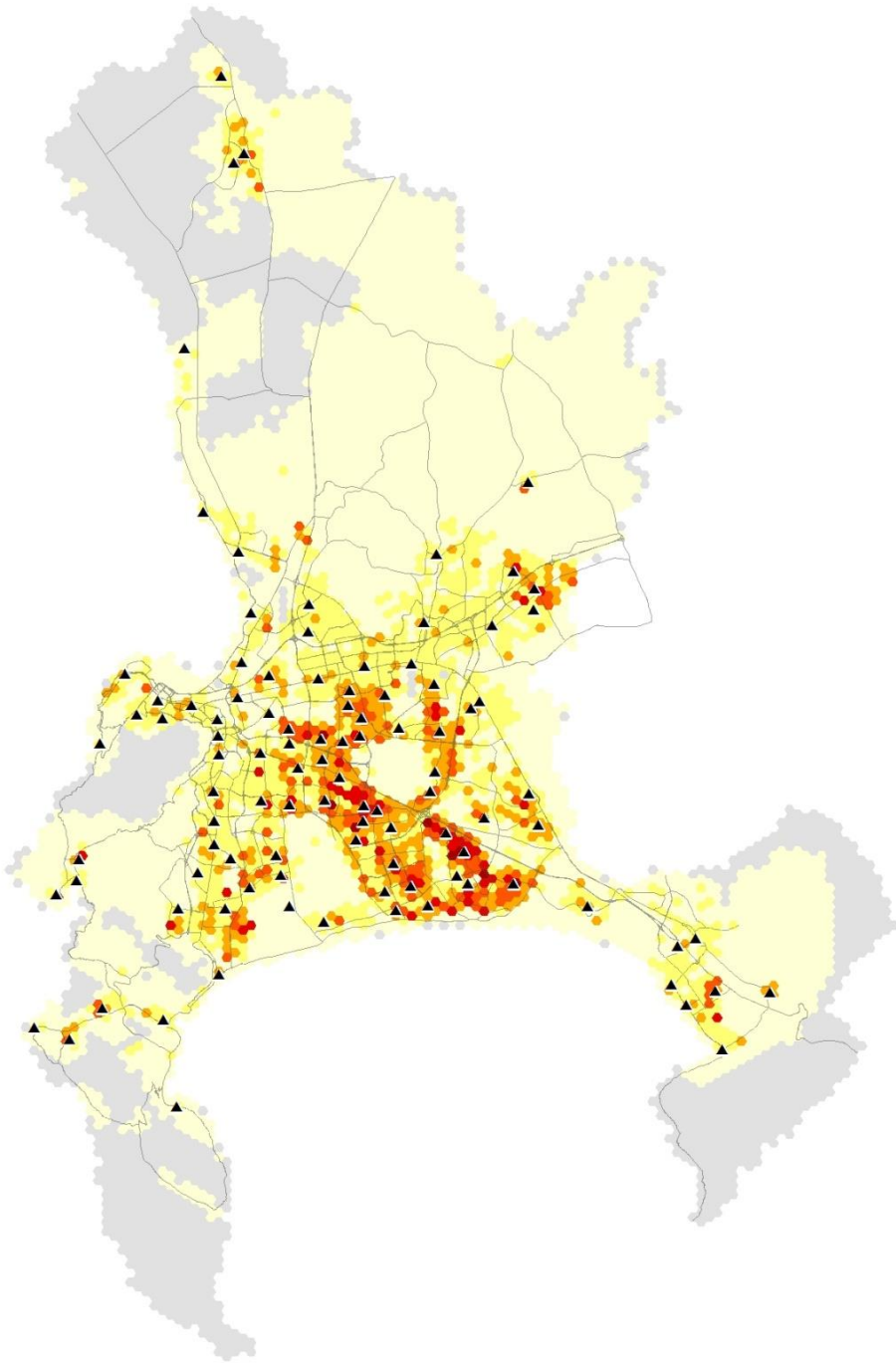
Libraries big and small

Objectives:
- fewer larger facilities of higher quality greater focus
- slightly longer travel distances
- sharing, co-location and integration
- location – nodes & main travel network
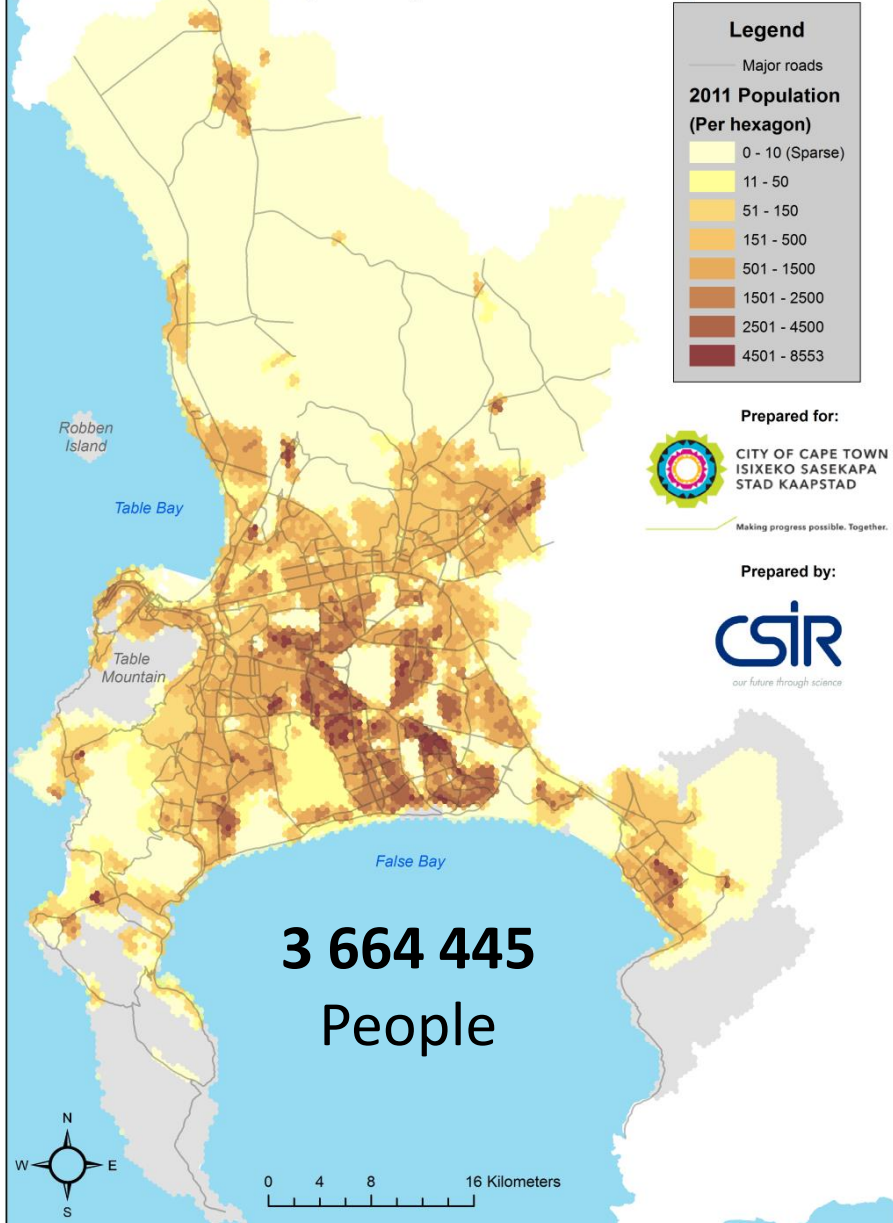- consolidation & rationalisation
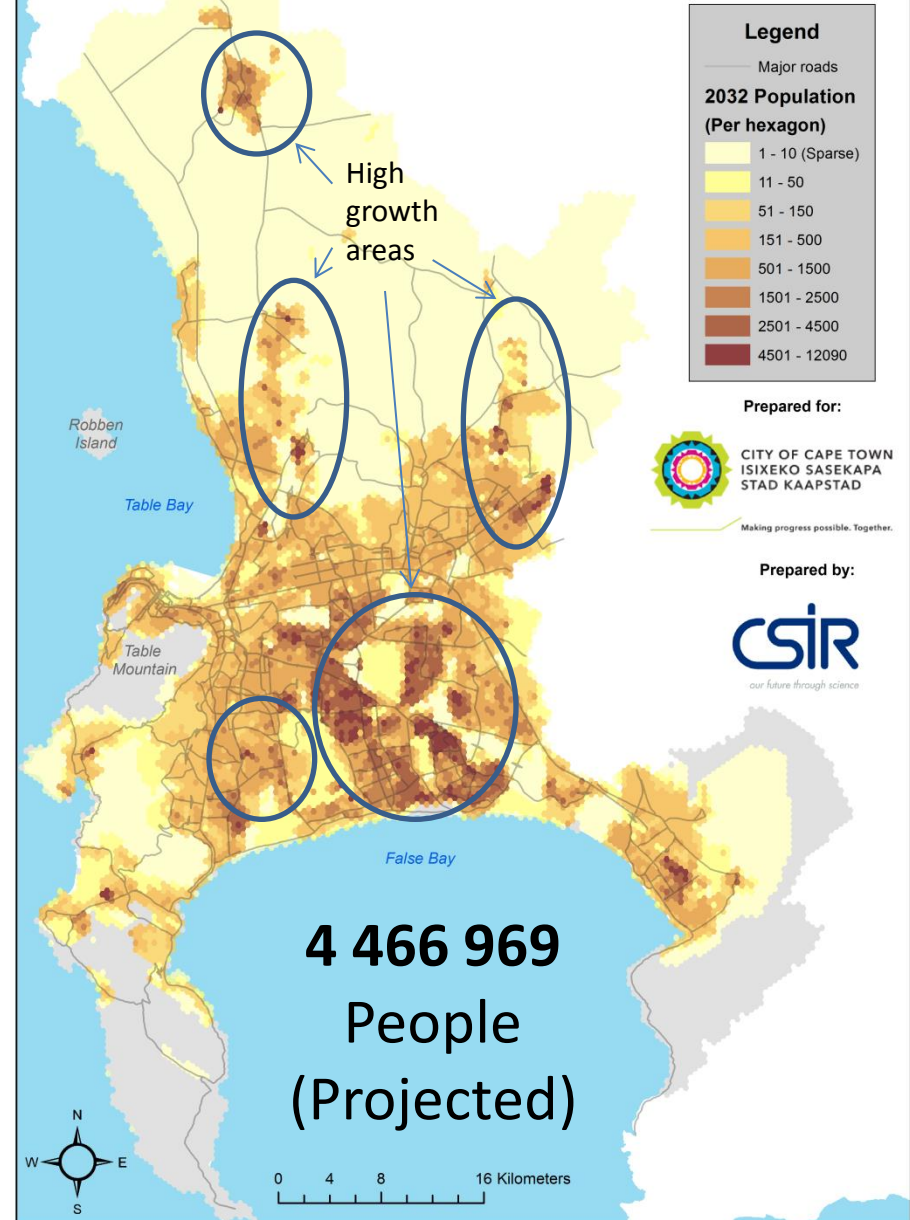
Key Assumptions: Libraries

- The entire population = users of public library services.

- Larger facilities preferred: up to 120 000 threshold per facility.

- Distance limit: 5km maximum for Community

    10km for Regional Libraries.

Population Demand

City of Cape Town: 2011 Population
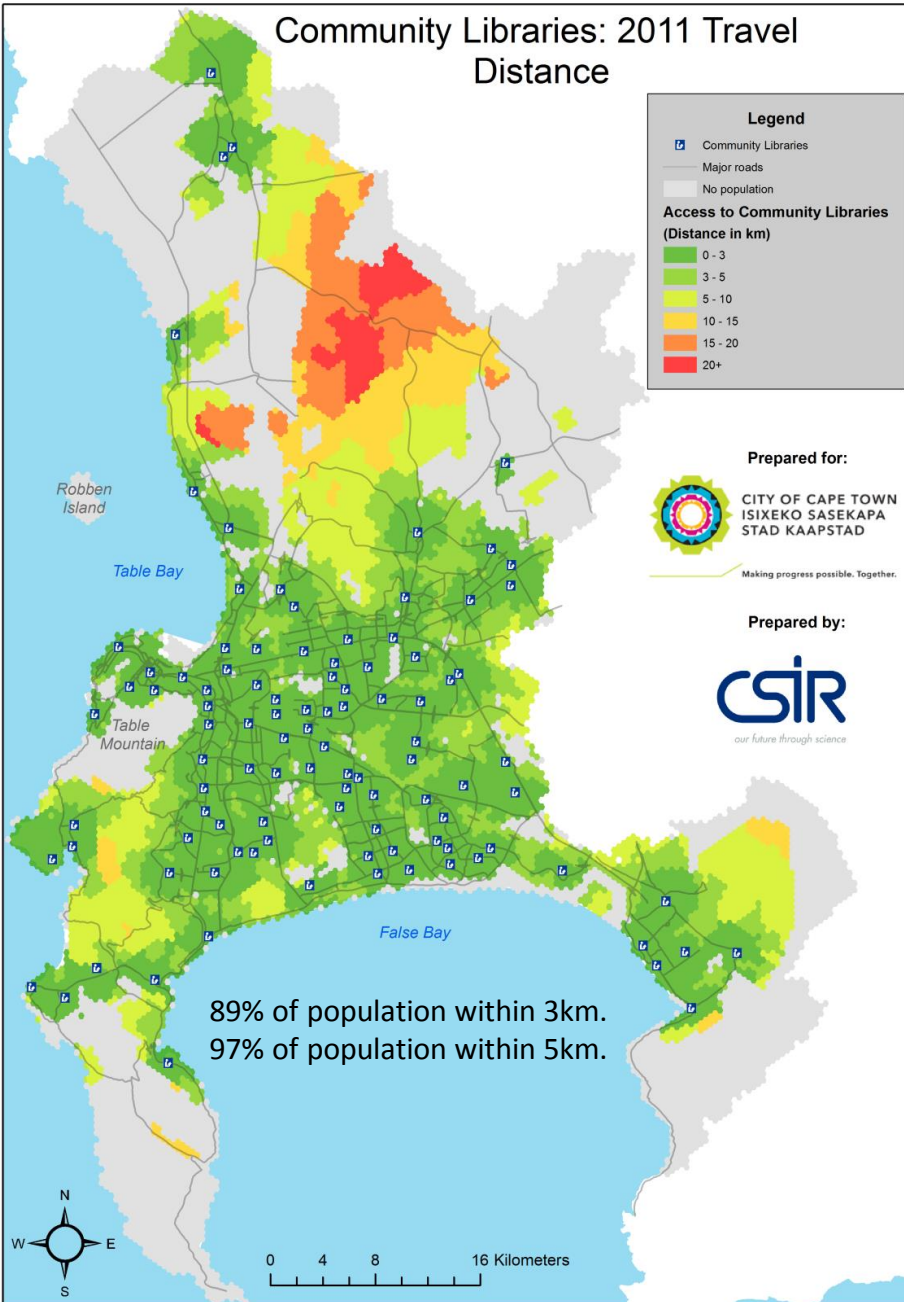
Legend
- Major roads

2011 Population (Per hexagon)
- 0 - 10 (Sparse)
- 11 - 50
- 51 - 150
- 151 - 500
- 501 - 1500
- 1501 - 2500
- 2501 - 4500
- 4501 - 8553

3 664 445 People

City of Cape Town: 2032 Population

Legend
- Major roads

2032 Population (Per hexagon)
- 1 - 10 (Sparse)
- 11 - 50
- 51 - 150
- 151 - 500
- 501 - 1500
- 1501 - 2500
- 2501 - 4500
- 4501 - 12090

High growth areas

4 466 969 People (Projected)

Community Libraries - Travel Distance Maps 2011 & 2032

Community Libraries: 2011 Travel Distance

Legend
- ⊡ Community Libraries
- Major roads
- No population

Access to Community Libraries (Distance in km)
- 0 - 3
- 3 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20+

Prepared for:

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

Making progress possible. Together.

Prepared by:

CSIR
our future through science

Robben Island

Table Bay

Table Mountain

False Bay

89% of population within 3km.
97% of population within 5km.

0 4 8   16 Kilometers

Community Libraries: 2032 Travel Distance

Legend
- ⊡ Community Libraries
- Major roads
- No population

Access to Community Libraries (Distance in km)
- 0 - 3
- 3 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20+

Prepared for:

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

Making progress possible. Together.

Prepared by:

CSIR
our future through science

Robben Island

Table Bay

Table Mountain

False Bay

85% of population within 3km.
95% of population within 5km.

0 4 8   16 Kilometers

Community Libraries - Served Areas 2011 & 2032

Community Libraries: 2011 Served Regions
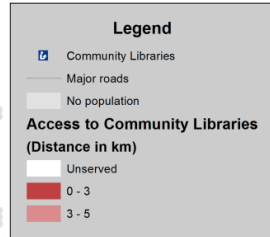
76% Served = 2 803 219
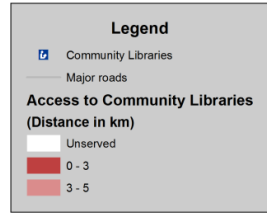
Community Libraries: 2032 Served Regions
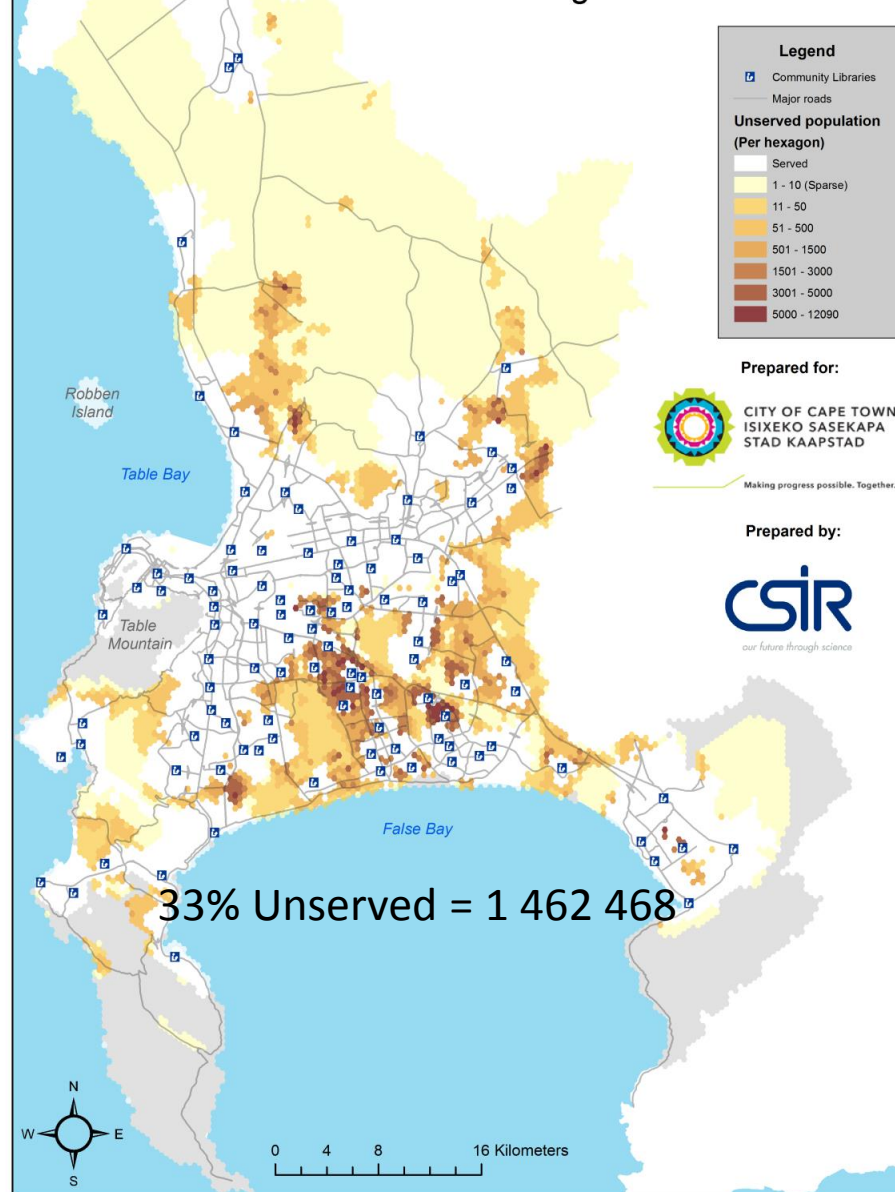
67% Served = 3 004 500
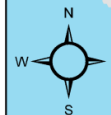
Community Libraries - Unserved Areas 2011 & 2032
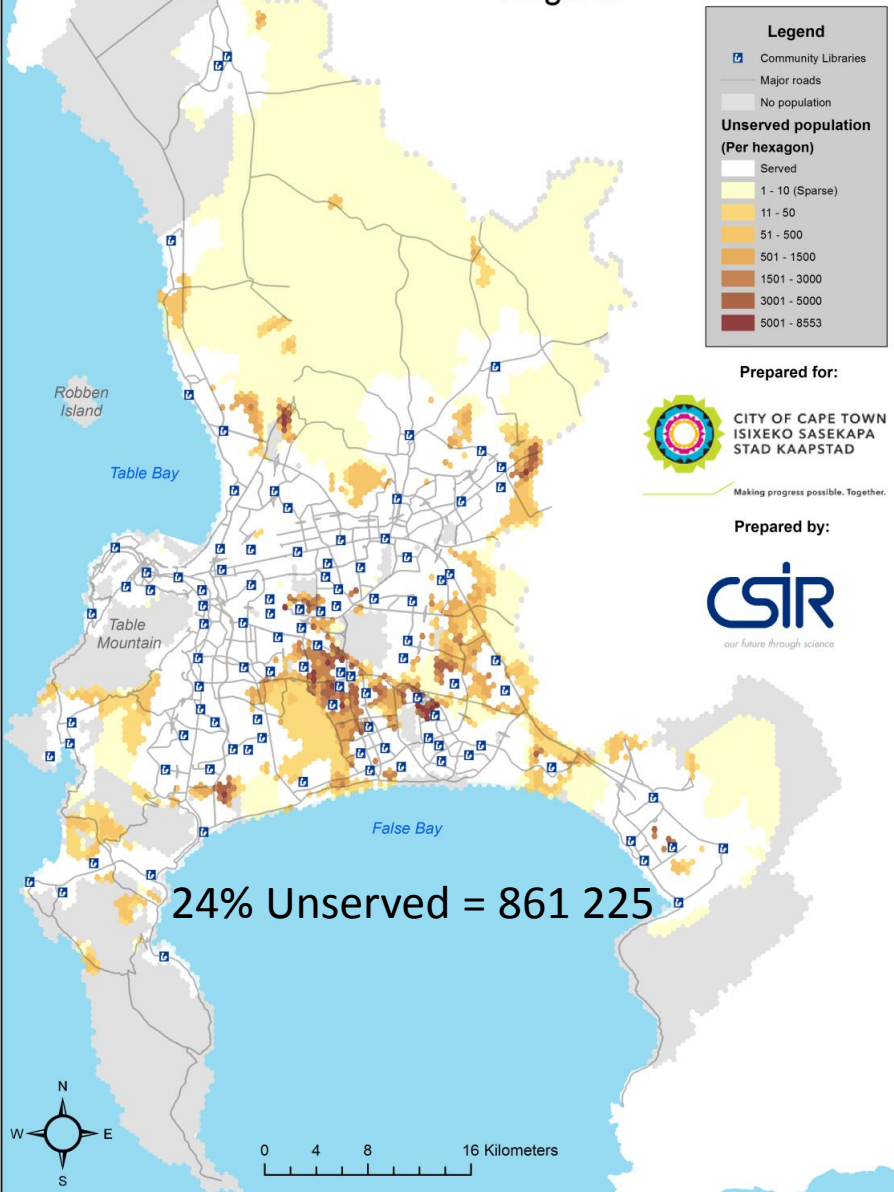
Community Libraries - Service Coverage Statistics per Planning District - 2011 & 2032

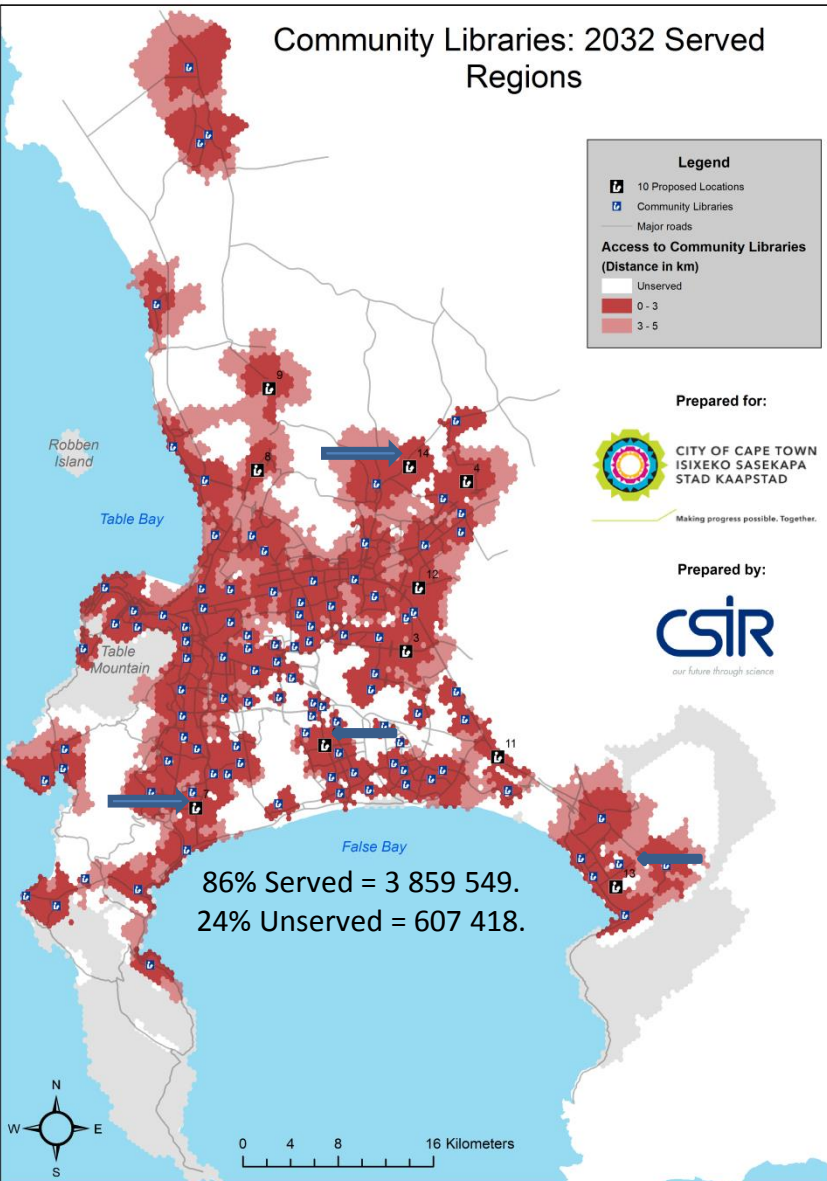| 2011 Community Libraries Served & Unserved				
Planning district	**Unserved**	**Served**	**% served**	**Total pop**
Blaauwberg	55 215	190 758	77.55%	245 972
Cape Flats	177 450	400 197	69.28%	577 648
Helderberg	36 512	180 528	83.18%	217 039
Khayelitsha/Mitchells Plain	405 075	683 431	62.79%	1 088 506
Northern	102 422	228 642	69.06%	331 063
Southern	21 123	296 149	93.34%	317 272
Table Bay	7 947	160 801	95.29%	168 748
Tygerberg	55 482	662 714	92.27%	718 196
Grand total	**861 225**	**2 803 219**	**76.50%**	**3 664 444**

2032 Community Libraries Served & Unserved				
Planning district	**Unserved**	**Served**	**% served**	**Total pop**
Blaauwberg	145 881	235 565	61.76%	381 446
Cape Flats	286 873	412 741	59.00%	699 614
Helderberg	57 127	220 122	79.40%	277 249
Khayelitsha/Mitchells Plain	614 064	690 000	52.91%	1 304 064
Northern	204 257	252 640	55.29%	456 896
Southern	35 749	312 746	89.74%	348 495
Table Bay	10 623	178 555	94.38%	189 179
Tygerberg	107 894	702 132	86.68%	810 026
Grand total	**1 462 468**	**3 004 500**	**67.26%**	**4 466 968**

CSIR
our future through science

Community Libraries - What investment is required for 86% service level?

Community Libraries: 2032 Served Regions

Legend
- 10 Proposed Locations
- Community Libraries
- Major roads

Access to Community Libraries (Distance in km)
- Unserved
- 0 - 3
- 3 - 5

Prepared for:
CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD
Making progress possible. Together.

Prepared by:
CSIR
our future through science

86% Served = 3 859 549.
24% Unserved = 607 418.

- *** New locations to be considered by 2022:**
  - Location 6 @ 100 000 capacity (Regional + Community) ;
  - Location 7 @ 70 000 capacity;
  - Location 13 @ 25 000 capacity (Regional + Community); and,
  - Location 14 @ 20 000 capacity
- *** New locations to be considered by 2032:**
  - Location 3 @ 100 000 capacity (Regional + Community);
  - Location 4 @ 100 000 capacity (Regional + Community) ;
  - Location 8 @ 70 000 capacity;
  - Location 9 @ 60 000 capacity (Regional + Community);
  - Location 11 @ 30 000 capacity; and,
  - Location 12 @ 30 000 capacity (Regional + Community)
- **Current Libraries to be considered for expansion by 2022**
  - Crossroads Public Library to 100 000 (Regional + Community);
  - Delft Public Library to 100 000;
  - Guguletu Public Library to 70 000;
  - Lotus River Public Library to 40 000;
  - Lwandle (Hector Peterson Memorial Library) to 50 000; and,
  - Mfuleni Public Library to 100 000 (Regional + Community)
- **Current Libraries to be considered for expansion by 2032**
  - Bishop Lavis Public Library to 100 000 (Regional + Community);
  - Brackenfell Public Library to 100 000; and,
  - Ottery Community Library to 60 000

Notes:
* See numbers on map to left.

All facilities shown in red text serve as both Community and Regional libraries.

CSIR
our future through science

Libraries – Key outcomes

- Most of City's population have good access.

- More than sufficient Library capacity but not equally distributed.

- Used informed decision making based on empirical analysis to agree requirements with Regional Managers and District Level Workshops.

- Results

- 10 new Community Library locations needed by 2032; of which 6 should also function as Regional Libraries

  - 8 current Community Libraries – expansion required - good locations

  - 9 current Community Libraries have good locations to serve as Regional Libraries with capacities of 120 000.

Integrated Guide For Social Facility Investment 2032
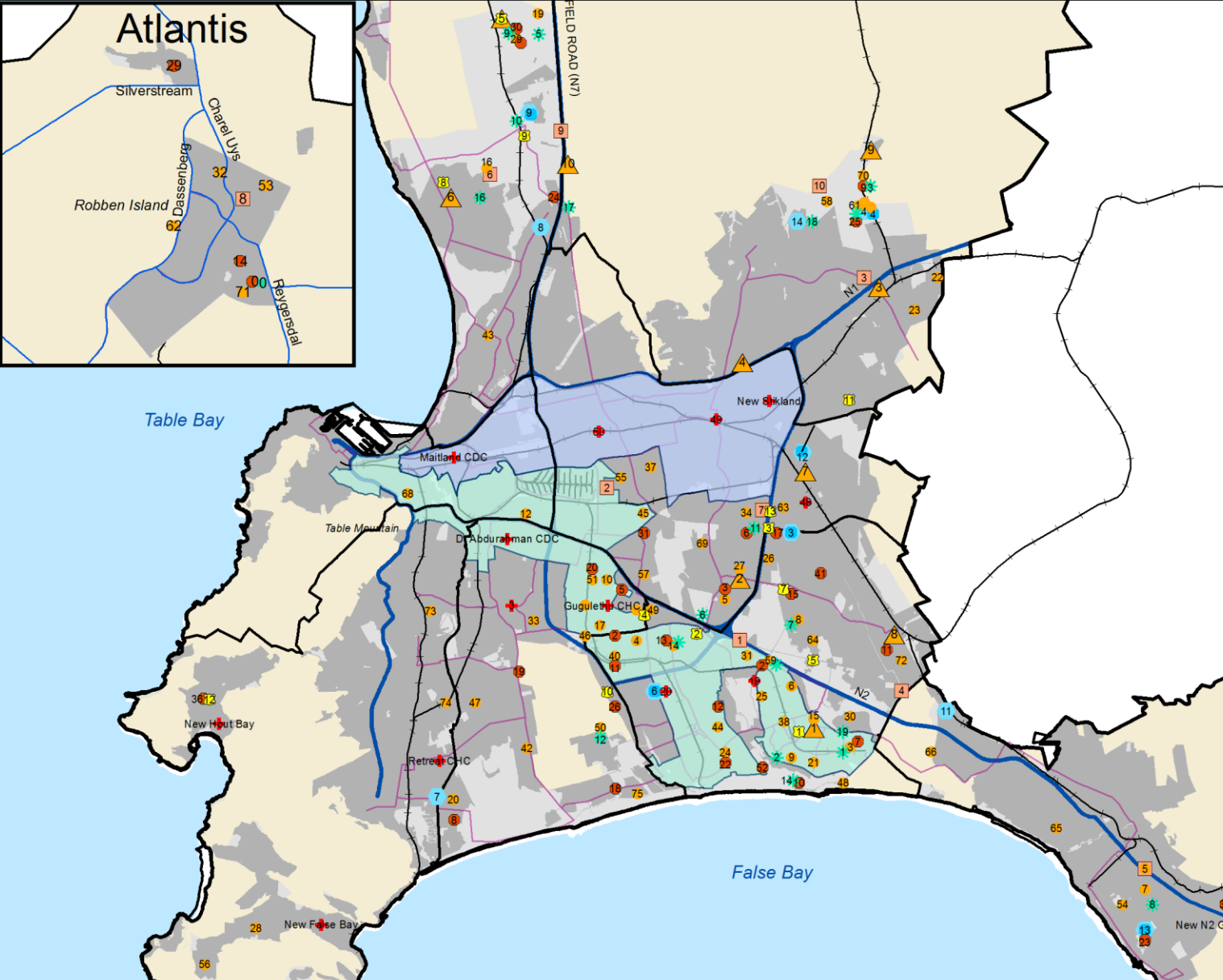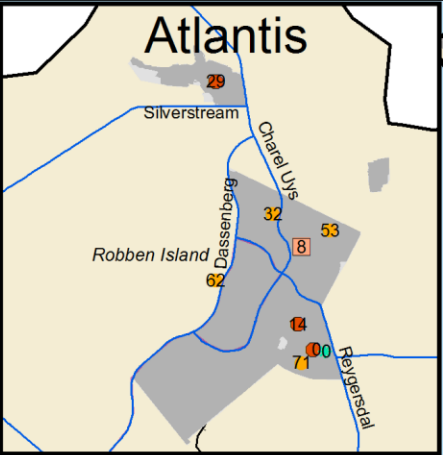
Planning implications (1)

Shortfalls in most facilities – difficult to find suitable, well located land. Thus:

- Unconventional approaches required.

- Sharing, clustering and multi-storey developments with innovative **space saving designs**.

- Greater focus on re-use/ retrofitting of existing well located facilities.

- Rental within retail malls for libraries or clinics.

- Private Public partnerships.

- Sharing with other government sectors(cross sectoral management).

our future through science

Planning implications (2)

- Need to reduce space standards & improve quality especially of land intensive facilities such as parks, sport fields & cemeteries.

- Reduce footprint of buildings.

- Operational budgets need to be aligned to capital investment to achieve goal.

our future through science

www.csir.co.za

Uses of accessibility analysis outputs

- Evaluating requests for new facilities

- Capital budget strategic planning

- Informing community participation process

- Evaluating impact of new development with respect to facility demand

Applications to date

- 4 metros   14 million people   28 % SA Population

- National and provincial level applications for prioritisation of non-metro investment

Value of the research application

- Results are visual & spatial
- Technical competence builds trust in results
- Defendable, empirical, fair, A-POLITICAL
- Provides statistics for backlog monitoring
- Limits construction of white elephants
- Brings GIS/ICT into mainstream city infrastructure planning
- Provides technical support for planning

CSIR

our future through science

www.csir.co.za

Conclusions

- Approach & tools provide empirical base for determining needs between areas.

- Together with the standards, analysis supports human capacity for informed planning.

- Integration between sectors is enhanced & mutli-sector facilities can be planned for better resource allocation.

- Investment directed to areas of greatest backlogs for biggest impact and ROI.

www.csir.co.za

our future through science

HOWEVER …It all depends on

- Having the right people, in the right place, at the right time.

- Political will, lack of ego and a clear vision to do what is right.

- Skills and desire to apply best available technical skills to the problem and apply standards without favour.

www.csir.co.za

BRICS Partnership for Global Security, Peace and Prosperity

Contact:

Cheri Green – cgreen@csir.co.za

CSIR

our future through science