Review of Adequacy of ESIA Environmental Mitigation for the CNOOC Kingfisher Oil Development Project

May 12, 2019

Bill Powers, P.E., E-Tech International

I. Summary

The ESIA should be revised to incorporate the following recommendations:

Issue	Best practices recommendations
Location of CPF	Best practices is to locate the Central Processing Facility (CPF) above the escarpment to avoid the highly sensitive Buhuka Flats and Lake Albert.
Location of well pads	Best practices is to locate the well pad(s) above the escarpment adjacent to the CPF to avoid highly sensitive Buhuka Flats and Lake Albert.
Feeder pipeline starting point	Feeder pipeline begins at the CPF above the escarpment to avoid damage to the escarpment and noise from a pipeline pump station on Buhuka Flats.
Well drilling	Use extended reach drilling (ERD) as necessary to reach the 31 well targets described in the ESIA from a well pad above the escarpment.
Drilling mud	Use only water-based mud (WBM) for drilling all wells.
Disposal of drilling cuttings	Reinject drilling cuttings waste.
Produced water	Reinject produced water without use of makeup water from Lake Albert.
Sewage effluent	Inject treated sewage effluent via the produced water wells.
Hydrotesting feeder pipeline	Hydrotest section of the feeder pipeline should not exceed 10 km.
Hydrotest discharge water quality	CNOOC must have plan to treat non-compliant hydrotest water to meet IFC limits prior to discharge to surface waterbody.
Noise	Locate all infrastructure above the escarpment.
Drilling rig noise	Utilize an all-electric drilling rig.
Visual impacts	Locate all infrastructure above the escarpment.
Geotechnical hazards	Review and verify, by an independent auditor, the mitigation plans for geotechnical hazards potentially impacting oil production infrastructure and the feeder pipeline prior to the initiation of construction activities.
Construction ROW width – general,	International best practices for a pipeline construction ROW is 15 meters. Maximum construction ROW width for EACOP should be 15 meters.
permanent wetlands	Maximum construction ROW in permanent wetlands should be 10 meters.
Waterbody crossings	Utilize horizontal directional drilling (HDD) to traverse the < 900 meters of permanent wetlands that connect with the wetlands in the Bugoma Forest.
Location of block valves	Block valves should be installed on both sides of each permanent wetland connecting with wetlands in the Bugoma Forest.
Crossing seasonally wet locations	The ESIA should be modified to read "seasonal watercourses and wetlands will only be crossed during the dry season."

Hydrotest	No hydrotest section should exceed 10 km in length, and a plan must be developed (and described in the ESIA) to treat hydrotest water that is not in compliance with IFC water discharge limits.
Open pipeline trench safety	Escape ramps and temporary fences must be provided along the open sections of pipeline trench.
Contingency planning	Integrity testing of the feeder pipeline using smart pigging should occur at intervals not exceeding 7 years.
Feeder pipeline design standard	Explicitly state in the ESIA that the feeder pipeline will be designed and constructed in conformance with ASME B31.4 –2016 and ASME B31.3.
Geotechnical studies	The mitigation plans for the geotechnical hazards along the feeder pipeline and well pad flowline routes must be reviewed and verified by an independent auditor prior to the initiation of construction activities.
Management plans	Management plans and sub-plans must be reviewed and approved by independent auditors representing stakeholders before field work begins.
Revegetation of ROW	Irrigation of seeds must be conducted as long as necessary to assure the seeds germinate and establish a self-sustaining grassland, and the natural drainage contours present prior to construction must be re-established prior to the application of seeds.

The location of the Kingfisher project on Buhuka Flats does not represent international best practices. CNOOC proposes to build the Kingfisher project on the same general footprint as the original exploratory drilling pads and associated infrastructure on Buhuka Flats. The exploratory drilling infrastructure was placed in the midst of traditional fishing villages on a narrow strip of land without road access between Lake Albert and a steep escarpment. Lake Albert supports the most diverse commercial fishery in Uganda. The consequences to Lake Albert and the people of Buhuka Flats of a substantial oil spill would be grave, according to the Environmental and Social Impact Assessment (ESIA) for the project.[1] All project infrastructure should be located above the escarpment, along the proposed feeder pipeline route approximately 2 km east of the proposed Pad 2 location, to protect Lake Albert and the villages on Buhuka Flats from major and permanent impacts.

Extended reach drilling (ERD) is a drilling technique in use since the 1990s that enables reaching oil deposits up to 14 km from the drilling pad.[2] A single well multi-pad above the escarpment, large enough to concurrently drill two wells if CNOOC chooses to do so, should be utilized to drill the planned Kingfisher oil production wells and produced water wells. Extended reach drilling (ERD) should be utilized to drill the longer wells. Both CNOOC and Total have been drilling ERD wells of 8 km or longer for more than 20 years. The maximum ERD well horizontal distance from a well pad above the escarpment would be about 10 km. Only 5 of 31 planned wells would be 8 km or longer. The average horizontal reach of these wells would be about 6 km. This compares to the average horizontal reach of wells proposed in the ESIA, drilled from well pads on the Buhuka Flats shoreline, of about 4 km.

[1] ESIA, Vol. 1, p. 10-36.
[2] offshoreenergytoday.com, *Rosneft drills "world's longest well" in the Sea of Okhotsk*, November 17, 2017. See: https://www.offshoreenergytoday.com/rosneft-drills-worlds-longest-well-in-the-sea-of-okhotsk/.

The central processing facility (CPF) should be collocated with the well pad above the escarpment. CNOOC determined in the ESIA that the CPF location was superior to the Buhuka Flats location, but for the logistical challenge of having the CPF above the escarpment and the proposed well pads on Buhuka Flats. The ESIA did not evaluate placing the well pad(s) above the escarpment adjacent to the CPF. In this alternative, the feeder pipeline would start at the CPF above the escarpment. This would avoid the permanent scarring of the escarpment that would result from the construction of a feeder pipeline commencing on Buhuka Flats.

Drilling cuttings are the overwhelming majority of hazardous waste that will be generated by the Kingfisher project.[3] Direct injection of drilling waste at the well pad is best practices and avoids the potential for spills or mismanagement at a permanent waste storage site. It also avoids the ever-present danger of spills due to transport accidents as the waste is trucked up the potentially dangerous escarpment road out of Buhuka Flats.

Electric motors should substitute for the proposed 6,000 kilowatt diesel engine capacity of the single Kingfisher drilling rig, to substantially reduce noise and air emissions that would otherwise be caused by the diesel engines. Use of electric motors for drilling rig power needs would also provide another electric load for the Kingfisher power generation facility (at the CPF). This would reduce the potential for gas flaring by increasing the demand for gas to generate power. The location above the escarpment is also near an existing high voltage transmission line on the Uganda national grid. Interconnecting with the Uganda grid above the escarpment would assure that CNOOC could burn all available gas, with excess generation supplied to the Uganda grid.

CNOOC drilled an 8 km ERD well in 100 days (3+ months) 20 years ago.[4] CNOOC's target completion time for each Kingfisher well is 2 to 4 months.[5] Drilling time should not be substantially different at the alternative well pad location above the escarpment than at the proposed Buhuka Flats well pad locations.

II. Introduction

The purpose of this review of the CNOOC Kingfisher Oil Development Project ESIA is to determine the extent to which the Kingfisher project and the associated feeder pipeline, as they are currently designed, do not meet international best practices and whether the project is likely to have a serious and irreversible impact on the environmental and social health of the affected communities.

The ESIA for the Kingfisher project was issued in September 2018. The project as proposed would produce crude oil from four well pads and a central processing facility (CPF) located on the Buhuka Flats. The oil deposits are just offshore. Twenty (20) production wells and eleven (11) produced water reinjection wells will be constructed. Oil will be pumped from the CPF on

[3] ESIA, Non-Technical Summary, p. 50. "Drilling wastes constitute by far the largest potentially hazardous waste stream."
[4] Society of Petroleum Engineers, *Critical Aspects Experienced in Drilling a World Record Extended Reach Well in South China Sea*, SPE 50876, 1998.
[5] ESIA, Volume 1, p. 2-14.

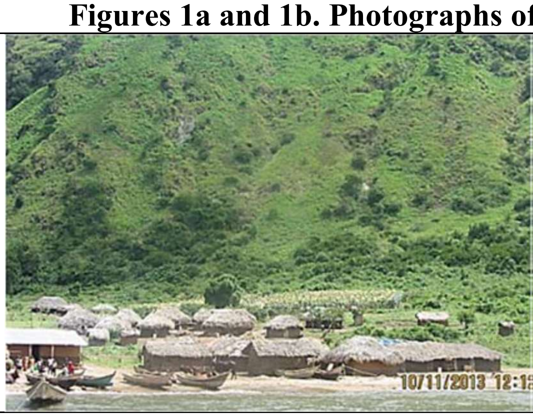
Buhuka Flats via a 12-inch diameter feeder pipeline to Kabaale, approximately 46 km to the northeast. Kabaale will be the location of a proposed oil refinery to serve the Ugandan domestic market as well as the starting point of the East Africa Crude Oil Pipeline (EACOP).

Buhuka Flats is a narrow strip of land, about 10 km long and a width of about 2 km wide tapering into the escarpment at the north end, between Lake Albert and a 1,000-foot escarpment. Buhuka Flats is populated with established fishing villages operating in a non-cash traditional economy. There was no road into Buhuka Flats until 2016, when the government of Uganda built a road down the escarpment to support the proposed project. Due to the very limited amount of land on Buhuka Flats, the oil project would be located on top of, and adjacent to, established villages.

CNOOC proposes to build the Kingfisher project on the same general footprint as the exploratory drilling pads and associated infrastructure on Buhuka Flats. Heritage Oil and Gas Limited conducted the exploratory drilling program beginning in 2006.[6] Tullow purchased the Uganda assets of Heritage in 2010.[7] At about the same time, CNOOC and Total each purchased one-third of the Uganda assets from Tullow.[8]

The purpose of the exploratory drilling program is to assess the commercial viability of the oil deposits, typically by locating the drilling pad(s) as close to the deposit as possible. It is not to achieve a balance between oil production cost, over what could be a 40- to 50-year operational lifetime, and minimum impact on the people and environment of the affected area. According to the ESIA, relatively little of the exploratory drilling infrastructure, including the gravel airstrip, will be utilized in the production phase. A photograph of the Buhuka Flats area is shown in Figures 1a and 1b.

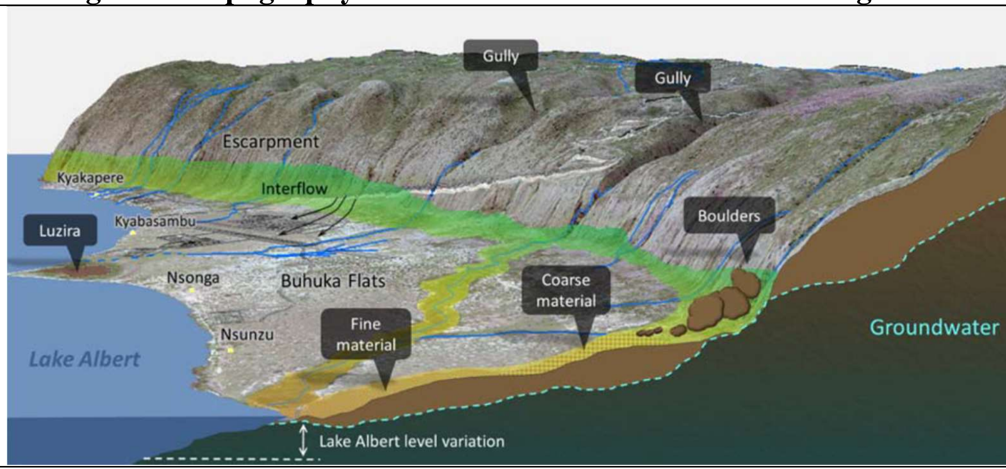
Figures 1a and 1b. Photographs of representative villages on Buhuka Flats[9]



The topography of Buhuka Flats and the adjacent escarpment are shown in Figure 2:

[6] ESIA, Vol. 1, p. 2-4.
[7] Rigzone, *CNOOC, Total to Divvy Up Ugandan Oil Assets*, March 10, 2010. See: https://www.rigzone.com/news/oil_gas/a/89070/cnooc_total_to_divvy_up_ugandan_oil_assets/.
[8] Ibid.
[9] ESIA, *Non-Technical Summary - CNOOC Uganda Ltd Kingfisher Oil Development, Uganda*, Sept. 2018, p. 18.

Figure 2. Topography of Buhuka Flats and the surrounding area[10]



The ESIA describes a highly sensitive environmental and social situation in Buhuka Flats:[11]

> The project is located on the shores of Lake Albert where the ecological consequences of oil pollution would be extremely high. . . Even small quantities of oil entering the lake would be likely to impact materially on the local fishery and would have a major effect on CNOOCs social license to operate. A large spill could have regional effects, spreading across large parts of the Lake and impacting on critically sensitive Lake and lakeshore habitats and many fishing communities.
>
> Receptor vulnerability is extremely high around the (proposed) production facility, with multiple receptors immediately beyond the boundaries of the areas of potential hazard at the CPF and on the well pads. These include households, wetlands, valuable grazing land and the Lake Albert fishery. The consequence of a major accident spreading outside of the boundaries of the facility would be grave.
>
> The greatest social concern will be the uncontrolled influx of people, and the potential for a free-for-all around the production facility. While to the benefit of some, if unmanaged this is likely to impact severely on the current inhabitants; causing a breakdown of the fabric of the communities, increasing violence and vandalism, an escalation of alcohol and drug use and spread of STDs and many other social pathologies. There is already evidence of factionalism.
>
> Local people on the Flats will be sensitive to the aesthetic changes that the project will bring about, especially since they attach cultural and religious values to the landscape. Eighty-eight sites of cultural importance were identified. Many of these sites were disclosed by villagers in confidence and are considered secret and highly sensitive.

[10] Ibid, p. 21.
[11] Ibid, p. 42, p. 55, p. 69, p. 72, p. 92, p. 94, p. 97.

> Loss of land as a result of the Kingfisher project has been one of the most significant concerns of the Buhuka Parish community. Land is intensively utilised and there is limited usable land readily available and in close proximity with which to compensate in kind. Without effective compensation and livelihood restoration, these impacts will be long term, of high magnitude and high significance.

The location of the Kingfisher oil production infrastructure on Buhuka Flats will largely convert Buhuka Flats into an industrial oil production center. Contamination of the Lake Albert shoreline will likely occur,[12] especially given drill cuttings generated at the shoreline will not be reinjected and drilling will be continuous for 5 years. The most effective alternative available to minimize the environmental and social impacts on Buhuka Flats is to locate the oil production infrastructure above the escarpment.

The September 2018 ESIA states that the IFC's *Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development* applies to the Kingfisher oil project.[13] The IFC's *Onshore Oil and Gas* guidelines are used in this review as the principal point of reference to determine if the Kingfisher oil project and associated feeder pipeline design and construction elements are consistent with international best practices. The term "international best practices" in this review means that multiple oil and gas projects have used, or have proposed to use, a specific practice that most effectively avoids or mitigates the environmental or safety challenge being presented.

In addition to the Kingfisher ESIA and the IFC's *Onshore Oil and Gas Guidelines*, I relied on the following documents in the course of my review:

- E-Tech International, *Best Practices: Design of Oil and Gas Projects in Tropical Forests*, 2012 and 2015 editions.
- Penn State Extension (U.S.), *Negotiating Pipeline Rights-of-Way in Pennsylvania*, 2015.[14]
- Toyota Tsusho Corporation, *Hoima-Lokichar-Lamu Crude Oi l Pipeline - Final Report*, 2015.
- www.plosone.org, *Potential of Best Practice to Reduce Impacts from Oil and Gas Projects in the Amazon*, PLOS One, Volume 8, Issue 5, May 2013.
- Society of Petroleum Engineers, *Critical Aspects Experienced in Drilling a World Record Extended Reach Well in South China Sea*, SPE 50876, 1998.
- Society of Petroleum Engineers, *Design of Water-Based Drilling Fluids for an Extended Reach Well with a Horizontal Displacement of 8,000 m in the Liuhua Oilfield*, SPE130959, 2010.

[12] Toyota Tsusho Corporation, *Hoima-Lokichar-Lamu Crude Oi l Pipeline - FINAL REPORT*, 2015, p. 213. "Oil pipelines have a risk of spills as a primary concern. Historically, pipelines lead to some number of oil spills over the course of their operating life regardless of design, construction and safety measures." It is my experience that this same statement holds true for oil production facilities as well as pipelines.

[13] ESIA, Volume 1, p. 5-28. Also, p. 2-18 specifically refers to IFC 2017 (draft) *Health and Safety Guidelines for Onshore Oil and Gas Development*.

[14] See: https://extension.psu.edu/negotiating-pipeline-rights-of-way-in-pennsylvania.

- Society of Petroleum Engineers, *Extended Reach Drilling at the Uttermost Part of the Earth*, Total Austral S.A. SPE 48944, September 1998. National Petroleum Council (U.S.), North American Resource Development Study, *Sustainable Drilling of Onshore Oil and Gas Wells*, Paper #2-23, prepared by the Technology Subgroup of the Operations & Environment Task Group, September 15, 2011.
- Society of Petroleum Engineers, *Simultaneous Operations in a Multi-Well Pad: A Cost-Effective Way of Drilling Multi-Well Pad and Delivering Eight Fracs a Day*, SPE-170744-MS, October 2014.
- Society of Petroleum Engineers, *Methods to Establish Canopy Bridges to Increase Natural Connectivity in Linear Infrastructure Development*, prepared by Smithsonian Conservation Biology Institute, 12LAHS-P-157-SPE, 2013.
- MINEM (Peru Ministry of Energy and Mines), *Directorate Resolution – EIA for the Development Phase of Blocks 67A and 67B*, No. 202-2012-MEM/AAE, August 3, 2012.
- Exponent, Inc., *Integrity Analysis of the Camisea Transportation System, Peru, S.A.,* prepared for Inter-American Development Bank, June 2007.
- E.W. McAllister, *Pipeline Rules of Thumb Handbook*, 2005.

A challenging aspect of this project, from a monitoring and enforcement standpoint, is that the Government of Uganda is a junior partner in the Kingfisher consortium. The government is not a neutral party to the application and enforcement of the requirements described in the ESIA. It is Ugandan civil society and the environment that will be impacted by the disruptions and environmental impacts during construction, as well by impacts, such as oil spills, that may occur during the operation of the Kingfisher oil project and feeder pipeline.

This is a situation where independent auditors monitoring compliance with the conditions of the ESIA must be working on behalf of civil society interests. This is necessary to assure that the monitoring and enforcement function is perceived as transparent and legitimate by the Ugandan public and the international community.

III. Extent to which current Kingfisher oil development and feeder pipeline design does not meet international best practices

A. Well drilling technique to be used and drilling pad location(s)

The IFC *Onshore Oil and Gas Guidelines* include the following requirements related to the width of the ROW:

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements[15]
20	88	Site all facilities in locations that avoid critical terrestrial and aquatic habitat and plan construction activities to avoid sensitive times of the year.

[15] The draft 2017 guideline elements include the elements in the 2007 *Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development* final document, as well as additional elements.

21	88	Minimize well pad size for drilling activities and satellite/cluster, directional, extended reach drilling techniques should be considered, and their use maximized in sensitive locations.
21	88	Avoid construction of facilities in a floodplain, whenever practical, and within a distance of 100 m of the normal high-water mark of a water body or a water well.

Extended reach drilling (ERD) is a drilling technique in use since the 1990s that enables reaching oil deposits up to 14 km from the drilling pad.[16] ERD is a refinement of the directional drilling technique that has been in use in the oil drilling industry for many decades. The National Petroleum Council (U.S.) identifies ERD as a "key technology" to enable sustainable drilling.[17]

A few of the proposed Kingfisher wells identified in the ESIA will be ERD wells, such as Well KFN2 and Well NFN2.[18] Each of these wells will have a horizontal displacement of about 6.5 km. CNOOC has not yet done a detailed analysis of the subsurface geology along the preliminary trajectories of the proposed wells.[19]

ERD from a single well pad above the escarpment, large enough to concurrently drill two wells, should be utilized to drill the planned Kingfisher oil production wells and produced water wells. Both CNOOC and Total have been drilling ERD wells of 8 km or longer for more than 20 years.[20,21] The maximum ERD well horizontal distance from a well pad above the escarpment would be about 10 km. Only 5 of 31 planned wells would be 8 km or longer.[22] The average horizontal reach would be about 6 km. The average horizontal reach of wells described in the ESIA, drilled from well pads on the Buhuka Flats shoreline, is about 4 km. The approximate location of the alternative well pad location above the escarpment is shown in Figures 3a and 3b.

//

//

//

//

//

[16] www.offshoreenergytoday.com, *Rosneft drills "world's longest well" in the Sea of Okhotsk*, November 17, 2017. See: https://www.offshoreenergytoday.com/rosneft-drills-worlds-longest-well-in-the-sea-of-okhotsk/.

[17] National Petroleum Council, *Sustainable Drilling of Onshore Oil and Gas Wells*, Paper #2-23, prepared by the Technology Subgroup of the Operations & Environment Task Group, September 15, 2011, p. 7.

[18] ESIA, Volume 1, Figure 2-5, p. 2-9.

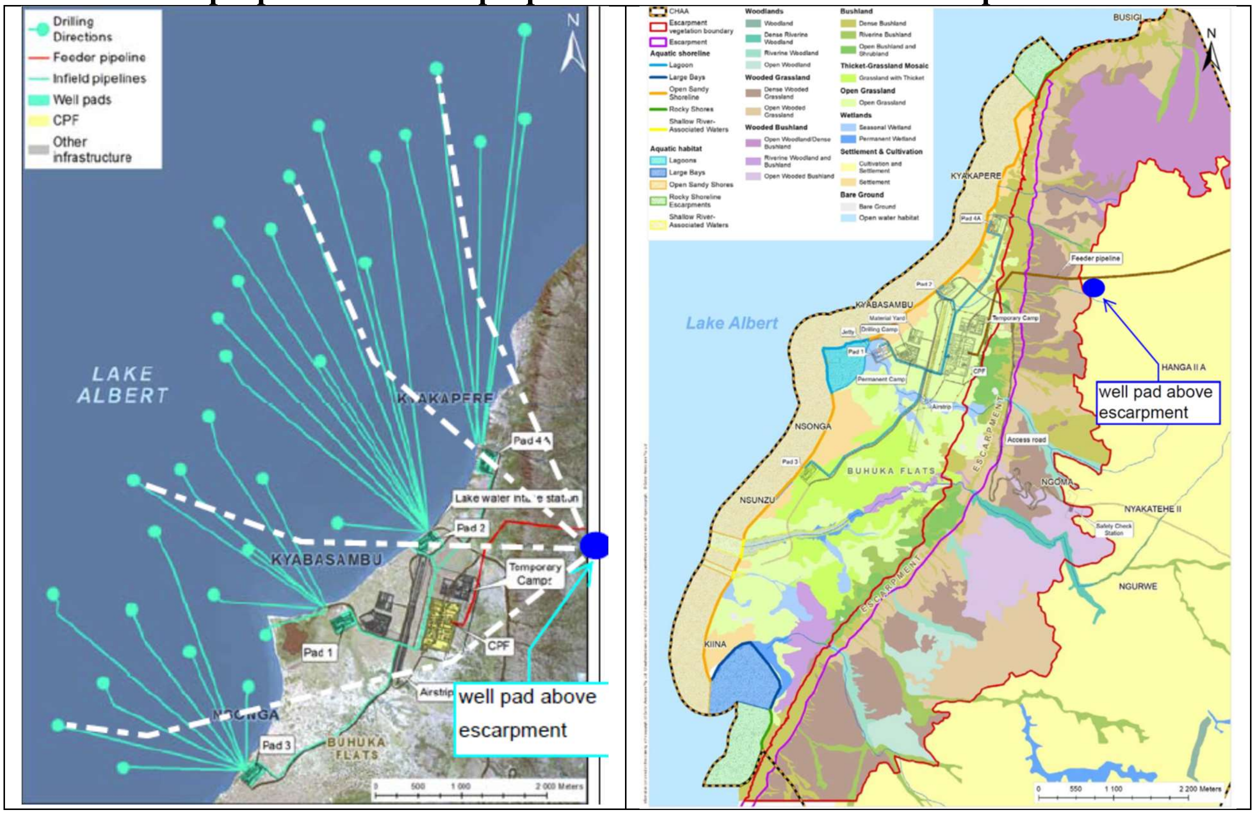
[19] Ibid, p. 2-10. "Offshore geotechnical data are limited to shallow subsurface information. Risks associated with earthquake impact on well bores and the potential escape of produced water along fault zones will be investigated in more detail by the contractor."

[20] Society of Petroleum Engineers, *Critical Aspects Experienced in Drilling a World Record Extended Reach Well in South China Sea*, SPE 50876, 1998.

[21] Society of Petroleum Engineers, *Extended Reach Drilling at the Uttermost Part of the Earth*, Total Austral S.A. SPE 48944, September 1998.

[22] ESIA, Vol. 1, p. 2-9.

Figures 3a and 3b. Alternative well pad location (blue dot) above the escarpment relative to proposed wells and proposed Lake Albert shoreline well pads



Note: blue dot added by author represents potential drill pad site above escarpment. Dashed white lines represent potential trajectories of wells drilled from this drill pad site overlaid on the proposed well trajectories in the ESIA.

CNOOC spent 101 days, or 3 months and 10 days, to drill and complete an 8 km ERD well in 1998 in the South China Sea.[23] Total drilled and completed an 8 km ERD well in 90 days in 1997 in South America.[24] There have been many advances in ERD technology over the last 20 years.[25] However, CNOOC and Total demonstrated 20 years ago they had the skill and technology to develop the all of the proposed 31 Kingfisher wells from an alternative drill pad above the escarpment.[26]

CNOOC's target completion time for each Kingfisher well is 2 to 4 months.[27] Assuming all wells drilled from the alternative well pad location above the escarpment can, on average, be drilled and completed in approximately 3 months, the well drilling and completion time should not be

[23] Society of Petroleum Engineers, *Critical Aspects Experienced in Drilling a World Record Extended Reach Well in South China Sea*, SPE 50876, 1998.
[24] Society of Petroleum Engineers, *Extended Reach Drilling at the Uttermost Part of the Earth*, Total Austral S.A. SPE 48944, September 1998.
[25] For example, long ERD wells can now be drilled exclusively with water-based drilling mud (WBM). See: Society of Petroleum Engineers, *Design of Water-Based Drilling Fluids for an Extended Reach Well with a Horizontal Displacement of 8,000 m in the Liuhua Oilfield*, SPE130959, 2010.
[26] Society of Petroleum Engineers, *Extended Reach Drilling at the Uttermost Part of the Earth*, Total Austral S.A. SPE 48944, September 1998, p. 9. "The progress achieved so far, both in performance and cost reduction, tend to support the objective of a 12 km departure (ERD horizontal displacement) within two years."
[27] ESIA, Volume 1, p. 2-14.

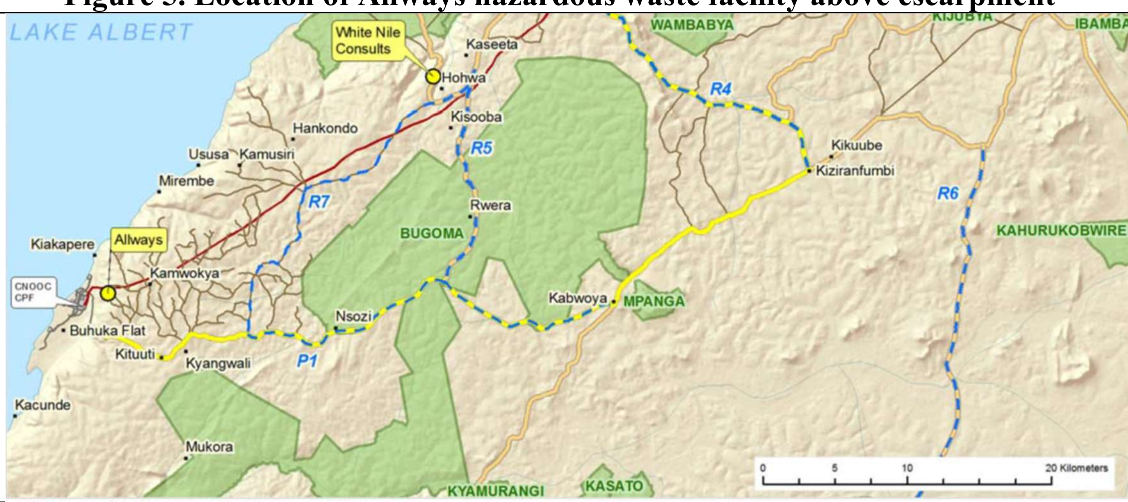
substantially different at the alternative well pad location above the escarpment than at the proposed Buhuka Flats well pad locations.

All of the proposed wells could be drilled from a single drilling pad above the escarpment. Drilling up to 40 wells for a single multi-well pad is a common in North America.[28] Wells are grouped into clusters on the multi-well pad. Two drilling rigs can be operational concurrently on different well clusters on the same multi-well pad. A photograph of a 6-well cluster on a 26-well multi-well pad in Canada is shown in Figure 4.

Figure 4. Example of 6-well cluster on a 26-well pad[29]

The well pad location shown in Figures 3a and 3b would also be in close proximity to an existing certified Ugandan waste disposal site, the Allways site. The collocation of the well pad and the CPF next to an existing certified hazardous waste disposal facility would largely eliminate the potential for offsite hazardous waste spills due to truck transport accidents. The location of the Allways hazardous waste landfill above the escarpment is shown in Figure 5. Some areas along the feeder pipeline route and near the Allways hazardous waste landfill are lightly populated, as shown in **Attachment A**.

Figure 5. Location of Allways hazardous waste facility above escarpment[30]



[28] Society of Petroleum Engineers, *Simultaneous Operations in a Multi-Well Pad: A Cost-Effective Way of Drilling Multi-Well Pad and Delivering Eight Fracs a Day*, SPE-170744-MS, October 2014, p. 1. “A pad in Shell’s North American assets . . . can comprise two opposing rows of 13 – 20 horizontal wells spaced three to six meters apart . . . a typical 26 well pad . . . would take approximately 2 years from spud to first gas.”
[29] Ibid. Figure 1, p. 2.
[30] ESIA, Volume 1, Figure 11-3, p. 11-6.

B. Location of CPF above the escarpment

The central processing facility (CPF) should be collocated with the well pad above the escarpment. CNOOC evaluated locating the CFP above the escarpment in the ESIA, and determined that the CPF location above the escarpment was superior to the Buhuka Flats location - but for the presumptive location of the proposed well pads 1-4 on Buhuka Flats. The ESIA did not evaluate the placement of the well pad(s) above the escarpment. The ESIA lists numerous advantages to placing the CPF above the escarpment, compared to the propsed Buhuka Flats site, including:[31]

- Flood risk was considered to be higher for the Buhuka Flats.
- The risk of impact by landslides is slightly greater for the Buhuka Flats option.
- Foundations (for structures) are likely to be more expensive for the Buhuka Flats option.
- Land acquisition was considered to be easier on the plateau.
- Equipment transportation was slightly in favour of the plateau option.
- Noise was considered to be a factor in favour of the plateau.
- Regarding the CPFs effect on local populations, there was a small preference for the plateau option.
- The main security issues were considered to be the possibility of incursions from the DRC - the CPF on the Buhuka Flats would be more exposed to such incursions.
- Overall socio-economic, security and corporate responsibility factors were rated slightly in favour of the plateau option.

The primary benefit identified in the ESIA for locating the CPF on Buhuka Flats instead of above the escarpment was the benefit of having all operations in the same general location, and not splitting operations between the well pads on Buhuka Flats and the CPF above the escarpment. The consultant referenced in the ESIA (Petrofac) describes this consolidation benefit in the following manner:[32] "*only one construction camp, only one storage site, all personnel together, enhanced security, easier overall management including (QA/HSE), and construction personnel not travelling up and down the escarpment daily*." All of these consolidation advantages would also apply to the CPF location above the escarpment if the wells are drilled from a single multi-well pad located adjacent to or near the CPF above the escarpment.

C. Management of drill cuttings

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements[33]
20	88	Feasible alternatives for the treatment and disposal of drilling fluids and drilled cuttings are: 1) injection into dedicated well, 2) injection into annular space of well, 3) temporary storage in tanks or lined pits, 4)

[31] ESIA, Volume 1, pp. 11-3 to 11-5.
[32] Ibid, p. 11-4.
[33] The draft 2017 guideline elements include the elements in the 2007 *Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development* final document, as well as additional elements.

		recycling of fluids, 5) productive use of non-hazardous cuttings, and 6) landfarming (with limitations).

The *IFC Onshore Oil and Gas Guidelines* identified the injection of drilled cuttings, either through a dedicated well or into the annual space of a well casing, as best practices. Direct injection of drilling waste at the point of generation is the most secure approach to prevent drilling waste from contaminating the surface environment. CNOOC states at p. 2-18 of the ESIA that "CNOOC waste management practices will be aligned with current government legislation . . . and with IFC (2017), Health and Safety Guidelines for Onshore Oil and Gas Development."

The ESIA Non-Technical Summary makes clear that drilling wastes are the predominant hazardous waste stream that will be generated:[34]

> Drilling wastes constitute by far the largest potentially hazardous waste stream. It is estimated that an average of 1158 m^3 of WBM (water-based mud) and SBM (solvent-based mud) drilling cuttings and liquid waste will be generated per well, together with 656 m^3 of other solids. This will occur throughout the construction phase and extend into the operational phase for a period of 5 years. Impacts on surface water or groundwater could arise from spillages on the well pads escaping into the environment, or (for groundwater) from inadequate sealing of the well bore where aquifers are intersected.

The National Petroleum Council (U.S.) identifies injection of spent drilling wastes into a subsurface formation as the most effective drilling waste disposal technique.[35] CNOOC currently proposes transporting the drilling waste from the well pads via truck up the escarpment road to a hazardous waste landfill.[36] This approach is not best practices. It creates three pathways to environmental contamination not present with the injection of drilling wastes at the well pad: 1) spillages on the well pads, 2) spillages during truck transport or truck transport accidents, and 3) spillages and leaks into groundwater at the hazardous waste landfill.

Oil projects permitted in the Peruvian Amazon in recent years have required injection of all liquid wastes, both hazardous and domestic. For example, the operation permit for Perenco's Block 67 oil development project includes the following waste disposal requirements:[37]

- The final disposal of produced water will be achieved by reinjection.
- Industrial and household effluents will be reinjected along with produced water, in order to ensure zero discharge into the environment.

[34] ESIA, Non-Technical Summary, p. 50.
[35] National Petroleum Council, North American Resource Development Study, *Paper #2-23 Sustainable Drilling of Onshore Oil and Gas Wells*, prepared by the Technology Subgroup of the Operations & Environment Task Group, September 15, 2011, p. 12.
[36] ESIA, Volume 1, p. 2-20, 2-21, and p. 2-24.
[37] MINEM (Peru Ministry of Energy and Mines), Directorate Resolution – EIA for the Development Phase of Blocks 67A and 67B, No. 202-2012-MEM/AAE, August 3, 2012.

- The final disposal of all drilling waste, and mud associated with drilling, will be achieved by reinjection, thus ensuring zero discharge into the environment.

D. Drilling mud composition

Best practices is the exclusive use of WBM on the Kingfisher wells to minimize the environmental impacts of any release of drilling fluid into the environment. No SBM should be utilized to drill the Kingfisher wells. Approximately 5 of the 31 Kingfisher wells will be ERD wells with a horizontal displacement of 8 to 10 km if drilled from the alternative well pad location above the escarpment that is recommended in this review (see Figures 3a and 3b). CNOOC is a world leader in utilizing WBM to drill ERD wells. CNOOC was drilling ERD wells with a horizontal reach of 8 km almost a decade ago, exclusively using WBM, in the Liuhua offshore oilfield in the South China Sea.[38] The U.S. National Petroleum Council states that, ". . the development of high-performance WBM may be ideal when considering the needs of an extended-reach or multilateral wellbore."[39]

CNOOC specifically chose to exclusively use WBM on the 8 km ERD well because it considered the South China Sea to be an "environmentally sensitive area."[40] Lake Albert is also an environmentally sensitive area and merits the same level of environmental stewardship that CNOOC applied in the South China Sea in 2010 when it selected WBM to drill ERD wells.

E. Produced water disposal

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements[41]
9	38	Alternatives may include injection into the reservoir to enhance oil recovery, or injection into a dedicated disposal well drilled to a suitable receiving subsurface geological formation. Other possible uses such as irrigation, dust control, or use by other industry, may be appropriate to consider if the chemical nature of the produced water is compatible with these options, and if no adverse environmental and/or human health impacts are caused. Produced water discharges to surface waters or to land should be the last option considered and only if there is no other option available.

[38] Society of Petroleum Engineers, *Design of Water-Based Drilling Fluids for an Extended Reach Well with a Horizontal Displacement of 8,000 m in the Liuhua Oilfield*, SPE130959, 2010.
[39] National Petroleum Council, North American Resource Development Study, *Sustainable Drilling of Onshore Oil and Gas Wells*, Paper #2-23, prepared by the Technology Subgroup of the Operations & Environment Task Group, September 15, 2011, p. 13.
[40] Society of Petroleum Engineers, *Design of Water-Based Drilling Fluids for an Extended Reach Well with a Horizontal Displacement of 8,000 m in the Liuhua Oilfield*, SPE130959, 2010.
[41] The draft 2017 guideline elements include the elements in the 2007 *Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development* final document, as well as additional elements.

The ESIA plan for produced water is partially adequate. The ESIA states at p. 2-1 that "*Produced water will be returned to the well pads for reinjection via separate flowlines*." Reinjection of produced water is best practices. However, it is atypical that large volumes of makeup water would be reinjected along with the produced water. The ESIA states at p. 2-11 that "*Injection water will consist of a combination of produced water, water from POC areas at the CPF and make up water from Lake Albert*." CNOOC is proposing to withdraw up to 2 million gallons per day of Lake Albert water to supplement the produced water being reinjected.[42] CNOOC must conduct an analysis of alternative methods of reinjection that do not require the extraction of makeup water from Lake Albert and choose an alternative that does not require makeup water.

The ESIA should also clarify that: 1) the produced water will be reinjected to a depth that is in the same depth range as the oil producing formation, and 2) the reinjection well(s) trajectory and target formation for injection will assure that the produced water cannot escape along fault zones to the surface or near subsurface potable aquifers.

F. Sewage effluent disposal

The ESIA Non-Technical Summary at p. 91 states "*The ESIA proposes that treated sewage effluent is irrigated onto pastures around the CPF, as a means of minimising the risks of local eutrophication in Lake Albert. This alternative has been accepted by CNOOC*." This sewage effluent disposal approach is not best practices and does create the potential for localized eutrophication in Lake Albert. Injection of sewage effluent is best practices and the most effective method to assure sewage effluent waste does not contribute to eutrophication in Lake Albert. The location of the CPF above the escarpment has the added benefit of putting more distance between the source of sewage effluent and Lake Albert.

G. Noise and light emissions from drilling rig

The ESIA Non-Technical Summary states at p. 53 regarding the impact of drilling noise that "*The most severe, ongoing, noise will be generated by drilling on well pads 1 – 3, one well pad at a time for over 200 days on each pad, throughout the day and night, causing a risk of both nuisance and sleep disturbance. For unmitigated drilling noise, the combined sources of all noisy equipment on the well pad was estimated to be 110 dBA*," and at p. 54 "*All households . . . will experience large noise increases, both during the day and at night, of 10 dBA to 20 dBA*."

Drilling rigs are extremely loud. One mitigation measure proposed in the ESIA at p. 7-31 is "*consider providing soft ear plugs to affected households*." This is not best practices and cannot be considered a legitimate mitigation measure. Community members would be unable to effectively communicate with each other if they were continuously wearing ear plugs around-

[42] ESIA, Volume 1, Table 2-3, p. 2-11. Maximum makeup water from Lake Albert = 301 m^3/hr. Therefore, 301 m^3/hr × 35.315 ft^3/m^3 × 7.5 gallons/ft^3 × 24 hr/day = 1,913,368 gallons per day.

the-clock – for as much as five years – to counter incessant drilling rig noise. The challenge is that too many people are already living too close to the proposed drill pad sites.

Drilling rig noise can be substantially reduced by utilizing electric motors to drive rig equipment instead of diesel engines. Electric motors should substitute for the proposed 6,000 kilowatt diesel engine capacity of the single Kingfisher drilling rig,[43] to substantially reduce noise and air emissions that would otherwise be caused by the diesel engines.[44]

Most wells will be completed prior to the CPF and associated electric power generation facility achieving operational status.[45] However, the location above the escarpment is near an existing high voltage transmission line on the Uganda national grid. Interconnecting with the Uganda grid above the escarpment would provide the necessary source of electric power to operate an all-electric drilling rig. The location of the existing Uganda grid 132 kilovolt transmission line, and proposed Kingfisher substation supplied by that transmission line, is shown in **Attachment B**.

Best practices for drilling rig noise would be to move the drilling to a location above the escarpment, to minimize the number of people in close proximity to drilling operations, and to utilize electric motor drive to reduce noise from drill rig operations.

H. Noise and light emissions from CPF

The CPF will be a major industrial facility with continuously operating crude oil export pumps and power generators. There will be significant and continuous noise as a result. The lighting at the CPF will be extensive and readily visible at night. The ESIA at p. 7-35 states that "*Inhabitants of the Flats will be acutely aware of the operation of the Kingfisher facility as they go about their daily lives.*" Best practices for reducing noise and light impacts on Buhuka Flats from the CPF would be to locate the CPF above the escarpment.

I. Feeder pipeline right-of-way (ROW) width

1. General

The IFC *Onshore Oil and Gas Guidelines* include the following requirements related to the width of the ROW:

---

[43] ESIA, Volume 1, Table 2-4, p. 2-16.

[44] National Petroleum Council (U.S.), *North American Resource Development Study, Sustainable Drilling of Onshore Oil and Gas Wells*, Paper #2-23, prepared by the Technology Subgroup of the Operations & Environment Task Group, September 15, 2011, p. 5. "Construction and operation of drill rigs has benefited from evolving diesel-electric and all-electric options for powering drill-rig motors. Reduced dependence on diesel technologies has led to reductions of noise, petroleum fuel transportation and storage and air emissions at drill pads."

[45] ESIA, Volume 1, p. 2-6.

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements[46]
20	88	Minimize areas to be cleared. Use hand cutting where possible, avoiding the use of heavy equipment such as bulldozers, especially on steep slopes, water and wetland crossings, and forested and ecologically sensitive areas.
21	88	Minimize the width of a pipeline right-of-way or access road during construction and operations as far as possible.
21	88	Install appropriate erosion and sediment control measures, slope stabilization measures, and subsidence control and minimization measures at all facilities, as necessary.

The 30-meter construction ROW proposed in the ESIA for the Kingfisher feeder pipeline is an industry typical ROW width,[47] and not representative of international best practices. A pipeline construction ROW width as narrow as 13 meters has been demonstrated-in-practice in sensitive tropical environments. A maximum pipeline construction ROW width of 15 meters (50 feet) is a general requirement in some parts of the U.S. This includes the state of Pennsylvania, a shale gas production region that has undergone intensive pipeline development in recent years.

Pipeline construction is a specialized industry with relatively few companies. These companies are accustomed to applying a similar conventional approach on every project. Priority is placed on maintaining the pace of pipeline installation, which imposes its own conditions of construction, including: ROW width, disposal of soils and debris, contouring of ROW slopes, and the equipment that is used in each construction stage. These are unchanging elements for conventional pipeline ROW builders. These accumulated habits and routines, which have evolved over the years among pipeline construction firms, constitute a major source of resistance to innovative ROW construction techniques.

The "narrow ROW" technique puts primary emphasis on manual labor and less emphasis on heavy machinery to open and close the ROW. The narrow ROW technique emphasizes having the ROW follow the natural terrain, as well as the manual logging of trees and bushes (instead of using heavy machinery) to further reduce impacts, especially on steep slopes. See E-Tech International, *Best Practices: Design of Oil and Gas Projects in Tropical Forests*, October 2012 for examples of pipelines and flowlines built in narrow ROWs in tropical environments.[48]Manual clearing creates opportunities for short-term employment during pipeline construction, an additional social benefit in contexts where expectations for jobs are high. Figure 6a and 6b show labor crews opening and closing a 13-meter ROW in Peru for a 20-inch diameter flowline.

//
//
//
//
//

[46] The draft 2017 guideline elements include the elements in the 2007 *Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development* final document, as well as additional elements.
[47] See **Attachment C** for the schematic of a typical 30-meter construction ROW presented in the ESIA at p. 2-72.
[48] See: https://static1.squarespace.com/static/52d71403e4b06286127a1d48/t/531cf8bce4b04c1bc67a1768/1394407612599/E-Tech.2012_BestPracticesHydrocarbonProjects.pdf

Figures 6a and 1b. Opening and closing narrow ROW using labor intensive technique[49]

The standard 15-meter pipeline construction ROW in Pennsylvania is shown in Figures 2a and 2b. The 15-meter ROW is the space between the two temporary plastic orange fences.

Figures 7a and 7b. Typical Pennsylvania 15-meter pipeline ROW (25 feet on either side of centerline),[50] **and clearing of ROW for 20-inch diameter Mariner East Pipeline**[51]

International best practices for a pipeline construction ROW is 15 meters. The maximum allowable construction ROW for feeder pipeline should be 15 meters.

---

[49] INMAC Peru, *Comparaciones de calidad y costo entre un gasoducto verde y una construcción tradicional*, presented at E-Tech Independent Monitoring Forum, Cusco, Peru, 2010.
[50] Penn State Extension, *Tips for Negotiating Pipeline Rights of Way* [in Pennsylvania], video, 2019. Screenshot showing ROW measuring 25 feet on either side of ROW centerline (50 feet total).
[51] State Impact Pennsylvania, *Mariner East: A Pipeline Project Plagued by Mishaps and Delays*, March 2019. See: https://stateimpact.npr.org/pennsylvania/tag/mariner-east-2/.

2. *Protected areas*

The proposed feeder pipeline route will pass through many permanent wetlands that connect to those in the Bugoma Forest Reserve.[52]

The maximum width of the construction ROW in protected areas, or headwaters to protected area waterbodies, should be no more than 10 meters. The primary reasons for this width restriction are to: 1) minimize the amount of ground-level disturbance in the protected area, and 2) maintain canopy bridges at regular intervals along the ROW to allow for the passage of forest animals that live primarily or exclusively in the tree canopy. Figure 8 is a photograph of a construction ROW cross-section limited to 8 meters in the Peruvian jungle. Canopy bridges were maintained at regular intervals along this ROW.

Figure 8. 8-meter construction ROW[53]

J. Crossing technique to be utilized at rivers and streams

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements
21	88	Carefully consider all of the feasible options for the construction of pipeline river crossings including horizontal directional drilling.

The ESIA states that open-cut trenching will be used exclusively on the feeder pipeline, stating, "*The trench for the pipeline is excavated using large tractor loader backactors (TLBs) or a specialized trenching machine*."[54] There is no discussion of the horizontal directional drilling (HDD) alternative to cross sensitive points along the feeder pipeline route.

There are two primary options available to cross rivers and streams: 1) open-cut trenching, or 2) horizontal directional drilling under the water body. The comparative cost of these two crossing alternatives is not discussed in the Kingfisher ESIA. However, the EACOP Uganda ESIA, in Table 3.8-2, p. 3-33, identifies the cost of open-cut as "lowest," and the cost of HDD as "low."

The ESIA contains conflicting information on the use of HDD for the feeder pipeline water crossings. At p. 16-1 the ESIA quotes the consultant (Petrofac, 2012) that selected the route stating "*It had limited impact on rivers and wetlands, crossing only minor seasonal watercourses*

[52] ESIA, Non-Technical Summary, p. 97.
[53] Society of Petroleum Engineers, *Methods to Establish Canopy Bridges to Increase Natural Connectivity in Linear Infrastructure Development*, prepared by Smithsonian Conservation Biology Institute, 12LAHS-P-157-SPE, 2013.
[54] ESIA, Volume 1, p. 2-72.

where open-cut excavation would be feasible," yet on the same page indicates a second consultant (Worley-Parsons, 2014) "*suggested that one of the small river crossings, could be done using trenchless methods of construction*." There is no indication that any consideration was given by these engineering contractors to the impact on the Bugoma Forest of use of open-cut trenching across the "*Many permanent wetlands along the feeder pipeline route (that) connect to those in the Bugoma Forest Reserve*."[55]

With the open-cut technique, the streambed where the pipeline will be located is physically isolated to allow laying of the pipeline in dry conditions. Pipes pass through the temporary barriers to allow water from the waterbody to continue to flow. However, the open-cut technique has the potential for substantial negative environmental impacts on aquatic fauna in perennial rivers and streams due to the disruption to natural flow. A photograph of this technique, with river/stream water flowing in pipes above the pipeline trench, is shown in Figure 9.

Figure 9. Open trench pipeline river crossing, horizontal flume pipes above pipeline for water flow[56]

Open-cut trenching of pipelines in streambeds carries operational risks. A major rupture on the Camisea liquids pipeline in Peru occurred sixteen months after the pipeline began operation at a point where the pipeline had been placed under the steambed of the Paratori River using open-cut trenching.[57] The river is less than 10 meters across where the rupture took place. The pipeline was exposed due to scouring of the streambed during a period of heavy rain.[58] It had been buried 2.1 meters below the stream bed.[59]

The automatic leak detection system did not register that a leak had occurred. The pressure reduction caused by the rupture "*was not sufficiently large to activate the automatic rupture detection mechanism of the block valves upstream and downstream of the rupture*."[60] The rupture

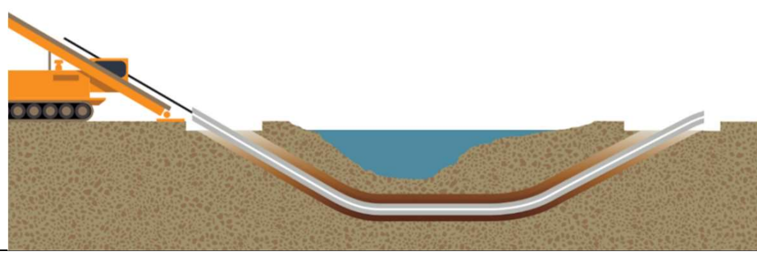
[55] ESIA Non-Technical Summary, p. 97.
[56] CNOOC, *ESIA: CNOOC Kingfisher Oil Project, Uganda*, Volume 1, p. 2-78.
[57] Exponent, Inc., *Integrity Analysis of the Camisea Transportation System, Peru, S.A.*, prepared for Inter-American Development Bank, June 2007, p. 21.
[58] Ibid.
[59] Ibid.
[60] Ibid.

was detected when control room operations staff identified a reduction in flow at the downstream pump station. The nearest block valves were ultimately closed about one hour after the rupture occurred. Approximately 4,600 barrels of liquid hydrocarbons were spilled into the stream.[61] Figure 5 shows the damaged pipe section and the pipeline bridge that replaced the pipeline section that had been buried under the streambed.

Figure 5. Photographs of the open-cut buried pipe section that ruptured and the replacement pipeline bridge[62]

The HDD technique involves drilling under the waterbody and avoiding any disruption to the waterbody itself. See Figure 10.

Figure 10. Schematic of horizontal directional drilling under a river[63]



It is important to underscore that HDD must be done properly to achieve the intended environmental and water quality protection purposes. There will be strong pressure in the field to keep laying pipe sections as fast as possible. A clear, detailed and sufficient work plan must be developed for each HDD crossing, and onsite independent inspection must verify that the work plan is being followed.

---

[61] ($736\ m^3 \times 35.31\ ft^3/m^3 \times 7.5$ gallons/ft^3)/(42 gallons/barrel) = 4,641 barrels.
[62] Exponent, 2007, pp. 23-24.
[63] Pittsburg Post-Gazette, *The lessons of Mariner East 2*, October 23, 2018: https://newsinteractive.post-gazette.com/mariner-east-2-pipeline-horizontal-directional-drilling/.

A recent 500 km pipeline project in the U.S. includes over 100 HDD crossings.[64] The pipeline company chose the best practices HDD technique to speed environmental approvals and begin construction sooner. However, due to restrictions on state regulation in this case, government authorities were not permitted to independently assess the adequacy of the HDD crossing designs planned by the pipeline company. The results in some cases were not acceptable, either because the HDD contractor had not drilled the pipeline bore at sufficient depth under the water body, or the contractor was under time pressure to keep moving at a fast pace and cut corners to stay on schedule. The problems encountered on this project underscore the need for independent review and approval of HDD work plans prior to the commencement of field work.

In summary, HDD is best practices for crossing the permanent wetlands that feed the wetlands in the Bugoma Forest Reserve.[65] HDD has no construction footprint on the waterbody itself. In contrast, open-cut has a large and negative footprint, at least temporarily, on the waterbody being crossed.

K. Location and number of block valves

The Kingfisher ESIA states at p. 2-70 that "*Provisional studies show that there will be two mainline Block Valve stations - one at KP 1.3 and one at KP 25.4; or this could be optimized to one mainline block valve station located near KP 10*". There is no indication that block valves will be located to minimize the impact of a spill in permanent wetlands on the escarpment that connect with wetlands in Bugoma Forest.

Best practices would be to install block valves on wetlands connecting to a downstream protected area, in this case the Bugoma Forest. The ESIA indicates that length of wetlands and riparian habitat to be crossed by the feeder pipeline is less than 900 meters.[66] Block valves should be installed on both sides of the primary wetlands connecting to the Bugoma Forest. Is important to note that, if the CPF is located above the escarpment, the feeder pipeline would begin at that point and would not impact any wetlands or riparian habitat it would otherwise traverse on Buhuka Flats.

L. Crossing seasonal streams and wetlands

The ESIA at p. 16-6 states that "*It is recommended that to the greatest extent practical, the construction of the pipeline through the wetlands and small drainage lines is undertaken in the dry season*." This is insufficient and does not represent international best practices. This statement in the ESIA should be modified to read "*seasonal watercourses and wetlands will only be crossed during the dry season.*" A definitive statement to this effect will allow a field inspector to readily determine whether or not this condition is being adhered to.

---

[64] Ibid.

[65] ESIA, Non-Technical Summary, p. 97.

[66] ESIA, Volume 1, Table 12-16, p. 12-26. 2.6 hectares of the 30-meter wide feeder pipeline route cross wetlands or riparian habitat. This converts to a 30-meter strip that is 867 meters long: (2.6 hectares x 10,000 m2/hectare) ÷ 30 m = 867 m.

M. Hydrotesting

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements
11	51	Following hydrotesting, the disposal alternatives for test waters include injection into a disposal well if one is available, or discharge to surface waters or land.
11	51	Hydrostatic test water quality should be monitored before use and discharge and should be treated to meet the discharge limits in Table 1 of Section 2.1 of this Guideline.
21	88	Limit the amount of pipeline trench left open during construction at any one time. Safety fences and other methods to prevent people or animals (livestock or wildlife) from falling into open trenches should be constructed in sensitive locations and within 500 m of human populations. In remote areas, install wildlife escape ramps from open trenches (typically every 1 km where wildlife is present);

The ESIA at p. 12-15 states that "*The current proposal is to fill the pipeline with approximately 2,400 m^3 of water, sourced from Lake Albert. The entire line can be tested in one section.*"

<u>Hydrotest section length</u>: A hydrotest pipe section of 46 km in length is far too long to be considered best practices. Leaving 46 km of open trench in order to conduct a single hydrotest would conflict with the IFC guideline to limit the amount of trench left open during construction. Covering the pipeline before conducting the hydrotest would complicate addressing deficiencies revealed by the hydrotest. Best practices also require that the elevation difference across a pipeline segment undergoing testing not exceed 300 feet (~90 meters).[67] In the current design, the feeder pipeline would climb more than 1,000 feet in elevation in the first 2 km from its starting point at the Buhuka Flats CPF. There is also a 300-foot elevation or more at least every 10 km of the feeder pipeline length above the escarpment to Kabaale.[68]

Shorter hydrotest section also means less hydrotest water will be discharged to the environment at a single point. For these reasons, no hydrotest section should exceed 10 km in length.[69]

<u>Hydrotest water quality</u>: There is no indication in the ESIA as to what CNOOC will do in the field to bring the hydrotest water into compliance prior to discharge to the environment if the water does not meet IFC water discharge limits in Table 1 of Section 2.1 of the IFC *Onshore Oil and Gas Guideline*. The IFC water discharge limits are provided as **Attachment C**. CNOOC's plan to address hydrotest water that is not in compliance with the IFC water discharge limits must be explicitly described in the ESIA.

[67] E.W. McAllister, *Pipeline Rules of Thumb Handbook*, 2005, p. 140.
[68] ESIA, Volume 1, p. 2-58 to p. 2-67. km 3.2 = 1,100 m; km 8.6 = 1,205 m; km 12.1 = 1,105 m; km 15.0 = 1,170 m; km 26.4 = 1,070 m; km 34.9 = 975 m; km 39.7 = 1,070 m; km 46.2 = 1,060 m.
[69] The one exception may be km 15.0 to km 26.4 of the feeder pipeline, a distance of 11.4 km.

N. Pipeline open trench safety

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements
21	88	Limit the amount of pipeline trench left open during construction at any one time. Safety fences and other methods to prevent people or animals (livestock or wildlife) from falling into open trenches should be constructed in sensitive locations and within 500 m of human populations. In remote areas, install wildlife escape ramps from open trenches (typically every 1 km where wildlife is present);

There is no mention of feeder pipeline trench escape ramps in the Kingfisher ESIA. In contrast, EACOP Uganda ESIA at p. 2-40 states "*Consistent with pipeline construction best practices, the trench will be excavated complete with escape ramps, or side cuts into the trench wall, to allow a safe exit from within the trench. The slope of the escape ramps should not exceed 45°. The ramps should be excavated every 500–1000 m (terrain dependent) to provide an escape route for any personnel working or animals that may become trapped in the trench*." This condition must be added to the Kingfisher ESIA and supplemented with a requirement to install safety fences to protect people and animals from falling into the open trench.

O. Contingency planning

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements
23	97	Conduct a spill risk assessment for the onshore facilities.
23	97	Ensure adequate corrosion allowance for the lifetime of the facilities and/or installation of corrosion control and prevention systems in all pipelines, process equipment, and tanks.
23	97	On pipelines, consider measures such as telemetry systems, Supervisory Control and Data Acquisition systems, pressure sensors, shut-in valves, and pump-off systems, including at normally unattended installations and unmanned facilities to ensure rapid detection of any loss of containment.
24	97	For flowlines and pipelines, maintenance programs should include regular pigging to clean the line, and intelligent pigging should be considered as required.
24	97	Implement adequate personnel training and field exercises in oil spill prevention, containment, and response.
24	98	A Spill Response Plan (SRP) should be prepared, and the capability to implement the plan should be in place.
32	134	Incidents related to land transport are one of the main causes of injury and fatality in the oil and gas industry.

Feeder pipeline oil spills will occur over the lifetime of the project.[70] It is imperative that periodic testing be conducted to assure the integrity of the pipeline, that block valves be

[70] Toyota Tsusho Corporation, *Hoima-Lokichar-Lamu Crude Oi l Pipeline - FINAL REPORT*, 2015, p. 213. "Oil pipelines have a risk of spills as a primary concern. Historically, pipelines lead to some number of oil spills over the course of their operating life regardless of design, construction and safety measures."

positioned to minimize spills into waterways and/or critical habitat, and that effective contingency planning is adequate to rapidly clean and remediate the spills that do occur.

There is no mention in the Kingfisher ESIA that smart pigging will be conducted periodically on the feeder pipeline. This is not best practices. In contrast, the EACOP Uganda ESIA states at p. 2-11 that "*Pigs sweep the pipeline by scraping the sides of the pipeline and pushing debris ahead of the pig to the pig receiver where the debris and the pig are recovered without interrupting the flow. Smart pigging for pipeline Integrity purposes will be conducted periodically.*" Best practices would an explicit interval, no more than every 7 years, for integrity testing using smart pigging on the feeder pipeline. The requirement that smart pigging be conducted, and the maximum interval between this integrity testing of 7 years, should be explicitly stated in the ESIA.

P. Adequacy of geotechnical studies and geotechnical mitigation measures

The ESIA at p. 2-9 states that "*The Kingfisher License Area is seismically active and is susceptible to geological hazards. A geohazard investigation has shown that well pad 4-2-KF is unsuitable for development, due to liquefaction potential of soils during earthquakes, and has been replaced by well pad 4A which has low geotechnical hazard,"* and p. 2-10 *"Offshore geotechnical data are limited to shallow subsurface information. Risks associated with earthquake impact on well bores and the potential escape of produced water along fault zones will be investigated in more detail by the contractor."*

The mitigation plans for geotechnical hazards potentially impacting the production infrastructure and the feeder pipeline should be reviewed and verified by an independent auditor prior to the initiation of construction activities.

The failure to incorporate adequate geotechnical mitigation measures at the design stage was a primary cause of subsequent pipeline ruptures and spills on the Camisea Pipeline in the Peruvian Andes.[71] Timely independent review of the proposed geotechnical mitigation measures along the final pipeline route in the Camisea case would likely have identified some of the design weaknesses that subsequently led to pipeline ruptures and associated spills.

Q. Independent auditing of each phase of pipeline design, construction and operation

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements
21	88	Construction areas no longer needed by a project development should be appropriately reclaimed, including by appropriate revegetation using native plant species and establishing/re-establishing appropriate drainage contours. Where applicable, accommodate requests of the local population regarding the reclaimed state of the disturbed land.
37	151	Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have

[71] Exponent, Inc., *Integrity Analysis of the Camisea Transportation System, Peru, S.A., prepared for Inter-American Development Bank*, June 2007, p. xviii.

		potentially significant impacts on the environment during normal operations and upset conditions.
37	152	Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment.

The ESIA Non-Technical Summary lists many elements of the Kingfisher project that are to be continuously monitored and/or reviewed by independent auditors, as detailed in the table below:

Page	Issue	ESIA monitoring or audit description
93	Monitoring and auditing	The staff responsible for the management of major hazards at the production facility must be highly trained and capable. **Continuous monitoring** must be included in the design as a part of the Facility Status Management System, as recommended by Bureau Veritas (2017).
93		A **six-monthly audit** must be undertaken by **external major hazard specialists** in the oil industry, with findings to be promptly disclosed to NEMA.
93	Review of all risk-related work	It is recommended that CNOOC commissions an **independent expert review** of all previous risk-related work before the completion of the final design. It must be demonstrated (and summarized in simple lay terms) that **in the context of the exceptionally high environmental and social sensitivity of the project area**, the risk of unplanned hydrocarbon releases into Lake Albert is reduced to an acceptably low level. The work should include a review of the potential triggers of accidents, including seismic events, flooding, fires and explosions, as well as any other reasonably credible causes.
93	Emergency response	It is also recommended that the **Emergency Response Plan** is finalized and **reviewed by independent experts**, taking into consideration the sensitivities in the project area and the need for very rapid response times in the event of an accident.
93	Risk management performance	it is recommended that CNOOC's safety management systems and **risk management performance in respect of accidents is reviewed annually by external auditors** with extensive experience of hazard management and best safety practices in oil industry facilities.
95	Community relations	Continue to implement the Community Relations Strategy (CRS) and strengthen the work of the **Oil and Gas Activities Monitoring Committees** at Parish level.
95	CNOOC personnel behavior	**Strictly control the behaviour of project personnel** in their day-to-day interactions with local communities. The production facility will be integrated among inhabitants on the Flats and daily interactions will be inevitable.
		CNOOC must become a trusted and influential neighbour and member of the Buhuka community as a basis for a social license to operate.

The ESIA indicates that *"The Environmental and Social Management Plans (ESMPs) for the CPF, Wells, Flowlines and Ancillary Infrastructure (Volume 2) are separate from the ESMPs for the feeder pipeline (Volume 3). Each ESMP is divided into construction, operation and decommissioning phases. Specific sub-plans dealing with environmental aspects and components* *are included in each plan*."[72] There is no statement in the ESIA that independent auditor review or approval will be required prior to the implementation of the management plans or sub-plans.

This omission underscores the need for: 1) review and approval of management plans and sub-plans by independent auditors representing stakeholders before the field work begins, and 2) independent onsite monitoring by monitors representing stakeholders to assure adequate time is allowed, per the time interval described in the approved plan, to do the described work properly.

R. Revegetation of feeder pipeline right-of-way

Page	Paragraph	2017 (draft) IFC Onshore Oil and Gas Guideline Requirements
21	88	Construction areas no longer needed by a project development should be appropriately reclaimed, including by appropriate revegetation using native plant species and establishing/re-establishing appropriate drainage contours. Where applicable, accommodate requests of the local population regarding the reclaimed state of the disturbed land.

The ESIA at p. 2-29 states that *"Rehabilitation may be from the natural seed beds in the soil and by colonisation from the surrounding area or by re-seeding using locally indigenous grasses."* The description of this seeding commitment should be expanded to make clear that temporary irrigation of seeds will be conducted as long as necessary to assure the seeds germinate and establish a self-sustaining grassland, and that the natural drainage contours present prior to construction will be re-established prior to the application of seeds.

S. Adequacy of proposed feeder pipeline design and construction standards

The ESIA makes no statement regarding the standard to followed to build the feeder pipeline. In contrast, the EACOP Uganda ESIA states at p. 2-4 states that the pipeline technical design is based on ASME B31.4 –2016, Pipeline Transportation Systems for Liquids and Slurries, and ASME B31.3, Gas Transmission and Distribution Piping Systems. These American Society of Mechanical Engineers (ASME) codes are the accepted international standard for pipeline construction and are adequate. The Kingfisher ESIA should be revised to explicitly state the feeder pipeline will be designed and constructed in conformance with ASME B31.4 –2016 and ASME B31.3.

IV. Summary of Recommendations

It is my opinion the ESIA should be revised to incorporate the following recommendations:

Issue	**Best practices recommendations**
Location of CPF	Best practices is to locate the CPF above the escarpment to avoid the highly sensitive Buhuka Flats and Lake Albert.

[72] ESIA, Volume 1, p. 1-8.

Location of well pads	Best practices is to locate the well pad(s) above the escarpment adjacent to the CPF to avoid highly sensitive Buhuka Flats and Lake Albert.
Feeder pipeline starting point	Feeder pipeline begins at the CPF above the escarpment to avoid damage to the escarpment and noise from a pipeline pump station on Buhuka Flats.
Well drilling	Use extended reach drilling (ERD) as necessary to reach the 31 well targets described in the ESIA from a well pad above the escarpment.
Drilling mud	Use only water-based mud (WBM) for drilling all wells.
Disposal of drilling cuttings	Reinject drilling cuttings waste.
Produced water	Reinject produced water without use of makeup water from Lake Albert.
Sewage effluent	Inject treated sewage effluent via the produced water wells.
Hydrotesting feeder pipeline	Hydrotest section of the feeder pipeline should not exceed 10 km.
Hydrotest discharge water quality	CNOOC must have plan to treat non-compliant hydrotest water to meet IFC limits prior to discharge to surface waterbody.
Noise	Locate all infrastructure above the escarpment.
Drilling rig noise	Utilize an all-electric drilling rig.
Visual impacts	Locate all infrastructure above the escarpment.
Geotechnical hazards	Review and verify, by an independent auditor, the mitigation plans for geotechnical hazards potentially impacting oil production infrastructure and the feeder pipeline prior to the initiation of construction activities.
Construction ROW width – general,	International best practices for a pipeline construction ROW is 15 meters. Maximum construction ROW width for EACOP should be 15 meters.
permanent wetlands	Maximum construction ROW in permanent wetlands should be 10 meters.
Waterbody crossings	Utilize horizontal directional drilling (HDD) to traverse the < 900 meters of permanent wetlands that connect with the wetlands in the Bugoma Forest.
Location of block valves	Block valves should be installed on both sides of each permanent wetland connecting with wetlands in the Bugoma Forest.
Crossing seasonally wet locations	The ESIA should be modified to read “seasonal watercourses and wetlands will only be crossed during the dry season.”
Hydrotest	No hydrotest section should exceed 10 km in length, and a plan must be developed (and described in the ESIA) to treat hydrotest water that is not in compliance with IFC water discharge limits.
Open pipeline trench safety	Escape ramps and temporary fences must be provided along the open sections of pipeline trench.
Contingency planning	Integrity testing of the feeder pipeline using smart pigging should occur at intervals not exceeding 7 years.
Feeder pipeline design standard	Explicitly state in the ESIA that the feeder pipeline will be designed and constructed in conformance with ASME B31.4 –2016 and ASME B31.3.
Geotechnical studies	The mitigation plans for the geotechnical hazards along the feeder pipeline and well pad flowline routes must be reviewed and verified by an independent auditor prior to the initiation of construction activities.
Management plans	Management plans and sub-plans must be reviewed and approved by independent auditors representing stakeholders before field work begins.

Revegetation of ROW	Irrigation of seeds must be conducted as long as necessary to assure the seeds germinate and establish a self-sustaining grassland, and the natural drainage contours present prior to construction must be re-established prior to the application of seeds.