APPENDIX B

RESPONSE TO ROUND 1 INFORMATION REQUEST DFO&EC_26, SUBMITTED TO THE BOARD ON APRIL 6, 2012

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TECHNICAL MEMO

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C:	Wayne Corso, JDS, Dan Johnson, JDS		
FROM:	Bill Horne, EBA Gordon Zhang, EBA, Hongwei Xia, EBA	**EBA FILE:**	E14101143
SUBJECT:	2012 Gahcho Kué EIS Supplement - Summary of Dyke Conceptual Design and Construction Material for Gahcho Kué Diamond Project, NWT, Canada		

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA) was retained by JDS Energy and Mining Inc. (JDS) to develop a waste and water management plan as a part of the project feasibility study for the Gahcho Kué Diamond Project. EBA completed the original waste and water management plan and submitted the report to JDS in September 2010 which included conceptual designs for dykes required for the Gahcho water and waste management.

Modifications to the waste and management plan were made as described in the 2012 EIS Supplement (De Beers 2012) Project Description. The mine waste and water management plan has been updated accordingly as well as the dyke conceptual designs. This memo is an update of EBA's previous dyke conceptual design and construction material summary memo (EBA 2011) to reflect the recent update on the mine waste and water management plan.

2.0 DYKE/BERM DESIGN AND CONSTRUCTION

2.1 Key Considerations

The key considerations for the dyke/berm design were as follows:

- Comply with the Canadian Dam Safety Guidelines;
- Minimize seepage through dykes while optimizing the construction efficiency;
- Maximize the use of mine waste materials produced during pit development;
- Minimize overall environmental footprints and effects;
- Facilitate an effective mine closure plan;
- Optimize the dyke construction sequences to reduce initial construction requirements during pre-operation stage and construction intensity during mine operation;

- Establish adequate setback from the open pit limits for mining safety and minimizing seepage into the open pits; and
- Incorporate mine site roads (including haul roads) into dykes, wherever practical.

2.2 Design Criteria

The following design criteria were adopted for the dyke design:

- All dykes were designated as Significant Dyke Class based on the recommendation of the Canadian Dam Safety Guidelines (CDA 2007)
- The Area 1 perimeter berms and water collection pond berms were designated as Low to Significant Dyke class
- Peak ground acceleration (PGA) of 0.06 g was adopted for the dyke design
- A minimum freeboard of 1.0 m was adopted for the dyke design
- The minimum factors of safety for dyke slopes meet or exceed the requirements in the Canadian Dam Association guidelines (CDA 2007).

2.3 Conceptual Level Dyke Design

A total of 14 dykes are required for the water and waste management during the mine operation. The locations of the dykes are shown in Figure 1, the overall layout of the mine site. The typical cross section for each dyke is presented in Figures 2 through 15.

2.3.1 Dyke A

The construction of Dyke A is required during early mine development before the initial lake dewatering and pit development. The dyke would be constructed in winter to satisfy the current mine construction plan. An existing water depth of about 2 m is anticipated along the main portion of Dyke A. Up to 6 m thick overburden till over bedrock was identified over the Dyke A area during the 2004 site investigation. Several boulders (up to 0.3 m) were recovered in the overburden zone from a borehole drilled in the main channel at the Dyke A location. A talik (unfrozen year-round) was identified within the main channel area during the site investigation. In consideration of the above information, a soil-bentonite slurry cutoff wall through a till fill zone placed over the overburden and the overburden to the bedrock surface has been adopted as the main seepage control measure for Dyke A. The cut-off wall will be protected by a downstream filter zone and a mine rock shell zone. The proposed dyke cross section is shown in Figure 2.

Dyke A will be breached to restore the original channel between Area 7 and Area 8 at the end of final mine closure after the water quality in the restored Kennady Lake in Areas 2 to 7 meets discharge criteria.

2.3.2 Dyke B

Dyke B is an 850 m long, internal water retention dyke between Areas 3 and 4 that will be constructed for draining Area 4 before mining the Tuzo Pit within the Area 4 basin. Dyke B will be constructed in Year 4 and early Year 5 when up to 11 m of water will be present above the lakebed along the Dyke B centreline. The overburden thickness along the dyke centreline is expected to be in a range from 1 m to 5 m.

Overburden materials from pit development will be available for Dyke B construction; therefore, a wide till core has been selected as the main seepage control measure for Dyke B. Several other options of seepage control measures, including sheet-pile wall, slurry cut-off wall, or jet grouting through dyke till fill and overburden foundation to bedrock surface, were also considered. Preliminary seepage analyses indicated that the magnitude of the seepage rates through the dyke and its foundation for those options would be similar to that for the dyke with a wide till core. The reason for the relatively low overall effectiveness of these advanced seepage control measures is that substantial seepage though fractured bedrock is predicted for all the cases. Without applying curtain grouting through the fractured bedrock zone beneath the dyke, the benefit gained from incorporating more advanced seepage control measures into Dyke B may not justify the anticipated high incremental cost.

Based on the above, Dyke B will be designed as a wide till core dam that excludes advanced seepage control measures and bedrock curtain grouting. The proposed dyke cross section is shown in Figure 3. This dyke design will maintain the seepage rate through the dyke in a manageable range. Seepage through the dyke will be collected in the water collection pond CP6 and the sumps in Tuzo Pit. The water will be either pumped back to Area 3 or directed to the process plant as a portion of reclaim water.

Dyke B will be constructed in two stages. The Stage 1 construction will include placing the upstream mine rock berm and downstream coarse PK berm in Year 4 when the projected water elevation in Areas 3 to 5 is below 419.5 m. The two berms will provide confinement to the wide till core materials to be placed in the water between the two berms. The upstream mine rock berm will also provide protection to the till core against wave action and potential slope instability through the core. The downstream coarse PK zone will provide downstream slope stability of the till core and partially serve as a filter zone to the till and overburden.

The till core will mainly serve as a low-permeable material to control the seepage through Dyke B. The overall permeability or hydraulic conductivity will depend on the source material properties, placement method, and in-place densities. Densification of a selected critical zone of the till core may be required to achieve the design intents. Depending on the till material gradation and placement method, particle segregation may occur during till placement. Special measures, such as using long-arm conveyer instead of truck end-dumping, may be required to reduce the potential particle segregation.

The till core dumped in the water will be relatively soft until any excess porewater pressure generated in the soil mass is dissipated and the consolidated is initiated; this is estimated to take several months. Trafficability of large construction equipment over the soft till will be an issue. This can be resolved before or during the early stage of the construction by conducting some field trafficability tests using selected construction equipment. Furthermore, the two Stage 1 construction berms may be used as solid bases for till placement from both the upstream and downstream sides inwards.

Dyke B will be lowered to a maximum crest elevation of 418.0 m at early mine closure and completely submerged under water when the Kennady Lake is restored to its original lake elevation of 420.7 m during the late stage of mine closure.

2.3.3 Dykes A1, D, E, F, and G

Dykes A1, D, E, F, and G are located away from major water bodies, so permafrost is expected to exist beneath the dyke footprints. Dyke A1 is a water diversion dyke to divert runoff water from the catchment area of Area 1 and to isolate the A watershed from Area 2. Dyke D is a water retention dyke to prevent water in Area 2 from flowing north into Lake N7 during the late stage of mine operation. Dyke E serves as a water diversion dyke initially and then a water retention dyke during the late stage of mine operation. Dyke F is a water diversion dyke to prevent water from the D watershed from flowing into Area 5 during mine operation. Dyke G is a water diversion dyke to prevent water from the E watershed from flowing into Area 6 during mine operation. The design concepts for these dykes are similar. The seepage control measures adopted for these structures include a liner keyed into competent frozen ground (saturated inorganic permafrost) or bedrock. The design intent was to protect the original permafrost foundation from thawing when possible and limit the seepage through these structures and their foundations. The till fill zone upstream of the liner provides thermal protection to the key trench and limits the seepage through the dyke that could result from a damaged liner. The mine rock shell provides the necessary overall stability and also serves as thermal cover to the dyke foundation around the key trench area. Proposed conceptual design cross sections for these dykes are shown in Figures 4 through 8.

Dykes A1 and D will remain in place after mine closure. Dykes E, F, and G will be breached to restore the original natural flow regimes during mine closure.

2.3.4 Dykes H, I and J

Dykes H, I, and J are internal water retention dykes between Area 5 and Area 6 (for Dykes H and I) and between Area 4 and Area 6 (for Dyke J). Two stages of construction will be adopted to limit the construction requirements during the early Stage 1 construction in Year -2 before pit development. The cofferdams for Dykes I and J will be placed under water during the early stage of the initial lake dewatering. The fills for the remaining Stage 1 construction for the dykes will be placed in dry conditions when the water level in Area 6 is further lowered to expose the lakebeds under the dyke footprints. A wide till core has been selected as a main water control measure to limit seepage through the dykes. The Stage 2 construction of the dykes will be completed before Year 3 when sufficient till is available from pit development and the projected maximum water level in Areas 3 to 5 remains below 419.5 m. Dyke cross sections are shown in Figures 9 through 11. Seepage through the dykes will be collected and pumped back to the source reservoir as required.

Dykes H and I will remain in place after mine closure. Dyke J will be lowered to a top crest elevation of 418.0 m to limit net fish habitat losses.

2.3.5 Dykes K, M and N

Dykes K, M, and N are internal water retention dykes and will be constructed in dry conditions. A wide till core has been selected as the main seepage control measure for these dykes. Dykes K and N will be constructed in two stages to meet the design intent and lower the overall construction cost. Dyke cross sections are shown in Figures 12, 14, and 15. The Stage 1 construction of Dyke N will serve as a portion of the haul road from the 5034 Pit to the south mine rock pile and will be constructed using overburden materials from the 5034 Pit. Similarly, the Stage 1 construction of Dyke K will serve as a portion of the haul road from the Hearne Pit to the west mine rock pile and will be constructed using overburden materials from the Hearne Pit. The Stage 2 construction will be completed in early Year 6 for Dyke K and in Year 9 for Dyke N. Dyke M will be completed before the Year 3 spring freshet. Seepage through the dykes will be collected and pumped back to the source cells as required.

Dykes K and N will be lowered to a maximum crest elevation of 418.0 m at early mine closure and completely submerged under water when the Kennady Lake is restored to its original lake elevation of 420.7 m during the late stage of mine closure. Dyke M can remain in place after mine closure.

2.3.6 Dyke L

Dyke L is a 1070 m long, curved filter dyke to retain the particles in the fine PK placed in Area 2 while allowing sufficient clean water passing through the dyke from Area 2 to Area 3. The dyke is designed based on past experience gained for similar filter dykes designed and construction managed by EBA at both the EKATI Diamond Mine and Jericho Diamond Mine. The dyke cross section is shown in Figure 13. The lower portion (below an elevation of about 419.5 m) of the dyke will be placed underwater with a maximum water depth of approximately 6.5 m. The mine rock benches within both the side slopes are required for slope stability. The dyke can be constructed in two stages to reduce early construction requirements. The Stage 1 construction to a crest elevation of 421.0 m will be in Year -1 before any fine PK is placed in Area 2. The remaining construction can be completed in Year 2.

A section (100 m width) of Dyke L crest close to the northwest abutment will be lowered down to an elevation of 421.0 m to create a contingency drainage path across the dyke after mine closure. The remaining portion of Dyke L will remain in place but will not retain water.

2.3.7 Area 1 Perimeter Berms

Three low berms are required at the low saddles along the west to south perimeter of Area 1 to retain water and provide some freeboard in Lake A1. The freeboard will prevent the water in the Lake A1 from flowing into Area 3 or Area 4 under an extreme precipitation event. The berms will be 2 to 3 m in height and constructed using available till materials and mine rock. A typical cross section of the berms is shown in Figure 16.

One of the berms will be breached to allow the excess water flowing from Area 1 into Area 3 after the water quality in the restored Kennady Lake in Areas 2 to 7 meets discharge criteria.

2.3.8 Water Collection Pond Berms

Four berms for water collection ponds CP3 to CP6 are required to limit surface runoff to flow into the active pits. A typical cross section of the berms is shown in Figure 16. The berms are designed to have a liner keyed into the key trench that is backfilled with selected till fill. The liner can be placed directly over the upstream surface of the berm slope and anchored into the fill immediately below the berm crest.

The berms for water collection ponds will not be requried after the end of mine life and will be completely submerged below water after the water elevation in Areas 4 and 6 is raised to above 418.0 m during mine closure.

2.4 Dyke Stability

Limited dyke slope stability analyses were conducted for Dyke L in this study. The design side-slopes for the remaining dykes and berms in this study were determined based on the findings from the stability analyses for Dyke L along with engineering judgement from previous engineering designs in the region and the mine rock pile stability analyses summarized in Appendix C of EBA's Water and Waste Management Report (EBA 2010). The design slopes are considered to be conservative and are expected to meet the design criteria

Detailed slope stability analyses with known soil properties of both the construction materials and foundation soils will be required to finalize and optimize the dyke/berm geometries in the final stage of designs for these dykes and berms.

2.5 Thermal Considerations

Permafrost is expected to exist beneath the majority of the footprint for each of Dykes A1, D, E, F, G, and M. These dykes, except for Dyke M, have been designed as zoned earth fill dykes with a liner keyed into the expected permafrost foundation to limit the seepage through the dyke and its foundation. No thermal analyses were conducted at this stage of study. Similar dykes have been successfully designed by EBA and constructed in other northern mines including EKATI and Jericho. The thermal behaviour of the dykes for this study was assessed based on the general site conditions at the Gahcho Kué project site and the experience gained from the dyke design for other northern mines. A minimum of 4 m thermal cover over the key trench area was adopted for Dykes A1, D, E, F, and G to maintain or delay thawing of the existing permafrost beneath the key trench.

A thermal cover of 3 m over the top of slurry cut-off wall in Dyke A was adopted to limit the freeze-thaw thermal effects on the wall.

Dykes A, E, F, and G are water diversion structures to limit water flowing into the internal water management ponds in the mine site area during mine operation. Any minor seepage through these dykes would be collected in the ponds and impose no or negligible negative effects on the surrounding environment. Dyke M is an internal dyke between Area 5 and Area 4. Any minor seepage through the dyke will be pumped back to its upstream side pond. Therefore, it is preferred, but not necessary, to maintain the existing permafrost beneath these dykes as long as the seepage rates through these dykes are manageable. A greater overall water storage capacity for the water management during mine operation is required when more water seeps through the diversion dykes. These dykes will be breached during mine closure or at the end of final mine closure.

Dykes A1 and D will remain in place after mine closure. It is expected that the permafrost could be maintained in the area beneath the key trench in these dykes over the relatively short period during the mine operation and early mine closure before the water quality in Area 2 to 7 meets the discharge criteria. The liner system together with permafrost foundation beneath the key trench will effectively cut off the seepage through the dykes. After the final mine closure when the water quality in Area 2 to 7 meets the discharge criteria, minor seepage through the dyke foundations would be acceptable; therefore, the presence of permafrost in the key trench area would be preferred but no longer a requirement.

The thermal designs in this study are experience-based and considered to be reasonable for the level of the current study and are expected to meet the general design criteria. Detailed thermal analyses with known site conditions and soil properties will be required to evaluate the thermal performance of the dykes and finalize the thermal designs during the next stage of study. The thermal analyses for these dykes must consider climate change (global warming) scenarios.

3.0 CONSTRUCTION MATERIALS AND QUANTITIES

3.1 Construction Materials

Eleven types of dyke/berm construction materials are proposed in this study, including mine rock fill, transition fill, liner bedding, till fill, till filter, road surface fill, rip-rap, fine PK filter, coarse PK, slurry cut-off wall material, and geomembrane liner. The general requirements for the materials are specified below for cost estimates only for the feasibility study. The requirements for each of the materials can vary slightly for a specific dyke or berm to meet specific design intents. The material specifications for construction will be developed in the final designs of the dykes and berms during the next stage of study.

Mine rock fill, used mainly for constructing the dyke/berm shell, can be sourced from selected run-of-mine mine rock from pit development or from rockfill quarry sites when required. The fill can have a wide variation in gradation, with a maximum particle size of 800 mm. The fill particles shall be angular and shall be derived from hard, durable, non-acid generating rock. The depth and spacing of drill holes and weight and delay of charge shall be selected to produce mine rock of specified size and quality.

Transition fill will mainly serve as a separator between mine rock fill and other finer materials such as liner bedding or till fill. It may need to meet filter design criteria under some applications. It can also be used as erosion protection and rip-rap bedding. The material shall be free of roots, organics, and other deleterious material and have a particle size distribution falling within the limits presented in Table 1. Processing will be required to achieve the specified gradation. The material can be processed from hard, durable, non-acid generating mine rock.

Table 1: Transition Fill Particle Size Distribution Limits

Particle Size (mm)	% Passing
150	100
100	75 – 100
50	40 – 70
20	20 – 50
10	0 – 30
5	0 – 10

Liner bedding fill will mainly serve as beddings placed above and below a geomembrane liner to protect the liner from damage during construction and under normal loading conditions. It may also be used to key the liner into the underlying permafrost foundation and to backfill the key trench. The required gradation will depend on the type of the liner to be protected and other specific applications. For construction planning purposes, gradation limits, as presented in Table 2, have been developed for the material. The maximum size of the particles could be larger if a more puncher-resistant liner, such as a bituminous geomembrane liner, is selected. The material can be processed from hard, durable, non-acid generating mine rock. Under certain applications, selected natural till or even coarse PK may be selected as potential alternatives to the specified liner bedding fill. This cost-saving opportunity can be investigated in the final designs of the dykes and berms.

Table 2: Liner Bedding Fill Particle Size Distribution Limits

Particle Size (mm)	% Passing
20	100
12.5	65 – 100
5	45 – 70
.63	15 – 35
.08	4 – 10

Till fill represents a wide range of natural overburden materials including inorganic till and even some lakebed sediments. An effective mixture of these two soil types may also be chosen. The major application of the till fill in this study is to serve as a low-permeable general fill to reduce seepage through dykes/berms and their foundations. The material shall be free of roots, organics, and other deleterious material. The material can have a wide variation in gradation with a maximum particle size of 300 mm and a fines (less than 0.08 mm) content of 10% to 40%. Selected till fill should be used to backfill the key trench over the liner for the water collection pond berms to form a low-permeable mass without damaging the liner. The overburden soils removed from the footprints of the three pits can be used as till fill material during the dyke and berm construction

Till filter is defined as a material that mainly protects the till fill from potential erosion/instability under seepage forces and hydraulic conditions. The material shall be free of roots, organics, and other deleterious material and have a particle size distribution falling within the limits presented in Table 3. Processing will be required to achieve the specified gradation. The material can be processed from hard, durable, non-acid generating mine rock.

Table 3: Till Filter Particle Size Distribution Limits

Particle Size (mm)	% Passing
38	100
20	75 – 100
12.5	50 – 100
5	35 – 60
.63	5 – 20
.08	0 – 5

Road surface fill will be used over either till fill or crushed rock to provide a stable foundation for the site roads. The fill should meet the requirements of site road designs, which are beyond the scope of this study.

The fill may have a tentative maximum particle size of 50 mm and a fines (less than 0.08 mm) content of less than 8%. The material can be processed from hard, durable, non-acid generating mine rock.

Rip-rap shall be used as erosion protection for Dyke L. The material shall be free of roots, organics and other deleterious material and have a particle size distribution falling within the limits presented in Table 4. Processing will be required to achieve the specified gradation. The material can be processed from hard, durable, non-acid generating rock that may otherwise go to the waste material storage sites.

Table 4: Rip-Rap Particle Size Distribution Limits

Particle Size (mm)	% Passing
300	100
150	75 – 100
50	25 – 65
25	10 – 40
5	0 – 15

Fine PK filter is defined as a filter material used in Dyke L to retain the majority of the fine PK particles but to have sufficient permeability for water to pass through. The material shall be free of roots, organics, and other deleterious material and have a particle size distribution falling within the limits presented in Table 5. Processing from hard, durable, non-acid generating rock will be required to achieve the specified gradation.

Table 5: Fine PK Filter Particle Size Distribution Limits

Particle Size (mm)	% Passing
20	100
12.5	85 – 100
5	65 – 80
1.25	43 – 55
0.63	32 – 45
0.315	23 – 33
0.16	16 – 26
0.08	10 – 18

Coarse PK from the process plant is planned to be used as a construction material for the construction of Dyke B. Its gradation has not been specified at this stage. It is expected to consist of predominantly sand-sized particles. The gradation, hydraulic conductivity, and durability of coarse PK should be investigated before coarse PK is selected as dyke construction material during the final design of the dykes and berms.

Slurry cut-off wall material for Dyke A will comprise either 50 mm minus crush rockfill with 6% bentonite (by weight) or sand and gravel with 6% bentonite.

Geomembrane Liner serves as a seepage barrier for each of Dykes A1, D, E, F, G, N14, E1, N18, and four water collection pond berms in this study. Generally, three types of the geomembrane liners are commercially available for this application. They are HDPE, polypropylene or bituminous geomembrane liners; each has its advantages and disadvantages. The bituminous geomembrane liner, Coletanche ES3 for Dykes A1, D, F, and G, and Coletanche ES2 for the remaining dykes and berms with liner, are selected for cost estimating purposes at this stage of design. If HDPE or polypropylene geomembrane liner is adopted, nonwoven geotextile cushion should be applied both above and below the geomembrane liner to protect the liner from damage during construction and normal operation. The final selection of the liner type will be made during the final design stage based on final design/construction requirements, construction season, and other considerations.

3.2 Construction Quantities

Tables 6 to 10 summarize the estimated material quantities for construction of dykes and berms for water and waste management. The material quantities are "in-place" and do not include material waste, bulking factors, liner seaming allowance, and contingencies. Seaming allowance and contingencies must be added to liner quantities to account for overlap, damaged sections, and/or waste during construction. Bulking factors and contingencies must be added to fill quantities. The volume of key trench excavation has been calculated assuming a trench depth of 2 m. The depth and volume of key trench excavation depend on the actual site conditions encountered.

Table 6: Construction Material Quantities for Dykes A, B, and L

Item	Unit	Dyke A	Dyke B		Dyke L	
			Stage 1 Construction	Stage 2 Construction	Stage 1 Construction	Stage 2 Construction
Mine Rock Fill	m^3	22,600	157,700	23,200	151,500	36,600
Transition Fill	m^3	N/A	N/A	18,400	19,800	9,900
Till Fill	m^3	2,500	N/A	835,400	N/A	N/A
Till Filter	m^3	1,300	N/A	18,400	N/A	N/A
Road Surface Fill	m^3	4,100	N/A	N/A	N/A	N/A
Rip Rap	m^3	N/A	N/A	7,200	12,200	8,800
Fine PK Filter	m^3	N/A	N/A	N/A	19,800	9,900
Coarse PK	m^3	N/A	133,500	50,200	N/A	N/A
Slurry Cut-off Wall Excavation	m^3	700	N/A	N/A	N/A	N/A
Slurry Cut-off Wall Backfill	m^3	700	N/A	N/A	N/A	N/A
Total Fill Volume	m^3	31,200	291,200	952,800	203,300	65,200

Table 7 Construction Material Quantities for Dykes A1, D, E, F, and G

Item	Unit	Dyke A1	Dyke D	Dyke E	Dyke F	Dyke G
Mine Rock Fill	m^3	19,000	7,200	18,800	11,300	17,100
Transition Fill	m^3	N/A	N/A	N/A	4,100	3,200
Liner Bedding	m^3	12,400	4,800	4,500	4,600	3,800
Till Fill	m^3	37,700	11,900	12,300	6,000	2,700
Till Filter	m^3	3,400	1,200	700	1,000	1,000
Road Surface Fill	m^3	4,200	2,300	2,700	1,300	3,000
Trench Excavation	m^3	14,000	5,900	4,200	4,600	5,900
Geomembrane Liner	m^2	16,400	5,300	4,100	4,400	4,100
Total Fill Volume	m^3	76,700	27,400	39,000	28,300	30,800

Table 8: Construction Material Quantities for Dykes H, I, J, K, M and N

Dyke	Construction Stage	Dyke Construction Material Volume (m^3)					
		Mine Rock Fill	Transition Fill	Till Fill	Till Filter	Road Surface Fill	Total Fill Volume
Dyke H	Stage 1	400	N/A	900	N/A	N/A	1,300
	Stage 2	4,400	N/A	13,900	900	2,600	21,800
Dyke I	Stage 1	1,700	1,500	19,200	500	N/A	22,900
	Stage 2	8,600	1,100	47,500	3,500	12,100	72,800
Dyke J	Stage 1	500	300	2,400	N/A	N/A	3,200
	Stage 2	1,300	N/A	5,000	400	1,200	7,900
Dyke K	Stage 1	N/A	N/A	75,900	N/A	10,100	86,000
	Stage 2	15,600	800	35,700	4,700	N/A	56,800
Dyke M	One stage	3,400	N/A	6,500	100	3,100	13,100
Dyke N	Stage 1	N/A	N/A	112,500	N/A	6,800	119,300
	Stage 2	23,400	900	57,700	6,400	N/A	88,400

Table 9: Construction Material Quantities for Water Collection Pond Berms for CP3 to CP 6

Item	Unit	Water Collection Pond Berm			
		CP3	CP4	CP5	CP6
Mine Rock Fill	m^3	5,400	500	3,000	8,500
Transition Fill	m^3	700	N/A	500	1,300
Liner Bedding Fill	m^3	1,800	300	800	2,000
Till Fill	m^3	3,800	700	1,300	3,500
Till Filter	m^3	500	100	200	600
Key Trench Excavation	m^3	4,600	900	1,400	3,800
Geomembrane Liner	m^2	4,100	600	1,400	3,600
Total Fill Volume	m^3	12,200	1,600	5,800	15,900

Table 10: Construction Material Quantities for Area 1 Perimeter Berms

Fine PK Management Berm	Berm Construction Material Volume (m^3)		
	Berm 1	Berm 2	Berm 3
Mine Rock Fill	2,300	1,100	1,900
Till Fill	7,500	4,000	6,500
Key Trench Excavation	2,500	1,500	2,400
Total Fill Volume	9,800	5,100	8,400

3.3 Construction Schedule

Table 11 presents the overall construction schedules for the dykes and berms required for the water and waste management.

Table 11 Summary of Dyke/Berm for Gahcho Kue Project, NWT

Name	Dyke/Berm Type	Approximate Construction Year	Maximum Design Operating Water Head at Dyke/Berm Centreline (m)	Total Length of Dyke/Berm (m)
Dyke A	Water retention /diversion dyke	Early Year -2 (before start of initial lake dewatering)	2.0	480
Dyke B	Internal water retention dyke	Year 4 to early Year 5	11.5	930
Dyke A1	Diversion/water retention dyke	Before Year -1 spring freshet	4.0	670
Dyke D	Water retention dyke	Before Year 2 spring freshet	2.0	240
Dyke E	Diversion dyke/water retention	Before Year 1 spring freshet	1.3	370
Dyke F	Diversion dyke	Before Year -1 spring freshet	3.0	290
Dyke G	Diversion dyke	Before Year -1 spring freshet	1.0	390
Dyke H	Internal water retention dyke	Stage 1 Construction in Year -2 ; full dyke (Stage 2) before Year 3	2.5	280
Dyke I	Internal water retention dyke	Stage 1 Construction in Year -2; full dyke (Stage 2) before Year 3	4.5	410
Dyke J	Internal water retention dyke	Stage 1 Construction in Year -2; full dyke (Stage 2) before Year 3	2.7	135
Dyke K	Internal water retention dyke	Stage 1 (haul road) construction in Year -1; full dyke (Stage 2) in Year 5 to early Year 6 (before Year 6 spring freshet)	7.7	340

Table 11 Summary of Dyke/Berm for Gahcho Kue Project, NWT

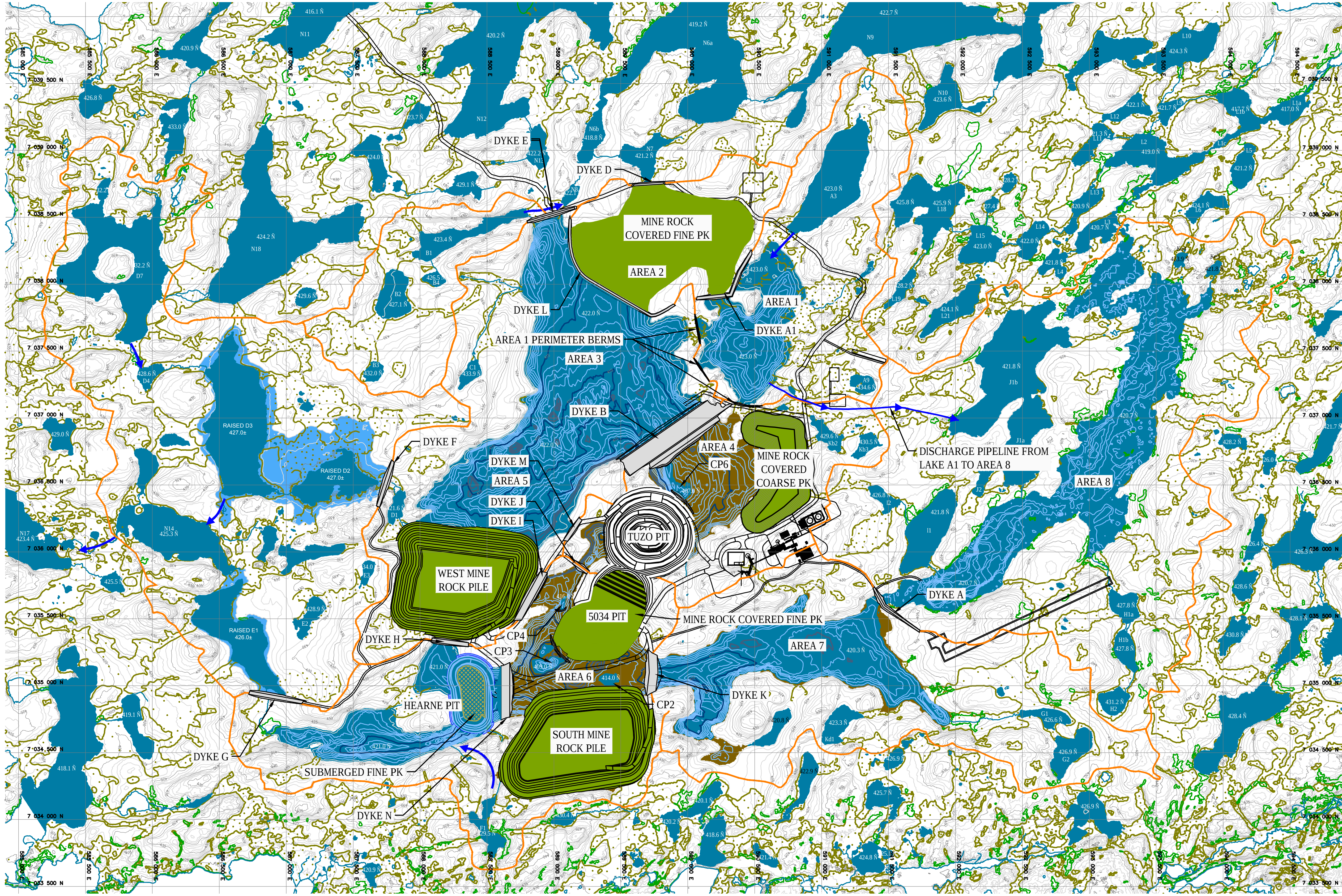
Name	Dyke/Berm Type	Approximate Construction Year	Maximum Design Operating Water Head at Dyke/Berm Centreline (m)	Total Length of Dyke/Berm (m)
Dyke L	Internal filter dyke	Stage 1 in Year -1 (before placing fine PK in Area 2) and full dyke (Stage 2) in Year 2	1.0	1065
Dyke M	Internal water retention dyke	Before Year 3 spring freshet	1.5	215
Dyke N	Internal water retention dyke	Stage 1 (haul road) construction in Year 4; full dyke (Stage 2) in Year 9	8.3	410
Area 1 Perimeter Berms	Internal water diversion berms	Year -1 or Early Year 1	1.0	680
Berms for Water Collection Ponds	Internal water retention berm	Road berm for CP2 in Year -1); berms for CP3 to CP5 in Year -1 and berm for CP6 in Year 5	3.0	1120

REFERENCES

CDA 2007. Dam Safety Guidelines. Canadian Dam Association, 2007, p.82.

EBA 2011. Summary of Dyke Design and Construction Material for Gahcho Kue Diamond Project, NWT, Canada. Technical memo submitted to De Beers Canada Lid. By EBA Engineering Consultants Ltd., December 13, 2011.

FIGURES



LEGEND:

EXISTING GROUND CONTOURS 5 m INDEX - 1 m INTERMEDIATE	MARSH AREA	LAKE/POND
BATHYMETRY CONTOURS 5 m INDEX - 1 m INTERMEDIATE	SCRUB	DRAINED AREA
	CATCHMENT BOUNDARY	MINE ROCK
	DRAINAGE FLOW DIRECTION	

0 — 1 000 m

Scale: 1: 30 000

NOTES
- ZONE 12, UTM NAD83 PROJECTION CENTRED ON 111°

STATUS
ISSUED FOR USE

CLIENT

DE BEERS CANADA

MOUNTAIN PROVINCE DIAMONDS INC.

JDS Energy & Mining Inc.

eba A TETRA TECH COMPANY

2012 GAHCHO KUƐ EIS SUPPLEMENT
NWT, CANADA

GENERAL LAYOUT OF SITE PLAN DURING MINE OPERATION

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 1

Q:\Edmonton\Drafting\CIVIL3D\E141\E14101143\Production Drawing\Updated Dyke Design Memo March 2012\E14101143_FIG 1_R1.dwg [FIGURE 1] March 26, 2012 - 4:31:10 pm (BY: GAMMIE, DON)