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BOTSWANA'S NORTH SOUTH CARRIER 2 WATER TRANSFER SCHEME

A new lifeline towards unlocking the potential of eastern Botswana

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1. Background

Botswana is a democratic emerging, but relatively small, economy within the SADC region of the developing world, with an economy heavily dependent upon mining, especially diamonds. Botswana's economy has exhibited robust growth since independence, but is sensitive to global economic contagion which directly impacts upon diamond trading. Botswana budgets for its public works under a cyclical national planning programme and recognises the importance of infrastructural investment as a key foundation for national, regional and local economic growth and development.

The eastern regions of Botswana are economically most active and home to most of Botswana's citizens. Botswana's capital, Gaborone and its environs, is the most densely populated and economically active region in the country and accordingly exerts the largest water demand on national resources. Coal and related deposits (related to the Waterberg geological complex in Botswana) have been proven in eastern Botswana and also contribute the primary water demand.

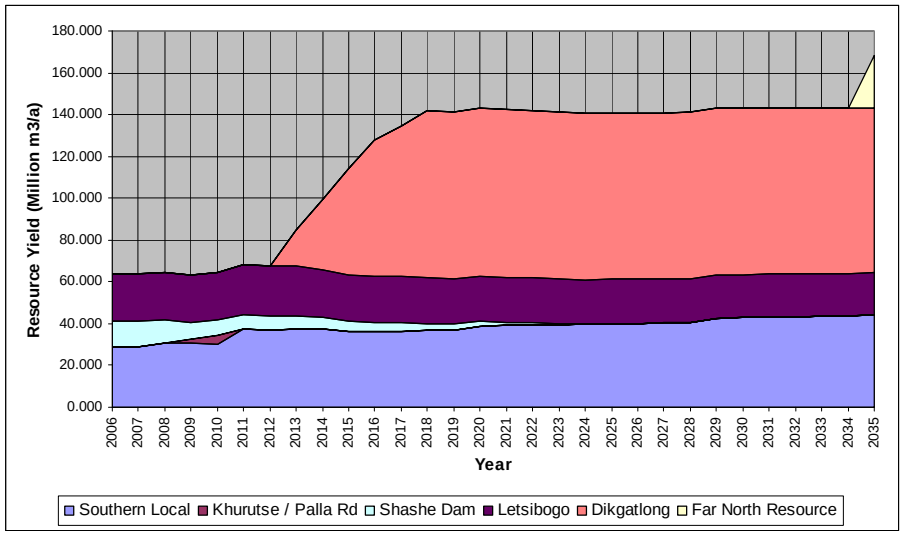
2. Water sector governance

Water resource planning and control is consolidated with the governance of minerals and energy within Botswana's Ministry of Minerals, Energy and Water Resources (MMEWR). Historically, the Department of Water Affairs took responsibility for the planning and implementation of the nationals water resources as well as rural water supply and sanitation, whilst Botswana's Water Utility Corporation (WUC) was responsible for the operation and maintenance of Botswana's dams as well as the NSC-1 and water services within the urban area of Gaborone. Recent water sector restructuring under the guidance of the World Bank transferred the function of rural water supply and sanitation from the Department of Water Affairs to WUC. MMEWR retrains the function of water sector legislation and regulation as well as the planning of national water resources.

3. Water resources and transfer requirements

Although various ground water resources have been developed within eastern Botswana for local and regional conjunctive use, by far the larger portion of Botswana's primary water demand requirements are met (or planned to be met) from surface water resources. The largest (over 75%) water demand within eastern Botswana is exerted by Gaborone and its environs. The climate and hydrology of eastern Botswana determines that Gaborone's local resources (Gaborone Dam and Bokaa Dam) cannot meet the current demands of this water supply district and will become increasing unable to do so in future as population and industry grows and more households are connected to regional water supply systems. Water transfer, importation, recycling and demand management is thus unavoidable. Importation of raw water to Gaborone from the Moletedi Dam in the North West province of RSA was implemented during the 1990's. Also during the 1990's, MMEWR identified that unutilised surface water resources in the Motloutse, Shashe and Tati rivers (tributaries of the Limpopo River) in central eastern Botswana were suitable for impoundment and transfer southwards to Gaborone. The Letsibogo and Shashe Dams were subsequently constructed and the larger Dikgatlhong Dam is currently nearing construction completion. The direct water transfer route (primarily alongside north-south traffic route A1), passes the demand nodes of Palapye, Mahalapye and Mmamabula, en-route to Gaborone. National electricity generation is at Morupule within the Palapye complex and potential export generation can be established in future on the Mmamabula coal field between Mahalapye and Gaborone. Water reclamation from the Gaborone Water Treatment Works at Glen Valley is also planned to supplement local water resources. Eutrophication of local Gaborone resources in Bokaa Dam and Gaborone Dam (and in future of the Dikgatlhong Dam), are technical matters that require management and design consideration. The summarised yield of the eastern Botswana dams is shown in Figure 1 at 95% assurance.

Figure 1 – Yield of NSC dams



The yield of the eastern Botswana dams is expected to be sufficient until around 2035. Thereafter, further resource augmentation will be required. This future source is currently expected to be the Zambesi River near Kasane where the Botswana Government has a significant allocation for both primary usage and agriculture.

Water demands and transfer requirements through the NSC for eastern Botswana at 98% assurance are shown in Table 1 (83Mm³/a in 2035):

Table 1: Adopted Reconciliation Strategy for Projected NSC Water

	CALCULATION	Year	2010	2015	2020	2025	2030	2035
A=	SUM(A1:A3)	**Adopted Total Direct Demands on Letsibogo**	13.436	9.364	11.478	14.394	19.724	25.055
B=	SUM(B1:B10)	**Adopted Total Palapye**	2.533	5.935	6.938	7.708	8.600	9.608
C=	SUM(C1:C5)	**Adopted Total Mahalaype**	2.953	3.681	4.170	4.717	5.251	5.775
D=	D1-D2	**Adopted Total Mmamabula (plus contingency)**	0.000	0.000	0.000	0.000	0.000	0.000
E=	SUM(E1:E36)	**Total Mm3/Annum**	49.811	69.446	79.712	89.198	99.895	111.391
F=	SUM(F1:F3)	**Total Southern Demand Reducing Factors**	6.974	14.245	17.096	18.045	20.940	22.089
G=	SUM(G1:G5)	**Total Southern Water Resources Yield**	23.640	21.840	21.840	21.840	21.840	21.840
H=	E-G-F	**Balance from NSC**	19.198	33.362	40.776	49.313	57.116	67.462
I=	H+D+C+B	**Total Adopted Demands on NSC at Source**	24.683	42.978	51.883	61.737	70.967	82.845
J=	I+A	**Demand on Supplies to NSC**	38.119	52.342	63.361	76.131	90.691	107.900
L=	L+K	**Total Incl. Chobe/Zambezi projected link 98%**	34.589	69.974	82.333	81.612	110.792	135.071

Transfer through the NSC is of raw water with treatment at Palapye, Mahalapye and Mmamashia.

4. North South Carrier 1 history

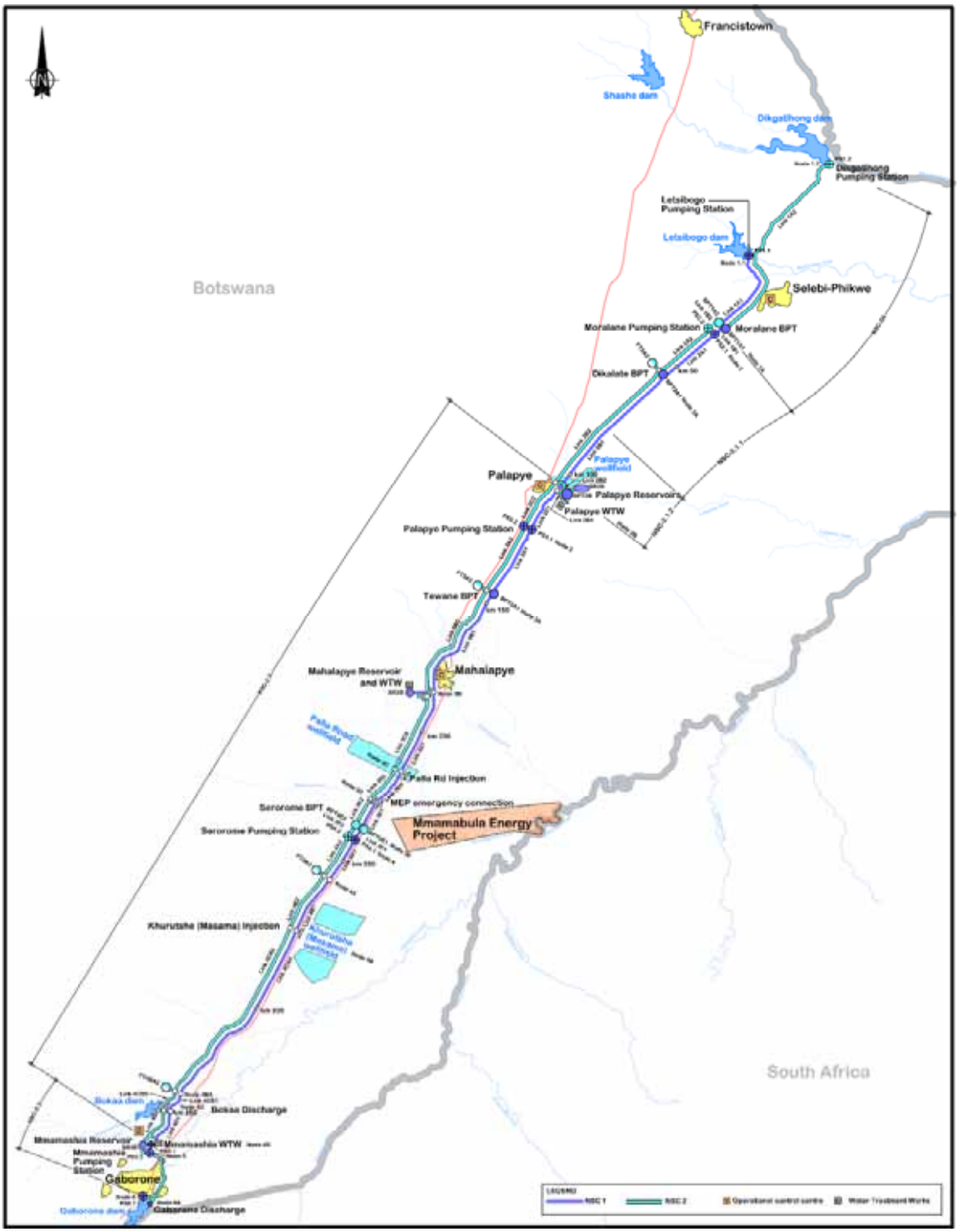
The Government of Botswana adopted a national water supply master plan during the mid-1990's. This plan identified the need for Botswana's North South Carrier, hereby connecting Letsibogo Dam on the Motloutse River to the Mmamashia Water Treatment Works in northern Gaborone and also supplying the Palapye WTW and Mahalapye WTW en-route. Mmamashia is also supplied from the smaller Bokaa Dam, directly north of Mmamashia, Phase 1 of the North South Carrier Water transfer scheme (NSC-1) was planned, implemented and commissioned by 1999. NSC-1 has three pumping stations, at Letsibogo (PS1.1), Moralane (PS2.1) and Palapye (PS3.1). A future pumping station at Seroroue (PS4.1) was envisaged at the time. NSC-1 varies in diameter from 1400 ND down to 1100ND and was constructed using a combination of pipe materials, both GRP and steel alternatively. NSC-1 has had reliability challenges since commissioning.

5. North South Carrier future planning

Planning of NSC-2 commenced in 2007 with the advancement of the planning and implementation of the second phase of the regional water transfer scheme. Implementation of Dikgatlhong Dam was commenced, as well as its connection via the NSC-2A to NSC-1's Break Pressure Tank 1. Thereafter, NSC-2 continues to Mmamashia in northern Gaborone. The

several principal components and work packages of NSC-1 and NSC-2 are shown in Figure 2 below.

Figure 2 – NSC principal components



NSC-2 was conceptually scoped to deliver 45Mm³/a and estimated in 2010 to cost P5.5 billion. Due to deteriorating global economic trading conditions, GoB resolved to construct NSC-2.1 (45Mm³/a) and to upgrade NSC-1 (38Mm³/a) during National Development Plans-10 (2010-2016) and to defer NSC-2.2 to NDP-11 (2017-2022). MMEWR also initiated environmental

scoping and pre-feasibility planning for NSC-3. For purposes of effective management and redundancy, NSC-1, NSC-2 and NSC-3 are planned (or envisaged) as separate independent delivery systems within a single corridor, but operating under an integrated communication and control system. An overall NSC transfer decision support system, factoring in current resource storage levels, water qualities, treatment demands and pumping and treatment costs will be established to determine water source and transfer requirements from local resources and via NSC-1, NSC-2 and NSC-3. Communication and control signals will be primarily by fibre optic cable with backup by wireless radio data link. Future pipe materials were determined to be either steel or ductile iron, whilst consistency in other principal plant and material selections including the key requirement of local maintainability, are required by GoB. Implementation of NSC upgrading works will be lead by MMEWR, with WUC participating as operator and key technical partner.

6. Land and environment

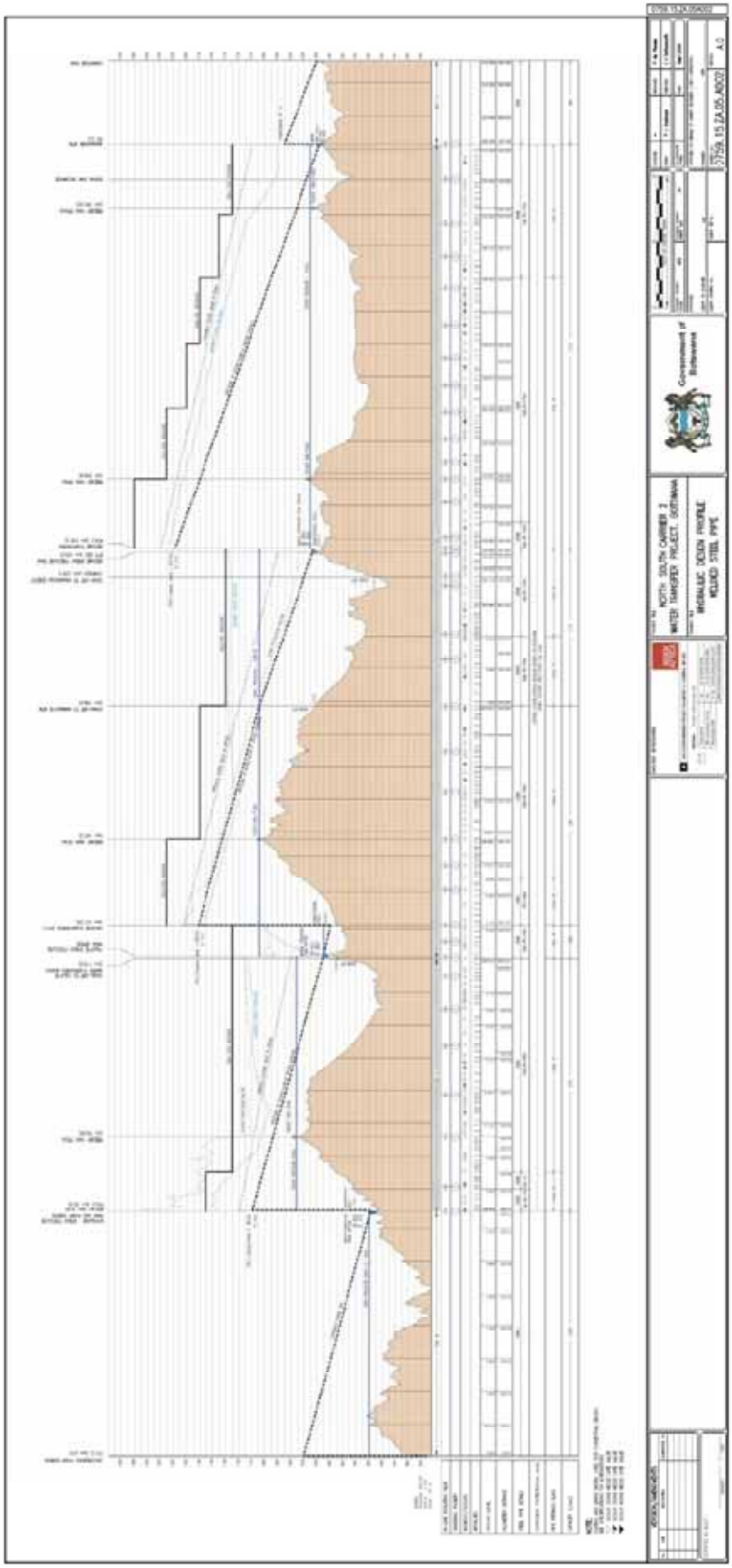
In order to protect and control access to this strategic national asset, MMEWR has resolved to acquire and register rights to the NSC corridor from Dikgatlhong Dam to Mmamashia. A single corridor varying between 50 and 70m wide will be acquired to accommodate each of NSC-1, NSC-2, NSC-3, the fibre optic communication backbone and the NSC maintenance road.

Environmental investigations, reporting, authorisation and subsequent management were undertaken for the primary corridor. Further investigation and authorisations were pursued on bedding and gravel wearing course materials along the route of NSC-2. Borrow pit leases and mining licenses are also a requirement.

7. New NSC-2 Works

NSC-2 comprises on all pumped system (starting at 45Mm³/a), with four separate pumping systems as shown in figure 3 below:

Figure 3 – Hydraulic design profile



ith operational capacity between 2
at Palapye WTW (SR2B) is 28Ml
400 ND steel reducing to 1000 ND
1.2 from Dikgatlhong Dam (PS1.2)
3 at Palapye to Mmamashia.

o defer NSC-2.2 works to NDP-11,
during NDP-10. NSC-1 upgrading
t PS1.1, PS1.2 and PS1.3 and the

t and upgrading of the existing 600
W, Gaberone WTW and Gaberone
water treatment works at Palapye
45 Ml/d pre-treatment (due to
will be added. At Gaborone WTW
uring NDP-10. A further 45Ml/day
NSC-2.2 is implemented.

NSC-2.1 and NSC-2.2 are being implemented using an EPC contracting strategy. Three bid stages are being employed; i.e. Stage 1 is pre-qualification, Stage 2 entails pricing of the Employer's conceptual design and Stage 3 is for EPC design and bid development. The three stage bid strategy produces efficient risk apportionment and strong, competitive bidding. Local content is a Government of Botswana key requirement to ensure a direct contribution to the growth of the national economy. Wet commissioning will be followed by 12 week trial operation period.

NSC-1 upgrading works will be undertaken using an Employer design/EPCM approach. The required adjustments to and upgrading of existing works make an EPC approach to these deliverables difficult to manage.

10. NSC-2.1 EPC Contract

The NSC-2.1 EPC contract is currently under Stage 3 bidding with a Successful Bidder Notice and subsequently Instruction to Proceed anticipated during Q2 2012. Construction will take 24 months to complete with commissioning and trial operation expected by mid-2014. Dikgatlhong Dam has already impounded and is expected to have filled significantly by the time of commissioning.

NSC-2A was let under a separate procurement process and the civil works have already been awarded.

11. Participants

The Employer for NSC-2 is MMEWR.
The operator and key technical partner is WUC.
The Employer's Representative is Bigen Africa Services.
The Preferred Bidder for NSC-2.1 is CWJV (WBHO and CCC).
The professional service provider for Dikgatlhong Dam and NSC-2A is the Bergstan, Gauff and Jeffares & Green JV.
The NSC-2A civil contractor is China State/ Excavator Hire JV.