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Kevin Wall, a Built Environment Fellow of the Council for Scientific and Industrial Research (CSIR), is a civil engineer and town planner. Posts that he has held include:

- Director of a firm of consulting engineers;
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He is a Past President of the South African Institution of Civil Engineering (SAICE), and has also been Honorary Professor at both the University of the Witwatersrand and the University of Pretoria.

Much of his recent work has been on:

- policy and protocol formulation; and
- on effectiveness of government spending on infrastructure, and ways to improve the effectiveness and sustainability of that infrastructure.

He was the principal author of the first SAICE national infrastructure report card (2006), and the leader of the CSIR research team on which the second SAICE national infrastructure report card (2011) was based. He was also the principal author of the National Infrastructure Maintenance Strategy, approved by Cabinet in 2006. Also the leader of the team appointed by DWAF to formulate the first phase of the National Water Services Infrastructure Asset Management Strategy (2008).

## **MUNICIPAL WATER QUALITY IN THE CONTEXT OF THE STATE OF SOUTH AFRICA'S INFRASTRUCTURE**

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### **ABSTRACT**

In 2006 the South African Institution of Civil Engineering (SAICE) released the first ever “report card” of the state of engineering infrastructure in South Africa. This report highlighted “the observations of the professionals responsible for the planning, construction, operation and maintenance of our nation’s life-support system”. It graded infrastructure on a scale from A+ through E-.

The purpose of the report card was to draw the attention of government, and of the public at large, to the importance of maintenance, and to factors underlying the state of repair of infrastructure – factors such as skills and finance, for example.

The SAICE 2011 Infrastructure Report Card, released in April updates the gradings and indicates the trend since 2006. Underlying reasons for performance are discussed.

Water quality management must be seen in the context of the management of South Africa's infrastructure. Conversely, measures to improve water quality management will often be the same measures needed to improve the management of other infrastructure.

## **THE SAICE 2006 INFRASTRUCTURE REPORT CARD**

In 2006, the South African Institution of Civil Engineering (SAICE) released the first ever report card (IRC) of the state of engineering infrastructure in South Africa. This highlighted “the observations of the professionals responsible for the planning, construction, operation and maintenance of our nation’s life-support system”. It graded infrastructure (water, sanitation, solid waste, roads, airports, ports, rail, electricity and hospitals and clinics) on a scale from A+ through E-. Overall, it gave the infrastructure a D+ grade.<sup>1</sup>

The initiative was, by any measure, very successful, exceeding all expectations. With this report card SAICE opened a public dialogue on the condition of public infrastructure, highlighting the importance of maintenance and drawing attention to its condition and importance by headlining issues in a manner understandable to technical, decision-making and lay persons.

## **THE SAICE 2011 INFRASTRUCTURE REPORT CARD: PROCESS**

In 2009 the decision was taken that, whereas so much construction was taking place in preparation for the FIFA Soccer World Cup, the next edition of the IRC should be published late in 2010 or early in 2011.

The modest resources available to a learned society such as SAICE also motivated the development of a partnership for the research component of the process. As in 2006, SAICE recognised that the organisation best placed to assemble and analyse the body of data required was the Council for Scientific

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<sup>1</sup> Refer to the SAICE website ([www.civils.org.za](http://www.civils.org.za)) for the full report.

and Industrial Research (CSIR). Thus an understanding was in 2009 reached between SAICE and CSIR -- CSIR would compile the research reports across all sectors (and cover the costs of its staff working on the research reports). While reserving the right to disagree with the findings of the research reports, SAICE would through the input of its network of engineering professionals refine and interpret these findings. SAICE would then perform the grading, and publish and publicise the report.

During 2010, having received the research reports from the CSIR, the SAICE team began a process of scrutiny, extension and elaboration through the assistance of the expert opinion of practitioners drawn primarily from the SAICE technical divisions. A moderation panel of senior SAICE members thereafter reviewed and refined these sector-specific grades, and balanced them across all surveyed sectors.

The new IRC was launched in April 2011, weeks before local government elections. It is anticipated that the 2011 IRC will be widely disseminated and debated. Even more so because, since 2006, service delivery problems, and in particular those problems attributable to inadequacies of operation and maintenance of infrastructure, have received heightened attention.

## **THE SAICE 2011 INFRASTRUCTURE REPORT CARD: OVERALL FINDINGS**

The 2011 IRC covers ten sectors, one more than in 2006. These are further divided into 27 sub-sectors, six more than last time. These have been graded (for interpretation of the grades, see Annexure A), and the trend since 2006 indicated (Refer to Annexure B for water supply and sanitation only). Nine show improvement, twelve remain unchanged and a further four have deteriorated. The public schools sector and the fishing harbours sub-sector are new and therefore do not have trend indicators. Overall, a grade of C- has been awarded.

It should again be noted that the grades refer only to the condition of existing assets – they cannot account for society’s actual needs or the historical backlogs of infrastructure never built.

The improvement from a grade of D+ in 2006 reflects marginal improvement in the overall condition of South Africa’s infrastructure over the past five years, influenced by the heavy investment, especially in national assets: ports, rail, airports and national roads, much of this in preparation for the 2010 FIFA Soccer World Cup. The authors strongly caution, however, against a perception that the shift from D+ to C- is a blanket improvement. On the contrary, **“the quality and reliability of basic infrastructure serving the majority of our citizens is poor and, in many places, getting worse. Urgent attention is required to stabilise and improve these”** (SAICE, 2011 – emphasis added). **That the grades for some sectors have held up since 2006 is primarily because of the high rate of new construction. Sadly, little maintenance is done and, were it not for these new investments, the trend would be downwards.**

The acceleration of projects required for the World Cup – highways, mass transit, airports and the many stadiums – provided South Africa with a welcome buffer from the negative consequences of the global financial crisis since 2008. The downside is that this appears to have distracted some authorities from the core business of maintenance and upgrading of other infrastructure – with predictable consequences. Given that resources are limited, the diversion has caused a delay in the delivery of basic services to the poorer sections of society.

## **THE SAICE 2011 INFRASTRUCTURE REPORT CARD: FINDINGS: MATTERS OF CRITICAL IMPORTANCE**

In the 2006 IRC, two key themes ran as a thread through all the grades. The first was the severe shortage of skills and the impact of this on planning, procurement, design, construction and care of infrastructure. The second was the inadequate funding of maintenance for the existing asset base and the stream of new assets continuously completed. It is not surprising that this situation still pertains.

However two new important themes have emerged, viz. the systems nature of infrastructure services delivery, and sustainability. Infrastructure, once created, is unrelenting in its demand for maintenance and this demand will increase the longer it is ignored. Skill constraints notwithstanding, institutional buy-in of good practice, political will, bold leadership and effective management are irreplaceable ingredients of successful and sustainable infrastructure provision.

The state, or condition, of water supply infrastructure, and water quality management, must be seen in a context of the management of all of South Africa's infrastructure -- but especially the management of municipalities in their role of water services authorities. Water sector professionals have long recognized the importance of skills and funding to the condition of water supply infrastructure and service delivery. The IRC confirms this importance, and links it to issues around the condition of infrastructure and service delivery in respect of other services -- e.g. local roads -- for which municipalities are responsible. Conversely, measures to improve water quality management will often be the same measures needed to improve the management of other infrastructure.

Each of the identified key themes is described below.

### **Skills and the state of infrastructure**

The links between technology professionals, infrastructure provision and quality of life must be recognised. The provision and maintenance of infrastructure that performs well and is sustainable into the future also depends on the quality of human capital and technological capacity in a country.

However South Africa has, by proportion of population, up to twenty times fewer engineers than Australia, America, Western Europe, India or China. Increasing the number of engineers (and scientists) is a recognised government priority, but it will need a multifaceted approach starting with urgent attention to mathematics and physical science education at school.

The grave shortcomings of South African basic education have been widely discussed and are generally known, as is the general nature of the constraints that they impose on virtually every activity in the country. However it is worth explicitly noting that this crisis compounds slow delivery of basic services through its effect on the engineering profession that provides this infrastructure.

A comprehensive municipal skills survey was undertaken by SAICE in 2007 (Lawless 2007). Of all 283 municipalities surveyed, 83 had no civil engineers, technologists or technicians on staff. A further 48 employed only one civil technician, and municipalities with civil engineering staff reported 35% vacancies (over 1000 professionals), often owing to budget constraints. This skills constraint has not been addressed in the interim. Moreover, it is further exacerbated by the inefficient deployment of these precious resources and the use of unqualified and inexperienced personnel in positions requiring technical ability.

### **Funding and the state of infrastructure**

The second key constraint identified by both IRCs, 2006 and 2011, was the lack of adequate funding for the maintenance of the existing asset base and the new assets that come on-stream each day. An annual maintenance budget allocation of 4% of replacement cost is a widely-understood -- if badly flawed -- indicator of the minimum needed in order to keep assets in good condition. However, even this allocation is rare. Moreover, it is simply not sufficient, especially when it is expected to cater for a maintenance debt that usually requires upgrading, repair or refurbishment rather than routine maintenance.

To make matters worse, all too frequently the inadequacy of the financial allocation is compounded by poor management which leads to part of the budget going unspent.

There is an old saying that somebody pays for maintenance, whether it is done or not. For example, roads maintenance that is delayed for one year could cost three to six times more, when there is eventually no choice but to do it, than the so-called "saving" from deferring it. The consequences of neglect are severe, impairing both quality and, sometimes, length of life, through outbreaks of water-borne disease, reduced safety on roads and rail, inconvenience and inefficient commercial activity.

### **Systems and the state of infrastructure**

Another technique to improve the delivery capability of a network is to improve the systems and efficiency of application of limited resources. A systems-based approach will enhance the integration of services and maximise the use of scarce human and infrastructural resources. It will also reduce the incidence of failure, as constantly updated knowledge of condition allows early identification of acute and chronic weak points in the delivery chain.

Since 1994, massive strides have been made in provision of basic services and associated infrastructure, e.g. water, sanitation, energy and transportation. However this provision has too often been made on a flawed basis, through an isolated focus on capital expenditure rather than through life-cycle costing models. Although departmental-specific policies or legislation often support life-cycle costing, this does not translate to implementation, especially in early stages such as procurement. We continue to undertake procurement in a way that ignores life-cycle costing, i.e. the bid with the lowest capital price receives preference, which will usually mean significantly more expensive maintenance costs later on. In some cases this is a result of the removal of procurement power from the engineering departments, who are most cognisant of long-term considerations.

### **Sustainability and the state of infrastructure**

While efficient infrastructure underpins economic and social development, South Africans currently ignore sustainability considerations across all social and public/private strata. As a result, there is a prevailing absence of awareness regarding the true or user costs of infrastructure and its environmental impact.

The practice of charging true costs to infrastructure users is an eminently fair one, to both human beings (as non-users do not subsidise users) and the general environment (as users pay for their environmental impact). However, provision of free basic services and years of subsidised infrastructure has rendered this concept alien to many South Africans. Thus, large numbers of users do not pay anywhere near the real costs of water treatment and supply, electricity supply or waste management services -- which encourages high levels of wastage and civic disrespect for and neglect of infrastructure. All citizens must take ownership of our infrastructure in order to ensure its sustainability, e.g. through water conservation, recycling and recognition of the necessity of "user pays" systems.

A final point on sustainability: national government has since the President's "state of the nation" address earlier this year placed great emphasis on job creation. It is common cause that construction generates more jobs per rand spent than almost any other sector of the economy. However construction jobs are invariably of short-term duration -- a matter of months, or maybe a year or two, then the construction is complete, and the workforce has to wait for the next job. In contrast, maintenance is a job for life. Investment in infrastructure maintenance surely both satisfies development needs and addresses a driving priority of our developing country, viz the creation of much-needed jobs. In addition to which, it protects the huge financial

investment in the construction of the infrastructure, and also improves the quality and reliability of service delivery. (Wall 2011)

## **THE SAICE 2011 INFRASTRUCTURE REPORT CARD: WATER**

Up to this point, this paper has dealt only at the generic level -- i.e. across all infrastructure sectors. This section describes the 2011 IRC findings in respect of water infrastructure -- water resources and water services. The next section discusses municipal water quality management in the context of the IRC's "matters of critical importance" findings.

Water quality management must be seen within the framework of the management of South Africa's infrastructure. Conversely, measures to improve water quality management will often be the same measures needed to improve the management of other infrastructure.

Water infrastructure consists of bulk abstraction and conveyance infrastructure as well as local treatment and distribution. The Department of Water Affairs (DWA) is responsible for much of this bulk infrastructure<sup>2</sup>, as well as policy and regulation, while municipalities and water boards are responsible for local water quality and provision, including treatment and distribution.

There are extreme variations in the condition and performance of the infrastructure in the water sector. Water quality for example, is good in the metropolitan areas, but frequently unacceptable in many of the more rural areas.

One very positive development since the previous IRC is the implementation in 2008 of the "Blue Drop" initiative in the monitoring of water quality.

While in 1994 only 59% of South Africans had access to basic water services, this has since improved to over 80% of the population. This however still means that six million South Africans lack a reliable source of safe drinking water. Nonetheless, since the 2006 IRC, approximately 2.2 million South Africans have been provided with basic water services.

Unfortunately the focus on building new water infrastructure is frequently at the expense of maintenance or improvement of existing infrastructure; hence the sustainability of water services in many areas is in doubt. One of the most debilitating problems in this regard is a severe lack of capacity at local level (unchanged or worse since 2006). Many of the poorer municipalities are more or less incapable of operating as Water Services Authorities and Water Services Providers.

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<sup>2</sup> The 2011 IRC describes at some length its assessment of the condition of South Africa's bulk abstraction and conveyance infrastructure. Highly relevant to water quality, but nonetheless, for the purposes of this paper, which focuses on water services, the reader is referred to the IRC (SAICE 2011 page 14).

There is need for greatly increased implementation of water demand management, so as to align demand growth with bulk infrastructure development, and reduce the risk of supply shortfall. This would also be highly beneficial to municipalities as it would reduce the pressure for new water supply and sanitation infrastructure. Further, it is a step towards more ethical management of a precious limited resource.

Bearing in mind these challenges, the foremost issue when it comes to water resources infrastructure must be: how do we best utilise the available water resources? There are several key related questions, including whether we are efficient and sustainable in our water use, and how and where any future water supplies will be obtained. These questions do not appear to be emphasised enough in DWA, nor in the public domain.

A culture of complacency has developed in South Africa regarding water resources and use. The country needs to do much more in terms of instituting appropriate water conservation technology, and a water conservation culture. Projects such as Durban Water Recycling, a private plant commissioned by the eThekweni municipality in 2001, which currently supplies 40 million litres of recycled water daily, should be highlighted.

## **LOCAL AUTHORITIES -- WATER SERVICES -- AND MATTERS OF CRITICAL IMPORTANCE**

Water quality management must be seen in the context of the management of all of South Africa's infrastructure -- largely, in the case of water services, by municipalities.

The critical importance of the local government sphere, with its considerable responsibilities for, among other things, service delivery, has been recognized by national government, as has the need to "turn" many municipalities "around". (CoGTA 2009, CoGTA 2010, SA Cities Network 2011) From the same evidence, reinforced by an abundance of evidence from other quarters (e.g. CDE 2010), it is clear that much of local government is in distress, and that this state of affairs has become deeply rooted within much of our system of governance. In assessing the reality of the too-often poor municipal performance, cognisance needs to be taken of the unresolved problems identified in previous assessments (despite recognition from national government, and legislation that is often in line with international best practice), and the intergovernmental impact of this failure, both institutionally and for communities. A recurring theme is the inadequate capacity of many municipal service providers to fulfil their responsibilities.

All of the "matters of critical importance" identified in the previous sections of this paper are very much in evidence in the majority of local authorities. For example, many municipalities are financially unsustainable, despite them being largely propped up by transfers from national government.<sup>3</sup>

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<sup>3</sup> "Municipalities are showing a poor ability to accurately plan and spend their budgets. [E.g.] Analysis of the operating adjusted budget indicates that 24



Clearly, measures to improve water quality management will often be the same measures needed to improve the management of other infrastructure, and indeed the same measures needed to improve the functionality, in the broad sense, of the municipality. Delivering and operating infrastructure services are complex activities but competent skilled persons are in short supply, especially in rural areas. Thus, to provide a simple example, should a municipality acquire an engineer for the first time, irrespective of whether that engineer is a roads, water or structural specialist, he or she is likely to have no option but to address all infrastructure issues, even those outside his or her specialisation. Thus, again for a simple example, measures that the engineer would introduce to improve infrastructure asset management in, say, roads, would, it should be expected, very soon be extended to the other sectors within his or her responsibility.

None of which is to say that no improvement in water quality can be achieved until all of the "matters of critical importance" have been at least partially addressed. Not at all -- there is much evidence, albeit largely circumstantial, that significant sector-specific infrastructure improvement can be achieved by a small team acting in concert, or even, to start with, by one enthusiastic and competent person.<sup>4</sup>

## **CONCLUSION**

The intention behind the SAICE infrastructure report card initiative has been for engineering professionals to provide a public opinion on the condition of infrastructure in the manner of "expert witnesses". By highlighting the current status of its condition, the public is informed about the importance of infrastructure in their daily social and economic intercourse. Furthermore,

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municipalities overspent their operating budget to the value of R2.6 billion while 166 municipalities underspent to the value of R12.3 billion. A very significant risk going forward is that municipalities' spending plans outstrip realistically collectable revenues. ....

"The assessment process has revealed that the financial environment in municipalities is a highly problematic area – at worst it is fraught with both a poor skills base, weak support from provinces, and then open to abuse and fraudulent activity. Many municipalities lacking a tax base, short of Equitable Share and with a weak revenue base simply cannot leverage the funds they need for even moderate municipal functionality. ....

"With respect to financial management, National Treasury reports referred to in this Assessment Report provide clear evidence of the dire financial situation of municipalities. Municipal revenue collection has begun to fall as greater reliance is placed on transfers as a revenue source." (CoGTA 2009 page 62)

<sup>4</sup> For example, one of the authors has come across more than one example of a water or wastewater team at a small municipality, realising that, thanks to the Blue Drop or Green Drop assessment processes, their efforts might for the first time be recognized by their senior municipal management, for that reason alone being motivated to improve their scores.

whereas many decision makers are technical lay-people, the report cards inform the making of better informed decisions, especially regarding maintenance management and planning for new expenditure. At the same time, they highlight the role and relevance of civil engineering professionals.

There is broad consensus within SAICE (and CSIR) that the initiative should be sustained and extended, but that at the same time the independence of the benchmarking process should not be compromised.

The reports and the indicated trends since 2006 make it possible to conclude that, while government should not change its drive to provide new infrastructure to address backlogs, the challenge is to supplement this by at the same time also focusing on the maintenance of both new and old infrastructure. If this is not done, the already considerable legacy of that infrastructure that is dysfunctional for want of sound operation and adequate maintenance in the past, and that therefore needs rehabilitation or replacement at considerable cost, will increase rapidly.

The IRC makes it clear that there is no service more important to the majority of our citizens than water supply, together with sanitation. "Urgent attention is required to stabilise and improve these", and ensure quality and reliability. (SAICE 2011) Investment in new infrastructure must continue, yes, but needs to take a back seat to the maintenance (and, where necessary, rehabilitation) of infrastructure already built.

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## ANNEXURE A: INTERPRETATION OF THE GRADES

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>WORLD CLASS</b>	<b>FIT FOR THE FUTURE</b>	<b>SATISFACTORY FOR NOW</b>	<b>AT RISK</b>	<b>UNFIT FOR PURPOSE</b>
Infrastructure is comparable to the best internationally in every respect. It is in excellent condition and well maintained, with capacity to endure	Infrastructure is in good condition and properly maintained. It satisfies current demands and is sufficiently robust to deal with minor incidents.	Infrastructure condition is acceptable although stressed at peak periods. It will need investment in the current MTEF period to avoid serious deficiencies.	Infrastructure is not coping with demand and is poorly maintained. It is likely that the public will be subjected to severe inconvenience and even danger without	Infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards. Immediate

pressure from unusual events.			prompt attention.	attention is required.
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*A + or – is sometimes used to indicate a grade which lies at the extremes of the range. The trend in the score since the 2006 IRC is denoted by an arrow: upward, horizontal or downward pointing to indicate improvement, no change or deterioration respectively.*

**ANNEXURE B: EXTRACT FROM SOUTH AFRICA'S INFRASTRUCTURE REPORT CARDS**

Sector	2006 Grade	2011 Grade	Trend	Brief condition report from 2011 IRC
<b>Water supply</b>	<b>C+</b> for major urban areas	<b>C+</b> for major urban areas		Major and ongoing strides in provision of water infrastructure since 1994, but insufficient maintenance has led to many problems of compliance with quality and reliability requirements. This is especially so outside metropolitan areas. Recently introduced improved monitoring might help. Water wastage (through leaks) is still too high. Serious shortage of skilled personnel.
	<b>D-</b> for all other areas	<b>D-</b> for all other areas		
<b>Sanitation (including wastewater)</b>	<b>C-</b> for major urban areas	<b>C-</b> for major urban areas		Serious problems continue with management of many wastewater (sewage) treatment works. Wastewater spillage is still too high. Recently introduced improved monitoring might help. Unsustainable design and construction becoming more apparent, e.g. on-site sanitation facilities not easily emptied once full. Inadequate operation and maintenance capacity, and serious shortage of skilled personnel.
	<b>E</b> for all other areas	<b>E-</b> for all other areas	