9-14-2016

Presentation: Spatial Design of an Objective Driven Theoretical Water Resources Monitoring Network

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SPATIAL DESIGN OF AN OBJECTIVE DRIVEN THEORETICAL WATER RESOURCES MONITORING NETWORK

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14 September 2016

ACKNOWLEDGEMENTS

- DWS: WIM (Mr. F. Guma, Mr. Z. Maswuma, Mr. M. Musariri, Dr. P. Wessels, Mr. D. van der Spuy, Mr. J. Naidoo)
- DWS: RQIS
- DWS: IWRP
- All DWS Regional Office
- >100 people providing input to process

OBJECTIVES

- Overview of the **DWS project**
- Provide overview the network **review process**.
- Describe process of **developing objectives driven theoretical water resources monitoring process**

Review, evaluation and optimisation of the National Water Resources Monitoring Networks Project

Aim to:

- undertake an **evaluation of each the 10 monitoring** networks in their **present condition**,
- **redesign and realign** (where necessary) the network with the **strategic and management requirements of the DWS and SA**,
- **optimised the networks** as far as possible, and
- ensure **sustainable, relevant and up-to-date data of an acceptable quality**.

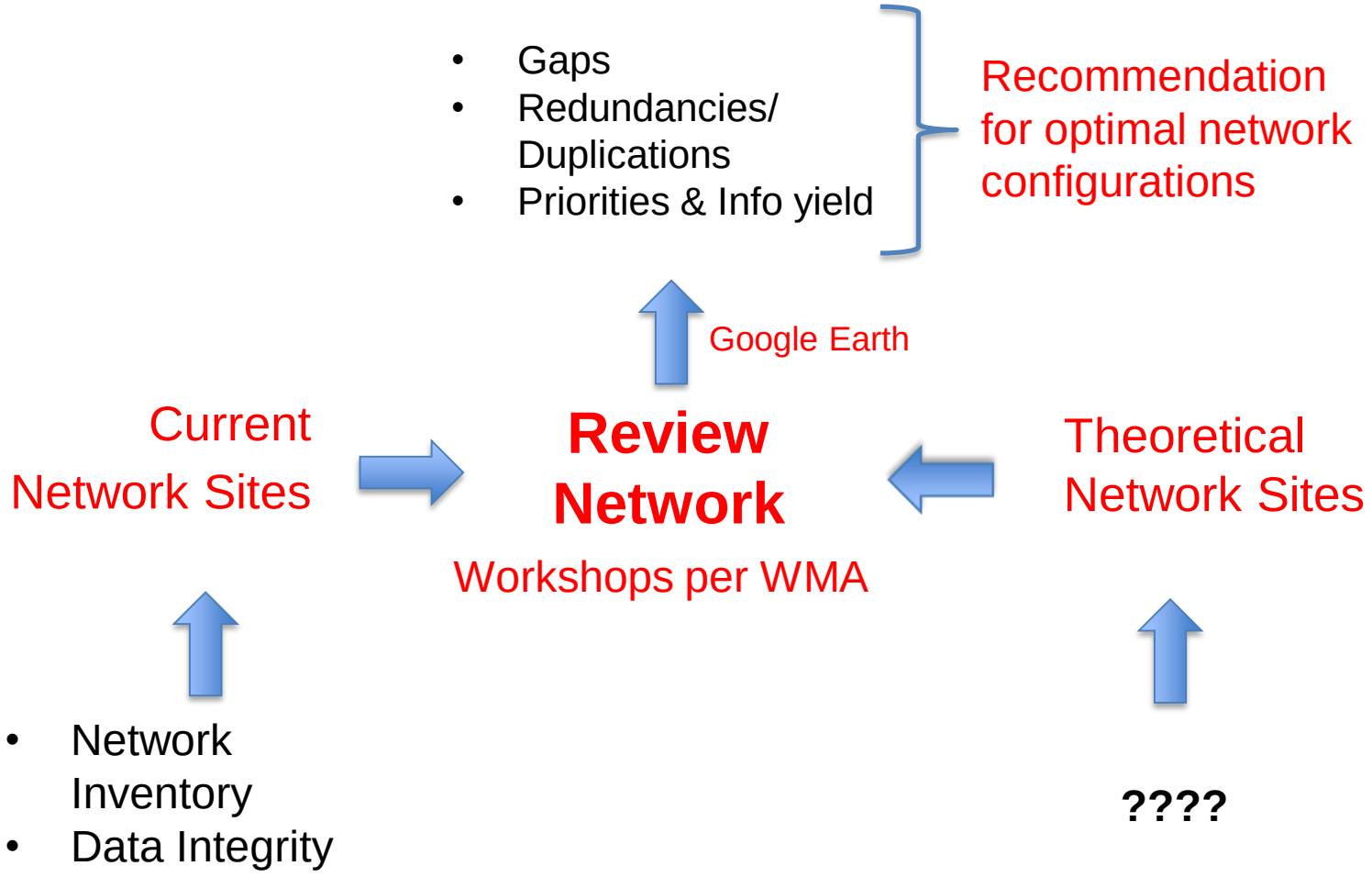
Outcome:

National Water Resource Monitoring Implementation Strategy

Redesign, realign and optimise.

- Extensive process undertaken to **get status quo of current monitoring** activities and integrity of data
- Require **independent way of evaluating existing network** to assess adequacy of meeting of DWS needs.
- What are the **objectives** of a national water resources monitoring network?
- Who are the **main clients**?
- **Where and what** should we be measuring?

National Network Spatial Review Process



Theoretical Water Resources Monitoring Network.

- A chance for a **new beginning**.
- Totally **independent** of current monitoring activities.
- Take **no constraints** into account (except the physical impossible)
- Would be **Theoretical Optimal Network** that would meet all DWS: WIMs legal and other requirements to monitor water resources **nationally**.

Development of a theoretical monitoring network

Why monitor?
What has priority?

→

Where should we monitor?
What and how often?

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National Water Resources Monitoring Objectives

National Water Resource Monitoring Objectives

Priority class	Objective	Description
1	Resource and infrastructure planning	To provide adequate monitoring data for determining the availability and quality of current and future water resources, aimed at providing strategic decision support for the equitable and sustainable allocation of resources to the population, environment and other economic sectors of society through planned infrastructure development and other interventions.
2	Resource operations and management	To provide timely monitoring data for the efficient operation and management of water resources to ensure the protection of resources and water users and to allocate water equitably and sustainably.
3	Early warning systems	To provide timeous water resources monitoring data for early-warning systems to mitigate negative impacts on humans, infrastructure, the economy and riverine and coastal ecosystems.
4	Compliance and auditing	To provide water quality and quantity monitoring data to ensure compliance and auditing functions required for water use licensing, and other functions.

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National Water Resources Monitoring Objectives ✓✓

↓

Legal and Scientific processes to meet needs

Sub-objectives and processes

Main objective	Sub-objective	Process
Resource and infrastructure planning	Quantify available resource	Rainfall-runoff modelling
		Groundwater modelling
		International obligations
		Research and baseline catchments
		Reserve requirements
		Estuarine requirements
	Determine fitness for use of resources	Quality trend and threshold analyses
		Salinity modelling
		Eutrophication modelling
		Groundwater modelling
	Development options analysis system operating rules	Water resource systems modelling, including demand projections
	Infrastructure design	Sediment analysis
		Flood analysis

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National Water Resources Monitoring Objectives ✓✓

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Legal and Scientific Processes to meet needs ✓✓

→ Spatial monitoring criteria to support legal/scientific processes

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Legal and Scientific Processes to meet needs ✓✓

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Spatial monitoring criteria to support legal/scientific processes

National Spatial Datasets ↑

National Spatial Datasets

Dataset description	Origin	Source	Status
A) Hydrological considerations			
Quaternary, Tertiary, Secondary and Primary Catchments	Source	Water Resources of South Africa 2005 (WRC, 2008)	Used
1:500 000 primary and secondary rivers	Source	Water Resources of South Africa 2005 (WRC,2008)	Used
Catchment Outlet Points	Derived	Generated from NASA ASTER 30m GDEM and Quaternary Catchment Data (WRC, 2008)	Used
International Boundaries	Source	CD NGI. Municipal Demarcation Board (2011)	Used
Natural cumulative mean annual runoff ($10^6 m^3/a$)	Derived	Generated from Water Resources of South Africa 2012 (WRC, 2015) MAR Data and WSAM Catchment Tree	Used
Natural incremental mean annual unit runoff (mm/a)	Derived	Generated from Water Resources of South Africa 2012 (WRC, 2015) MAR, Area and WSAM Catchment Tree data	Used
Topography (slopes)	Derived	Generated from NASA ASTER 30m GDEM	Not used
River network stream-orders - 30m DEM	Derived	Generated from NASA ASTER 30m GDEM	Not used
Sedimentation	Source	Water Resources of South Africa 2005 (WRC, 2008)	Not Used
MAP	Source	Water Resources of South Africa 2005 (WRC, 2008)	Not Used
MAE	Source	Water Resources of South Africa 2005 (WRC, 2008)	Not Used

National Spatial Datasets (Continued)

Dataset description	Origin	Source	Status
B) Geo-hydrological Considerations			
Geology	Source	Council for Geosciences	Used
Transboundary aquifers	Source	Hydrogeology map of Southern Africa 2010 (SADC)	Used
Vegter aquifer regions	Source	An explanation set of national groundwater maps (WRC)	Not used
High yielding aquifers (aquifer classifications)	Source	1:500 000 Hydrogeological map series (DWAF)	Used
Aquifer vulnerability	Source	Groundwater Resource Assessment: Phase 2 (DWAF)	Used
Groundwater quality (EC, N, F)	Source	Groundwater Resource Assessment: Phase 2 (DWAF)	Used
Baseflow sensitive groundwater areas	Source	Groundwater Resource Assessment: Phase 2 (DWAF)	Used

National Spatial Datasets (Continued)

C) Environmental considerations			
Ecological water requirement (EWR) Sites	Source and derived	Resource Classification and RQO Study EWR sites obtained from DWS: Water Ecosystems. Other EWR sites obtained from various consultants	Used
South African protected areas database	Source	SAPAD, (DEA, 2015)	Used
Present Ecological Status, Ecological Importance and Ecological Sensitivity	Source	Desktop PES, EI + ES (DWS, 2014)	Used
Groundwater Reserve areas	Derived	DWS: WES	Used in some areas

National Spatial Datasets (Continued)

Dataset description	Origin	Source	Status
D) Anthropogenic Considerations			
Inter-basin transfers	Source	Water Resources of South Africa 2005 (WRC, 2008)	Used
Dams (including DWS dams)	Sources and derived	DWS Hydstra Coordinates for active and inactive dams, Land Cover and DWS registered dam safety database.	Used
Landcover and negative landcover	Derived	Generated from SA Landcover © Geoterraimage (2014): Reduced classes and area summary per class	Used
Eskom Power Stations	Derived	Generated from www.eskom.co.za	Used
Fracking Geo-Exploration Zones	Source	Petroleum Agency of South Africa	Used
AMD Zones and Treatment Plants	Source	TCTA, 2011.	Used
WWTW and WTW	Source	DWS: Water Services	Used
Drought vulnerability map	Source	DWS:GI	Used
Governmental Groundwater Control Areas	Source	DWS:GI	Used
Groundwater dependent towns	Source	DWS:GI	Used

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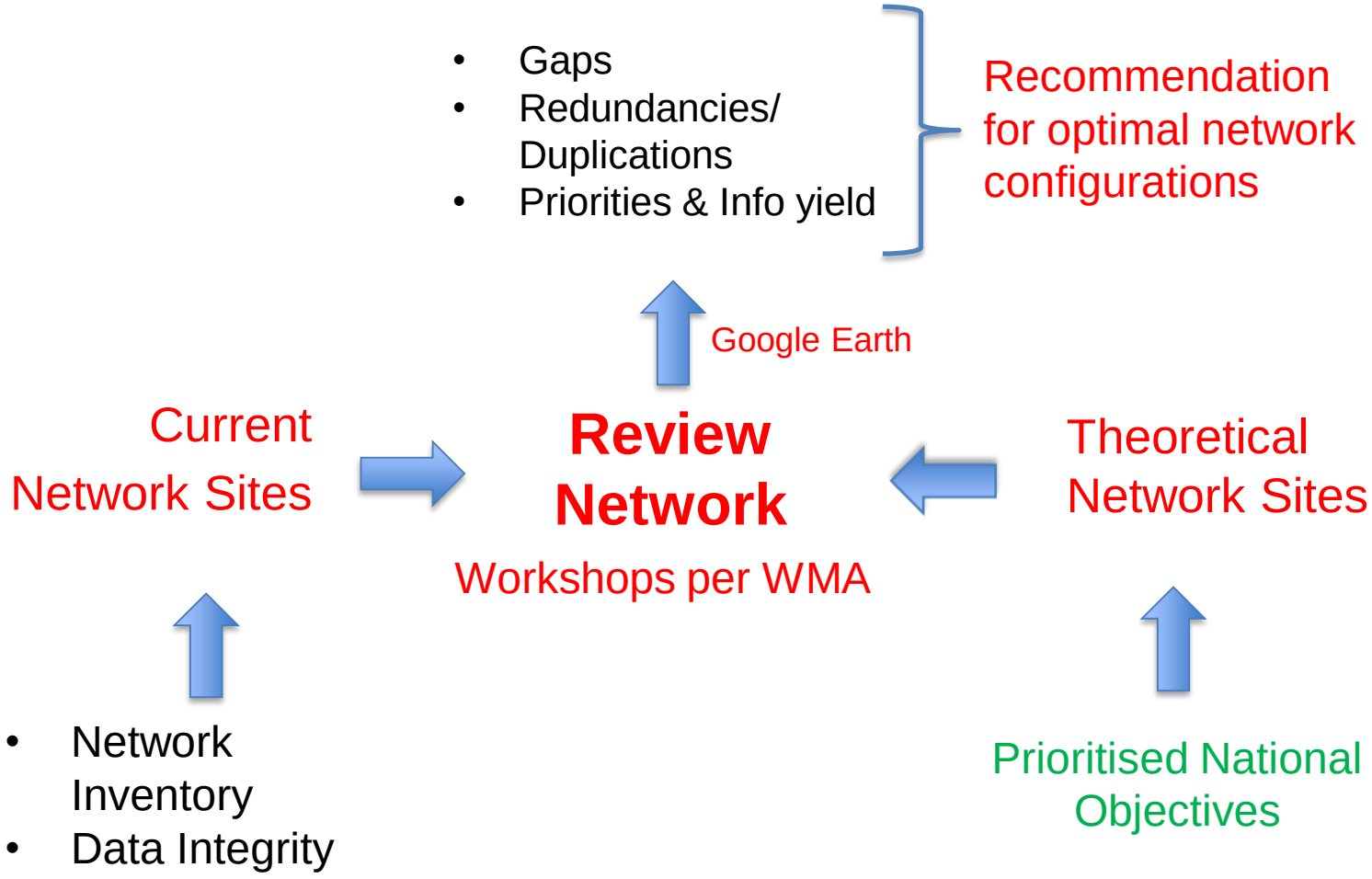
Spatial monitoring criteria to support legal/scientific processes ✓✓

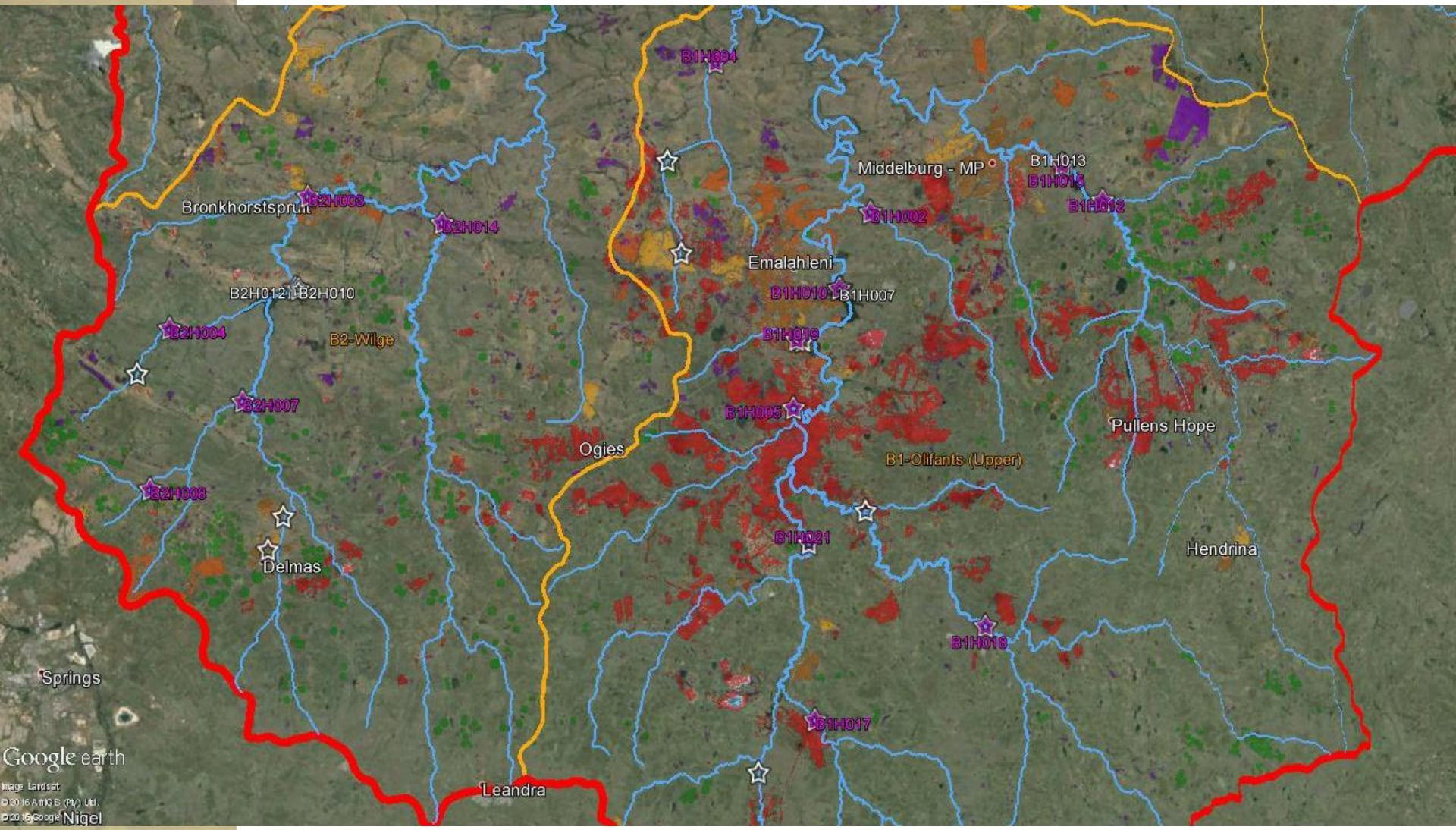
✓✓ National Spatial Datasets ↑

Theoretical Monitoring Sites

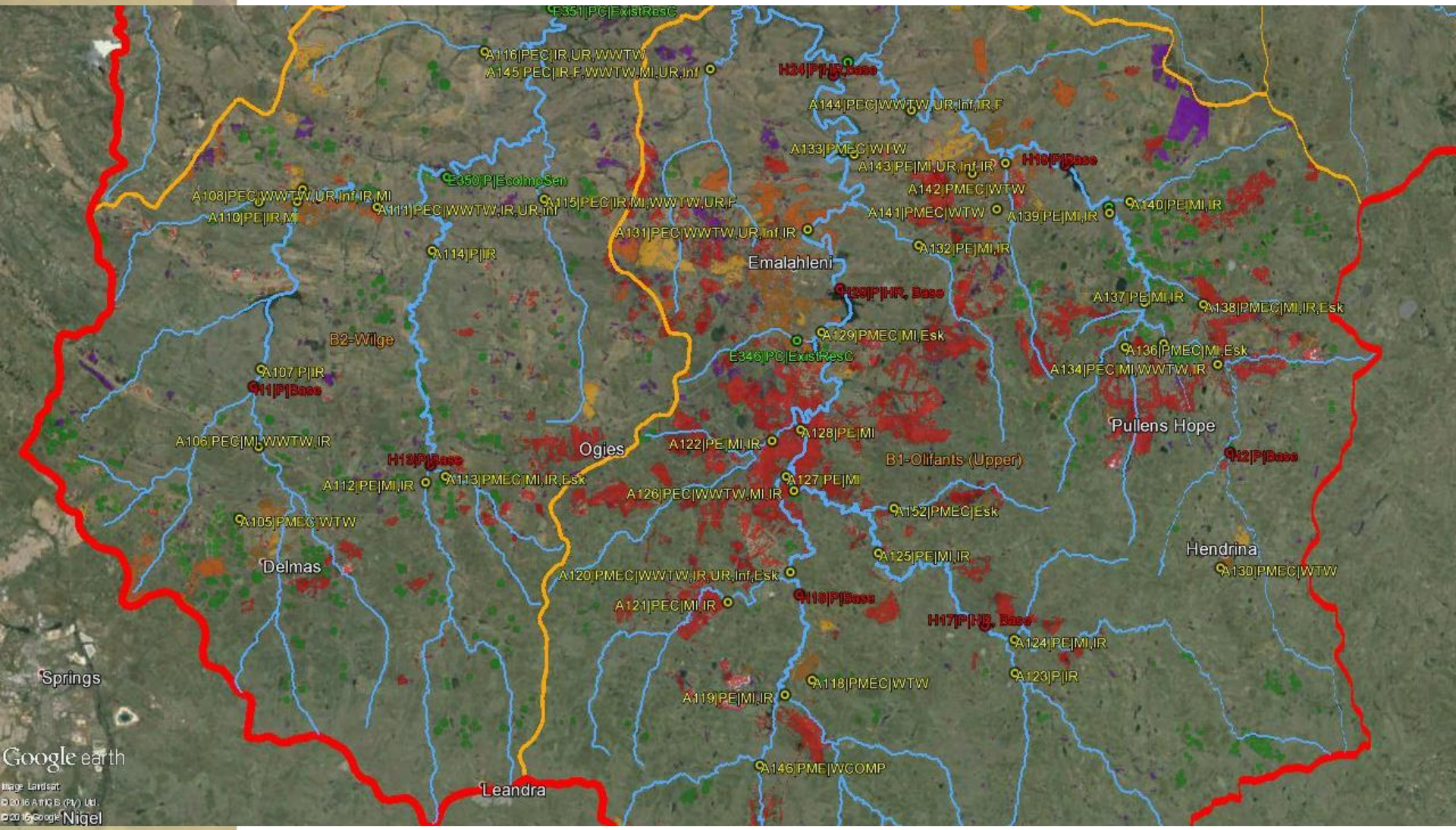
National Network Spatial Review Process



Current Monitoring Sites



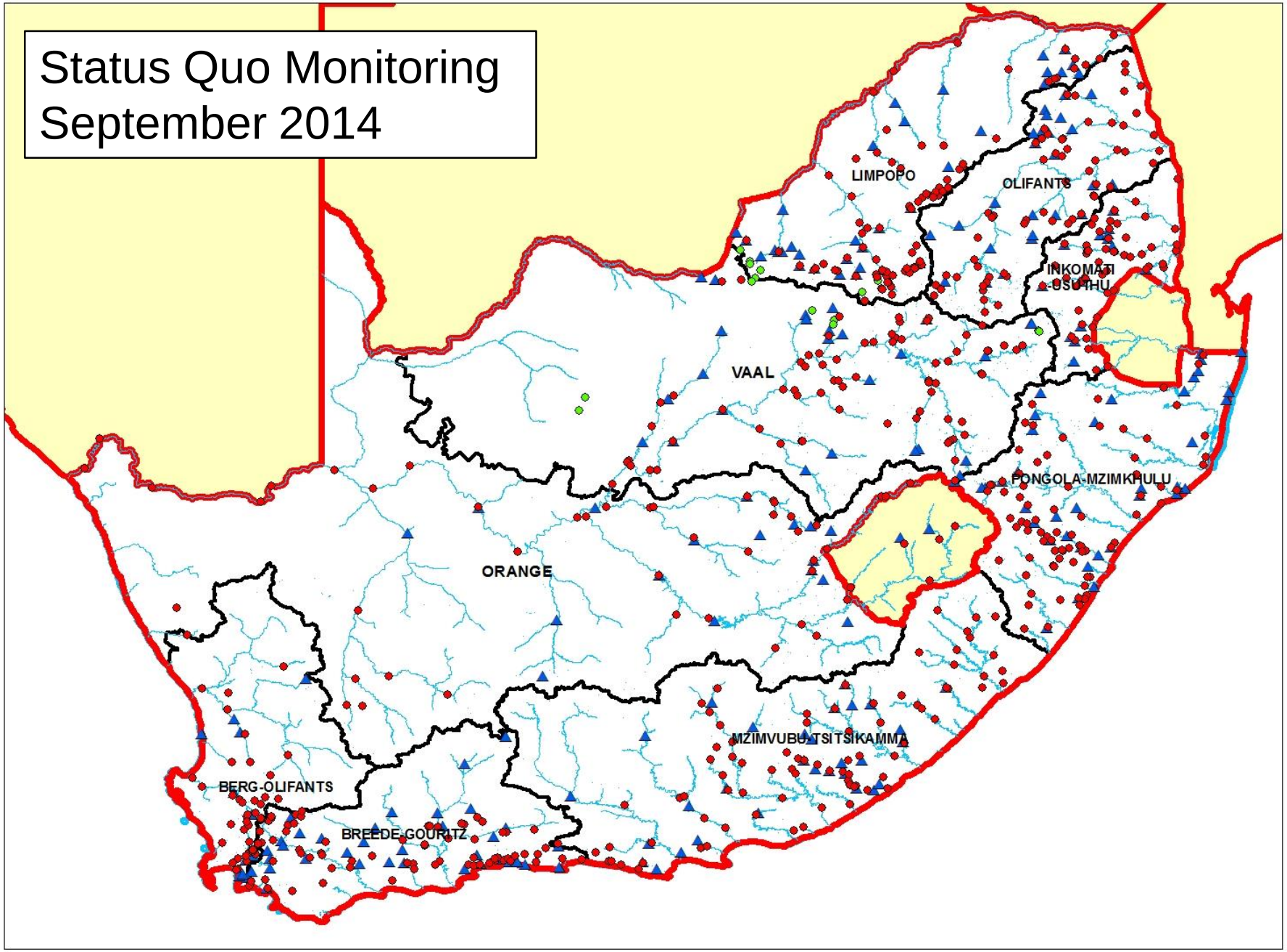
Theoretical Monitoring Sites



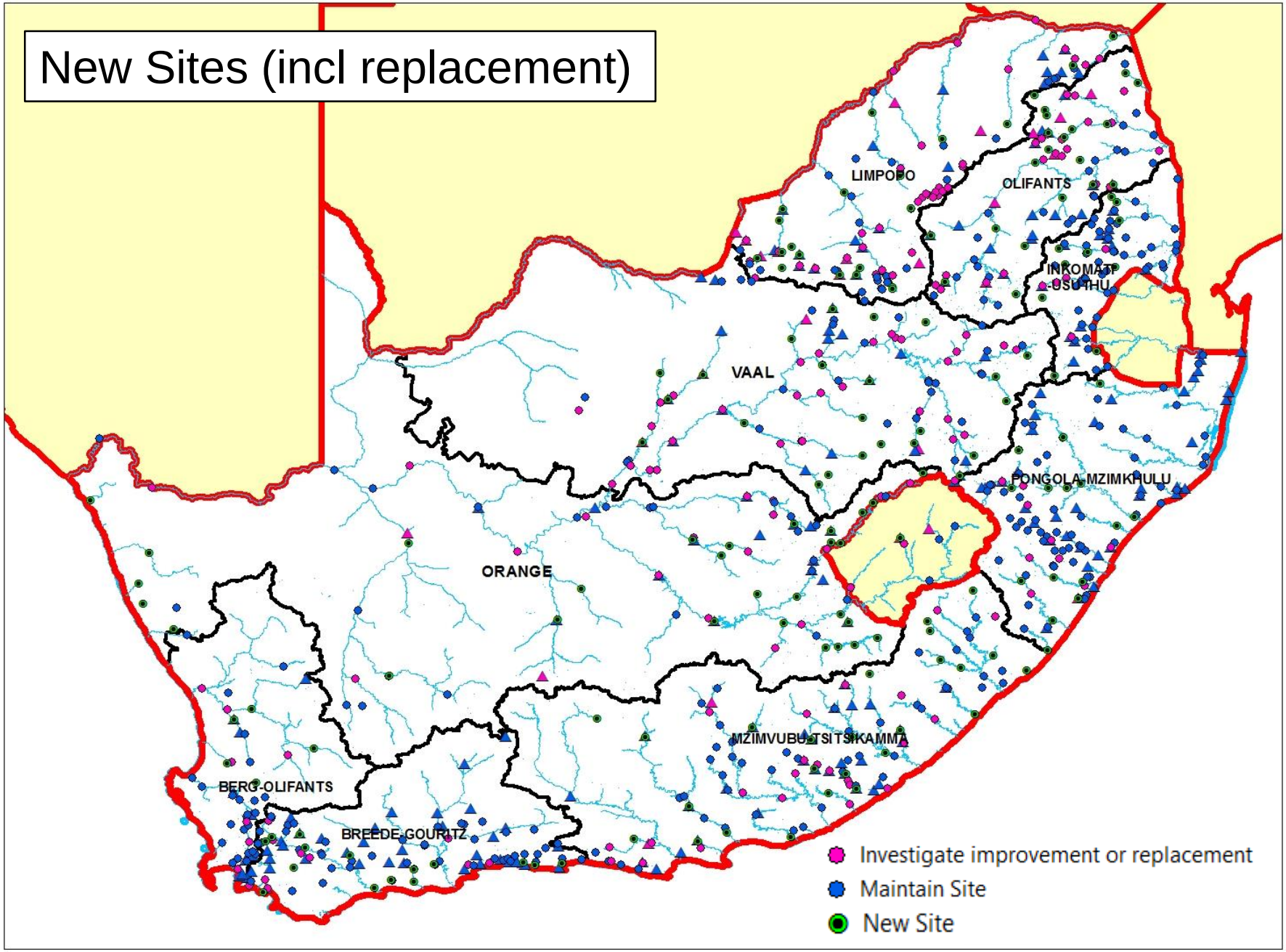
Conclusions

- All monitoring network reviews, redesigns and optimisation should **start with the objectives** of the network.
- Theoretical monitoring network development have the following **benefits**:
  - Keeps monitoring objectives in mind
  - Ignore constraints (network can be constrained later)
  - Provide spatial distribution that meets needs
  - Contribute towards less but more multi-functional sites
  - Great tool for evaluating existing networks for gaps, redundancies and priorities to existing and new sites.

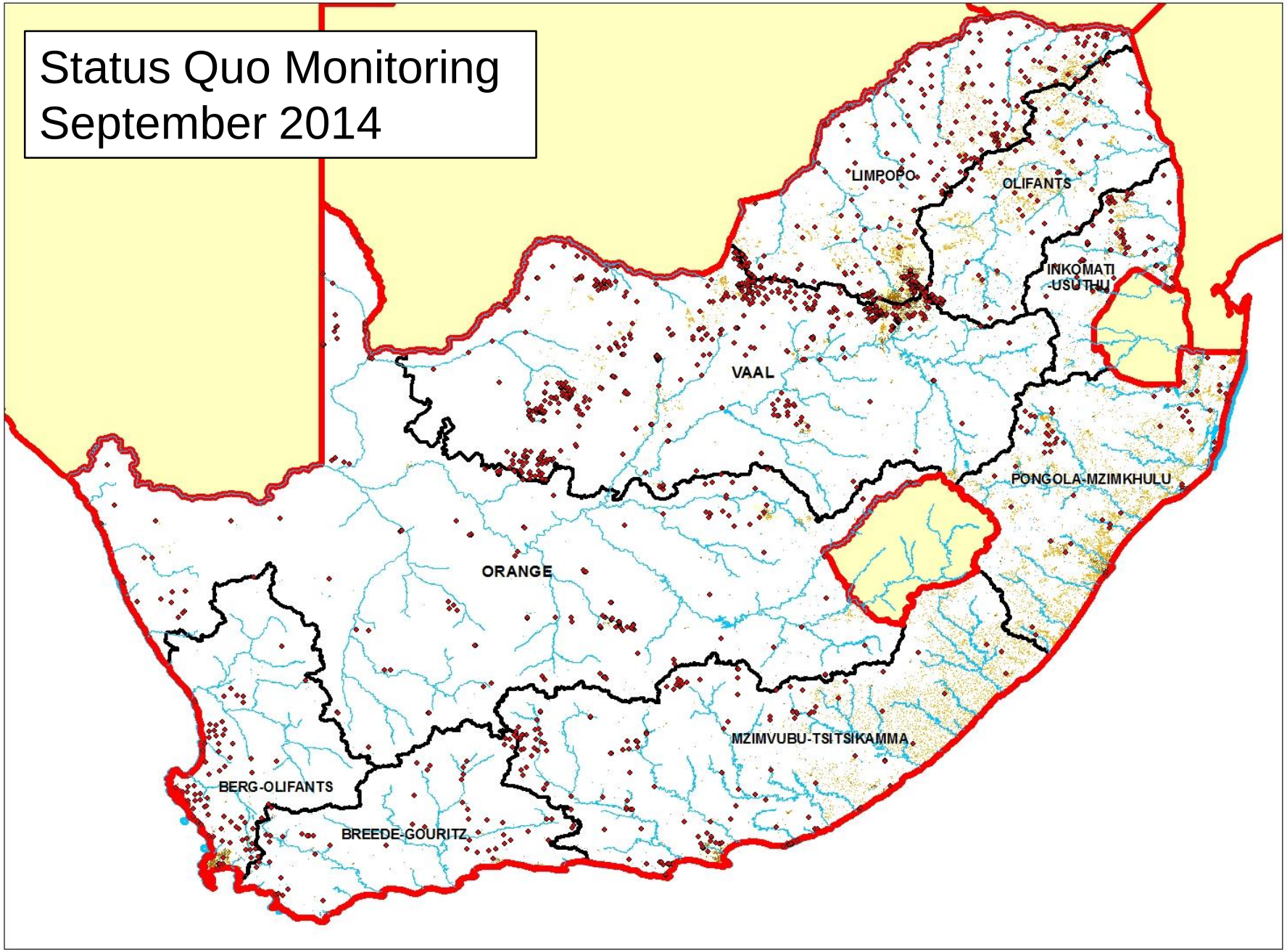
Status Quo Monitoring
September 2014



New Sites (incl replacement)



Status Quo Monitoring
September 2014



Integrated Theoretical and Existing Network