2. キューバ側本プロジェクト参加者一覧

1-1	1-2	1-3	2	3	4	Nombre	Institución	Cargo	Email
						INRH			
						Abel Salas Garcia	Vicepresidenta		
						Rosemiare Ricardo Batista	Director de Relaciones Internacionales y Colaboración		
						Miriam Valdés Pérez	Jefa de Despacho		
						Ana Lydia Hernández González	Directora de Gestión, Innovación y Tecnología		
						Yenisett Figueredo Chávez	Experto Coordinador en Cooperación		
						GEIPI			
						Bernardo Rodríguez Fernández	Directora General		
						Sebastian Crespo Delgado	Director de Gestión de Sistemas		
				●		Arturo González Báez	Especialista Principal		
						Ernesto Abreu Castillo	Director de Logistica y Administración		
	○					Hildelisa Jiménez Ponce	Especialista Superior Investigaciones y Proyectos		
			○			Lemuel Ramos	CIH		
			○			Odet C. Herrera Betancourt	Especialista		
						EIPH-Havana			
						Aímeé Aguirre Hernándrz	Directora General		
						José A. Dequero	antecesor (Director General)		
						Julio César Martínez	antecesor (Director Técnico)		
						Annia Morales Hondal	Directora de Investigaciones Aplicadas		
○				◎		Rafael Feito Olivera	Especialista Hidrogeólogo		
○						Néstor Piñero	Especialista Geofísico		
●		○		○		Ernesto Flores Valdés	Especialista Hidrogeólogo		
○						Andrés Portal Casanova	Especialista Geológico		
		○				Orlando R Laiz Aberoff	Especialista Superior, Medio Ambiente y Ecología Acuática		
			○	○	○	Lourdes Valdés González	Especialista Hidrogeólogo		
○			○		○	Amadelis Quesada Torres	Especialista		
○						Cesar Bujan Rubio	Especialista		
		●		○		Pedro Luis García	Especialista		
		○				Luis Ernesto Batista	Especialista		
	○					Adrián A. Lugo	Especialista		
	○					Laritza Socorro	Especialista		
				○		Isabel Pineiro Alfonso	Especialista		
				○		Juan Alberto Hernandez	Especialista		
						GEARH			
						Rigoberto Morales Palacios	Director General		
				○	○	Fermín E. Sarduy	antecesor (Director General)		
						Lázaro González Martínez	Director Técnico		
	●		●		●	Ibrahim Plaza	Especialista Hidrogeólogo		
						Lázaro González Martiñez	Director de Ingenieía		
						Luduy García Cartaya	Especialista de Ingeniería		
						Yanira González Cobas	Especialista de Ingeniería		
						Germán Melián Garcia	Especialista Principal Aprovechamiento Hidráulico		
						Yanisy D´rouville	Especialista Aprovechamiento Hidráulico		
○						Francis F. Rguez. Rguez	Especialista		
				○		Juan Hernández Sierra	Especialista		
						EAH-Mayabeque			
						Isvel Fernández	Director General		
						Daniel Amaury Romero	Directora Técnica		
			○		○	Dulce Mariá Rodrigez	Especialista Superior		
						Pedro García Rdguez	Director de Servivciós Técnicos		
	○	○	○	○	○	Humberto García	Especialista		
						EAH-Artemisa			
						Ludvi Garcia Cartaya	Directora OEB		
						Carlos Manuel Antela Acosta	Director Técnico		
	○	○		○	○	Ernesto Morales Chirino	Especialista Hidrologiá		
						Roberto Valdés Ulloa	Especialista		
						Carlos M. Moro Chirino	Especialista		
						EIPH y EIPH			
		○				Arturo Lorenzo Ferras	EIPI-Matanzas		
			○			Alberto Cuellar Valenzuela	EIPI-Matanzas		
			○			Luis Fidel Miranda	EIPH-Ciegode Ávila		
				○		Maricela Martínez Gracia	EIPH-Camagüey		
				○		Adán Echeme	EIPH-Camagüey		
					○	Manuel Burgos	EIPH-Villa Clara		
						EAH			
○		○	○		○	Ramón Yosvani Batista	EAH-Granma		
		○	○			Celia yaima Batista	EAH-Holguín		
			○			Rafael González Abreu	EAH-Ciegode Ávila		
			○		○	Gabriel Alfonso	EAH-Pinar del Río		
					○	Marta Suarez Acuña	EAH-Camagüey		
						MINCEX			
						Ivón Martinez Genis	Funcionaria		
						Provincia Mayabeque			
						Argelio González	Director, Colaboración		
						Ada Mariá Brito Ruiz	Directora		
						Yanesi Rodríguez	Directora, DPRHM		
						Modesto Cárdenas Pujol	Especialista Asesor, DRRHM		
						Provincia Artemisa			
						Jorge Orama	Jefe de Colaboración, OLPP Artemisa		
						Alexander Abreú Ortega	Director de Recursos Hidraúlicos, OLPP Artemisa		

1-1: Sub-Grupo del Hidrogeología / Hidrología
1-2: Sub-Grupo Observación del Agua Subterránea
1-3: Sub-Grupo SIG/DB
2: Grupo Modelación Agua Subterránea
3: Grupo Tec. Recharga Intrusión Salina
4: Grupo Manejo Acifero

● Lider del Grupo o Lider del Sub-Grupo
◎ Sub-lider
○ Miembro

3. 活動進捗状況評価結果

専門家チームによる各活動の進捗評価

	配点	第 1 年次 終了時点	第 2 年次 終了時点	第 3 年次 終了時点	第 4 年次 終了時点
成果 1:対象地域の帯水層のモニタリングが適切に実施される					
活動 1-1:地下水モニタリンググループを組織し、技術力を診断する					
技術力評価(第 1 年次:プロジェクト開始時)	70	70	70	70	70
技術力再評価(第 2 年次終了時)	10	－	10	10	10
技術力再評価(第 3 年次終了時)	10	－	－	10	10
技術力再評価(第 4 年次終了時)	10	－	－	－	10
	100	**70**	**80**	**90**	**100**
活動 1-2:観測所整備のベースとなる水理地質調査･物理探査･水文調査を実施する。					
水理地質解析	40	15	30	30	40
物理調査(電気探査)	10	0	5	5	10
物理調査(物理検層)	10	0	5	5	10
水質調査	30	5	25	27.5	30
気象･表流水調査	10	0	5	5	10
	100	**20**	**70**	**72.5**	**100**
活動 1-3:既存観測井に観測機器を設置する					
既存 7 井への自記水位計の設置	70	0	70	70	70
観測記録の回収･整理(第 2 年次終了時)	10	－	10	10	10
観測記録の回収･整理(第 3 年次終了時)	10	－	－	7	10
観測記録の回収･整理(第 4 年次終了時)	10	－	－	－	10
	100	**0**	**80**	**87**	**100**
活動 1-4:試掘井戸の掘削、孔内検層、揚水試験、観測機器の設置を行なう					
試掘井戸仕様の決定	10	0	10	10	10
No.1 井完成(掘削、孔内検層、揚水試験、機器設置、総合柱状図)	25	0	0	12.5	25
No.2 井完成(掘削、孔内検層、揚水試験、機器設置、総合柱状図)	25	0	0	15	25
No.3 井完成(掘削、孔内検層、揚水試験、機器設置、総合柱状図)	25	0	0	10	25
観測記録の回収･整理(第 2 年次終了時)	5	－	0	0	5
観測記録の回収･整理(第 3 年次終了時)	5	－	－	0	5
観測記録の回収･整理(第 4 年次終了時)	5	－	－	－	5
	100	**0**	**10**	**47.5**	**100**
活動 1-5:観測網を構築する					
既存データ(地下水位･地下水質)の収集･整理	30	5	20	25	30
新規観測地点の選定	40	0	0	0	40
観測体制の確立	30	0	0	0	30
	100	**5**	**20**	**25**	**100**

活動 1-6:GIS/DB を構築し、収集･整理されたデータを管理･更新する					
GIS 研修の実施	10	4	8	8	10
DB 研修の実施	10	0	2	8	10
GIS/DB の構築	20	0	10	17.5	20
既存データの収集･管理	30	10	25	25	30
新規データの収集･管理	15	0	5	12.5	15
データの管理体制の確立	15	0	0	7.5	15
	100	**14**	**50**	**78.5**	**100**
成果 2:対象地域の地下水モデルが構築される					
活動 2-1:地下水モデル構築グループを組織し、技術力を診断する					
技術力評価（第 1 年次:プロジェクト開始時）	70	70	70	70	70
技術力再評価（第 2 年次終了時）	10	－	10	10	10
技術力再評価（第 3 年次終了時）	10	－	－	10	10
技術力再評価（第 4 年次終了時）	10	－	－	－	10
	100	**70**	**80**	**90**	**100**
活動 2-2:水収支及び地下水涵養量解析のための各種要因を分析する					
気象データ収集･整理･解析	10	2	5	6.5	10
地下水位データ収集･整理･解析	10	3	5	6.5	10
表流水データ収集･整理･･解析	10	0	0	5	10
揚水量データ収集･整理･解析	10	0	0	8	10
水収支解析	60	0	0	20	60
	100	**5**	**10**	**46**	**100**
活動 2-3:地下水モデル/塩水侵入モデルを構築する					
V2D 簡易モデルの構築	20	20	20	20	20
V2D 詳細モデルの構築	20	0	0	10	20
3D 簡易モデルの構築	20	0	20	20	20
3D 詳細モデルの構築	40	0	20	35	40
	100	**20**	**60**	**85**	**100**
活動 2-4:新たな地下水観測データや水理地質データに基づきモデルの補正･更新を行なう					
V2D 詳細モデルの補正･更新	20	0	0	5	20
3D 詳細モデルの補正･更新（第 3 年次）	20	－	－	5	20
3D 詳細モデルの補正･更新（第 4 年次）	20	－	－	－	20
3D 緻密モデルの構築	20	0	0	5	20
3D 緻密モデルの補正･更新	20	0	0	0	20
	100	**0**	**0**	**15**	**100**
活動 2-5:地下水流動メカニズム及び塩水侵入の予測解析を行なう					
V2D 簡易モデルによる予備予測解析	10	10	10	10	10

予測解析用シナリオ作成	30	0	0	2.5	30
V2D 詳細モデルによる予測解析	20	0	0	0	20
3D 詳細モデルによる予測解析	20	0	0	0	20
3D 緻密モデルによる予測解析	20	0	0	0	20
	100	**10**	**10**	**12.5**	**100**
成果 3:地下水涵養、塩水侵入対策の観点から各種技術が研究される					
活動 3-1:地下水涵養、塩水侵入対策技術グループを組織する					
技術力評価（第 1 年次:プロジェクト開始時）	70	70	70	70	70
技術力再評価（第 2 年次終了時）	10	－	10	10	10
技術力再評価（第 3 年次終了時）	10	－	－	10	10
技術力再評価（第 4 年次終了時）	10	－	－	－	10
	100	**70**	**80**	**90**	**100**
活動 3-2:世界各地の事例研究を行なう					
地下水涵養事例の研修	20	10	20	20	20
地下水涵養テキスト（初版）作成	10	5	10	10	10
地下水涵養テキストの改訂	10	0	0	5	10
塩水侵入対策工事例の研修	30	10	30	30	30
塩水侵入対策工テキスト（初版）作成	20	5	20	20	20
塩水侵入対策工テキストの改訂	10	0	0	10	10
	100	**30**	**80**	**95**	**100**
活動 3-3:対象地の自然条件、社会条件、政治及び経済条件を考慮した最適な工法の検討を行なう					
自然条件を考慮した工法の検討	30	0	10	15	30
社会条件、政治及び経済条件の整理	20	0	0	10	20
最適工法（地下水涵養）の検討	25	0	0	5	25
最適工法（塩水侵入対策工）の検討	25	0	0	20	25
	100	**0**	**10**	**50**	**100**
成果 4:実施要領（ガイドライン及びマニュアル）に沿って、対象地域の地下水管理計画の運用が試験的に開始される					
活動 4-1:帯水層管理グループを組織し、技術力を診断する					
技術力評価（第 1 年次:プロジェクト開始時）	70	70	70	70	70
技術力再評価（第 2 年次終了時）	10	－	10	10	10
技術力再評価（第 3 年次終了時）	10	－	－	10	10
技術力再評価（第 4 年次終了時）	10	－	－	－	10
	100	**70**	**80**	**90**	**100**
活動 4-2:地下水モデル、塩水侵入モデルのシミュレーション結果を検証する					
3D 詳細モデルの検証	50	0	0	5	50
V2D 詳細モデルの検証	25	0	0	0	25
3D 緻密モデルの検証	25	0	0	0	25

	100	**0**	**0**	**5**	**100**
活動 4-3:許容しうる帯水層の基準状態を設定する					
指標井戸の選定	20	0	0	5	20
地下水位基準の設定	40	0	0	5	40
地下水質基準の設定	40	0	0	10	40
	100	**0**	**0**	**20**	**100**
活動 4-4:毎年キャリブレーションされる新しい地下水モデルの解析結果に基づき、個々の生産井の年間揚水計画を策定する					
基本シナリオによる揚水計画策定	10	0	0	0	10
地下水涵養量変動シナリオによる揚水計画策定	10	0	0	0	10
地下水利用量変動シナリオによる揚水計画策定	10	0	0	0	10
気象変動シナリオによる揚水計画策定	10	0	0	0	10
対策シナリオによる揚水計画策定	10	0	0	0	10
基本シナリオによる揚水計画改訂	10	0	0	0	10
地下水涵養量変動シナリオによる揚水計画改訂	10	0	0	0	10
地下水利用量変動シナリオによる揚水計画改訂	10	0	0	0	10
気象変動シナリオによる揚水計画改訂	10	0	0	0	10
対策シナリオによる揚水計画改訂	10	0	0	0	10
	100	**0**	**0**	**0**	**100**
活動 4-5;地下水管理計画及びその実施要領(ガイドライン、マニュアル)を策定する					
地下水管理計画目次(案)の作成	10	0	0	10	10
地下水管理計画(案)の策定	20	0	0	5	20
地下水管理計画(案)の改訂	20	0	0	0	20
地下水管理計画の発行	10	0	0	0	10
実施要領構成(案)の作成	10	0	0	0	10
実施要領の作成	20	0	0	0	20
実施要領の発行	10	0	0	0	10
	100	**0**	**0**	**15**	**100**
活動 4-6:地下水涵養工、塩水侵入対策工の実施計画を策定する					
短期計画の策定	40	0	0	0	40
中期計画の策定	30	0	0	0	30
長期計画の策定	30	0	0	0	30
	100	**0**	**0**	**0**	**100**
活動 4-7:気象変動、地下水涵養工事、塩水侵入対策工事の効果等を踏まえた長期の地下水管理計画を策定する					
長期地下水管理計画用シナリオの作成	20	0	0	0	20
長期地下水管理計画目次(案)作成	20	0	0	0	20
長期地下水管理計画の提示	60	0	0	0	60
	100	**0**	**0**	**0**	**100**

活動 4-8:地下水管理計画の運用に係る技術セミナーを開催する					
第 3 年次セミナーの開催	50	－	－	50	50
第 4 年次セミナーの開催	50	－	－	－	50
	100	**0**	**0**	**50**	**100**

4. ニュースレター（第 1 号～第 8 号）

Boletín Informativo Nº 1 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

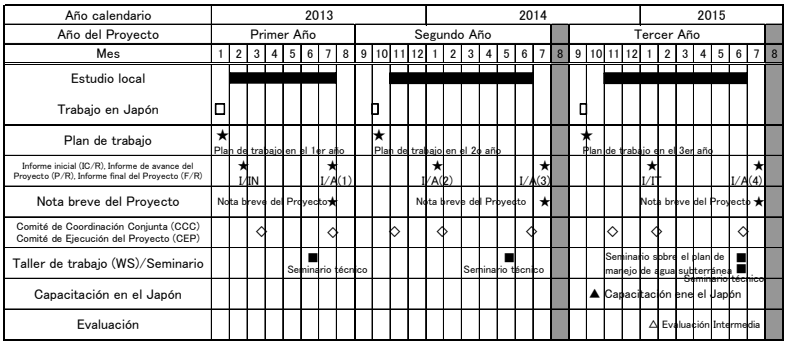
Arranque del Proyecto

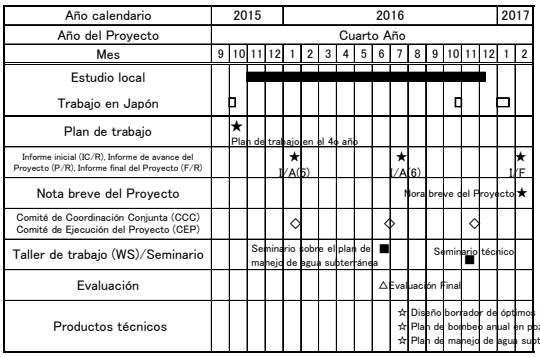
Este Proyecto es el resultado de un Acuerdo de fecha 28 de septiembre de 2012 firmado entre la República de Cuba y la Agencia de Cooperación Internacional del Japón (JICA), y se ejecutará en base al Registro de Discusiones (R/D) del Proyecto de Cooperación Técnica del citado Acuerdo.
Las actividades en Cuba de acuerdo al R/D se han programado entre enero de 2013 y diciembre de 2016 con el objetivo de contribuir al mejoramiento de la capacidad de desarrollo y manejo del agua subterránea, incluyendo medidas contra la intrusión salina, además del manejo adecuado del agua subterránea frente al elevamiento del nivel del mar resultante del cambio climático en una parte de la costa sur de las Provincias de Mayabeque y de Artemisa.

Grupo de expertos

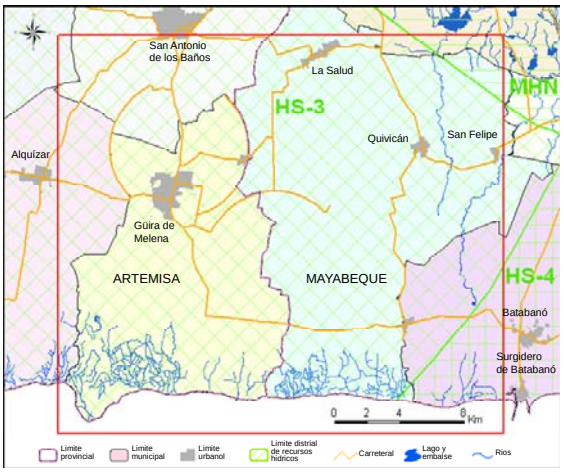
La Parte Japonesa (Grupo de Expertos) la conforman los 9 siguientes expertos.

- Shigeki Kihara (Líder/Gestión de Agua Subterránea)
- Hirokatsu Utagawa (Sub-líder/Calidad de Agua)
- Lei Peifeng (Modelo de Agua Subterránea 1)
- Naoaki Shibasaki (Modelo de Agua Subterránea 2)
- Kiyoshi Yamada (Hidrogeología)
- Tsugio Ishikawa (Prospección Geofísica)
- Masahiko Ikemoto (SIG/Base de Datos)
- Hiroshi Fujita (Diseño/Intrusión Salina)
- Masaru Obara (Programa de Capacitación/Coordinación)





Cronograma del Proyecto



Area del Proyecto

Antecedentes del Proyecto

En la zona costera de las Provincias de Mayabeque y Artemisa, al Suroeste de la Ciudad de La Habana, existe una zona que se conoce como Cuenca Sur, que abarca unos 300km^2 y constituye una importante fuente de agua que aporta el 17.3% del agua de abastecimiento a La Habana, además de satisfacer las necesidades agrícolas, industriales y de agua potable en las dos Provincias mencionadas.
Por otra parte, estudios del Gobierno de Cuba informan que en la Cuenca Sur se observan la disminución de lluvias y el aumento del nivel del mar como efectos del cambio climático, causando ambos el avance de la intrusión salina. En estas condiciones, el Proyecto busca investigar los efectos de la intrusión salina en los acuíferos, utilizando los modelos de agua subterránea para replicar la salinización existente y para estimar los efectos futuros, y para diseñar las contramedidas efectivas, en forma conjunta entre la Parte Cubana y la Parte Japonesa, con el fin de determinar los métodos sustentables de desarrollo y conservación del agua subterránea.

＜Objetivo y resultados del Proyecto＞

(1) Meta superior

Se manejará adecuadamente el agua subterránea en el área seleccionada de la Costera Sur de las Provincias Mayabeque y Artemisa, tomando en cuenta las influencias del cambio climático.

(2) Objetivo del Proyecto

Se mejoran las capacidades de las instituciones que participan en el Proyecto en la prospección y manejo del agua subterránea en el área objetivo incluyendo el control de la intrusión salina.

(3) Resultados esperados

Resultado 1.

- Se lleva a cabo adecuadamente el monitoreo de los acuíferos en el área objetivo.

Resultado 2.

- Se elaboran los modelos del agua subterránea en el área objetivo.

Resultado 3.

- Se llevan a cabo estudios de diferentes técnicas de recarga de acuíferos y control de intrusión salina.

Resultado 4.

- Se inicia la implementación experimental del plan de manejo de las aguas subterráneas de acuerdo con los lineamientos y manuales de operación en el área objetivo.

＜Entidades concernientes＞

(1) Entidad responsable

- Instituto Nacional de Recursos Hidráulicos (INRH)

(2) Instituciones ejecutoras

- Grupo Empresarial de Investigaciones, Proyectos e Ingeniería (GEIPI)
- Empresa de Investigaciones, Proyectos Hidráulicos La Habana (EIPH-La Habana)
- Grupo Empresarial de Aprovechamiento de Recursos Hidráulicos (GEARH)
- Empresa de Aprovechamiento Hidráulico de Mayabeque (EAH-Mayabeque)
- Empresa de Aprovechamiento Hidráulico de Artemisa (EAH-Artemisa)

＜Organización Cubana para Ejecución＞

(1) Director del Proyecto

- Ing. Aimeé Aguire Hernández
  (Vicepresidenta, INRH)

(2) Gerente del Proyecto

- Ing. Miriam Valdés Pérez
  (Directora General,GEIPI)

(3) Gerente Adjunto del Proyecto

- Ing. Fermin Sarduy Quintanilla
  (Director General, GEARH)

(4) Administrador Principal

- Ing. Ana Lydia Hernández González
  (Directora Técnica, GEIPI)

(5) Administrador Adjunto

- Ing. Ibrahim Plaza Peñalver
  (Ingeniero Principal Hidrogeólogo, GEARH)

(6) Resultado 1: Líder del Grupo de Monitoreo delAgua Subterránea

1) Líder del Sub-Grupo de Hidrología / Hidrogeología

- Ing. Ernesto Flores Valdés
  (Especialista Hidrogeólogo, EIPH-La Habana)

2) Líder del Sub-Grupo de Monitoreo del Agua Subterránea

- Ing. Ibrahim Plaza Peñalver
  (Ingeniero Principal Hidrogeólogo, GEARH)

3) Líder del Sub-Grupo de SIG/BD

- Ing. Pedro Luis García
  (Especialista, EIPH-La Habana)

(7) Resultado 2:Líder del Grupo de Modelación del Agua Subterránea

- Ing. Ibrahim Plaza Peñalver
  (Ingeniero Principal Hidrogeólogo, GEARH)

(8) Resultado 3:Líder del Grupo de Tecnología de Recarga y Control de la Intrusión Salina

- Ing. Arturo González Báez
  (Especialista Principal, GEIPI)

1) Sub-líder

- Ing. Rafael Feito Olivera
  (Especialista Hidrogeólogo, EIPH-La Habana)

(9) Resultado 4: Líder del Grupo de Manejo del Acuífero

- Ing. Ibrahim Plaza Peñalver
  (Ingeniero Principal Hidrogeólogo, GEARH)

Calendario

2013/2/6
Explicación y discusiones sobre el Informe Inicial

2013/2/18
Resultado 1: Inicio de las actividades del Grupo Hidrología / Hidrogeología, y del Sub-Grupo de Monitoreo del Agua Subterránea

2013/2/26-27
Capacitación básica sobre Modelos de Agua Subterránea en EIPH-La Habana

2013/3/4
Resultado 1：Inicio de actividades del Grupo SIG/BD.

2013/3/5
Resultado 3: Inicio de actividades del Grupo de Tecnología de Recarga y Control de la Intrusión Salina

2013/3/12
Resultado 4: Inicio de actividades del Grupo de Manejo del Acuífero

2013/3/19
Comité de Ejecución del Proyecto (CEP)

2013/3/20
Resultado 2: Inicio de actividades del Grupo de Modelación del Agua Subterránea

1ra. reunión del CEP (PEC)

1ra. reunión del Sub-Grupo Hidrología/Hidrogeología,y del Grupo de Tecnología de Recarga

Capacitación básica en Modelo de Agua

Publicación:
Grupo de Experto del Proyecto Agua subterránea de JICA
Centro de Negocios Miramer Edif. Jerusalén, Oficina 408 A
Ave. 3ra esq. A 80, Miramar, Playa, Ciudad de La Habana, Cuba
Tel: (53 7) 2045040

Boletín Informativo Nº 2 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

Seminario Técnico 1er Año

El Seminario Técnico 2013 se llevó a cabo el 20 de junio de 2013. En el Seminario, los expertos de Japón y Cuba presentaron sus Planes de Operaciones, el análisis y monitoreo de la intrusión salina, recarga artificial del agua subterránea y Dique Sur, y el análisis de cavernas y prospección geofísica en el área costera.

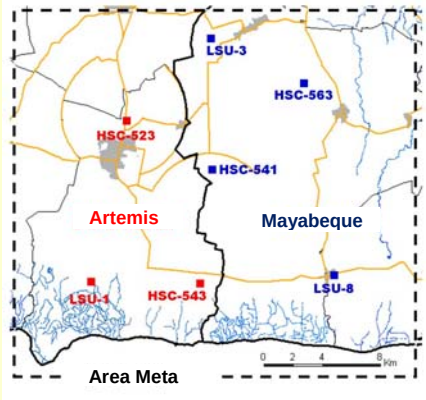
<Lugar>
- Hotel Chateau Miramar en La Habana

<Participantes>
- 31 ingenieros de GEIPI, EIPH y EIPI
- 15 ingenieros de GEARH y EAH
- 2 ingenierose de INRH
- 1 ingeniero de CITMA
- 2 profesores de CUJAE
- 7 expertos JICA
- Embajada de Japón: 1 persona
- JICA Cuba: 1 persona
- Otros: 11 personas

Plan de Monitoreo (Selección de pozos donde instalar los medidores automáticos del nivel de aguas)

El Grupo de Monitoreo del Agua Subterránea tuvo una reunión el 8 de Julio de 2013 para seleccionar los 7 pozos en donde se instalarán los medidores automáticos del nivel de aguas.

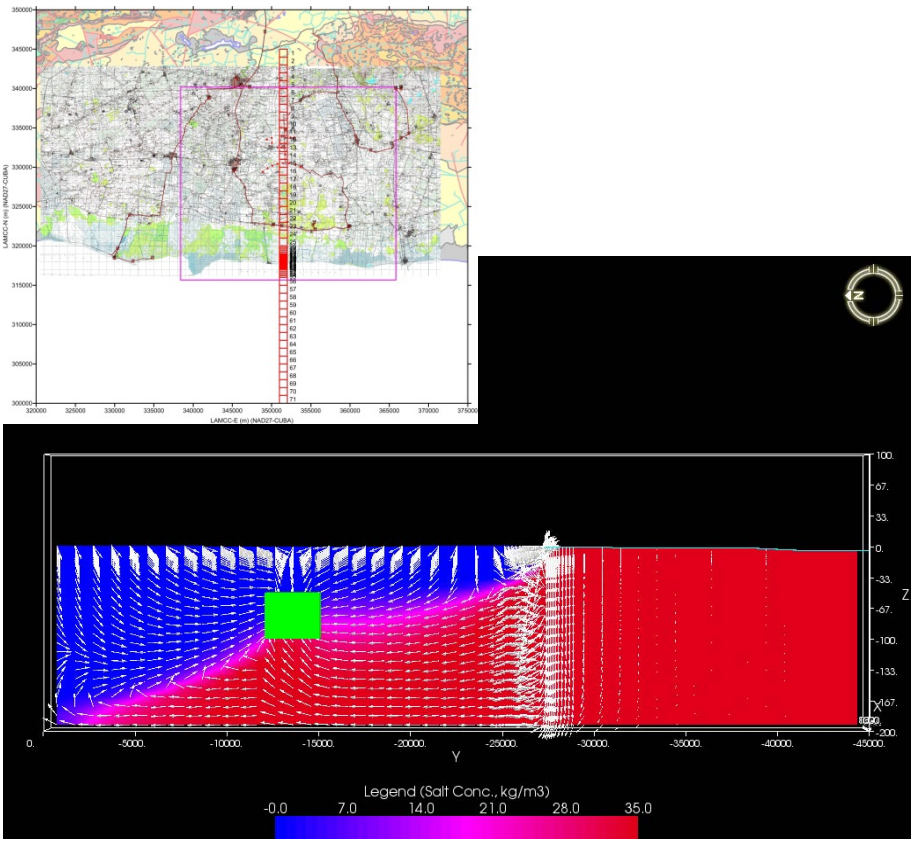
<Participantes>
- Experto JICA: Kiyoshi Yamada, Hirokatsu Utagawa
- Parte Cubana: Ibrahim Plaza Peñalver (GEARH), Dulce María Rodríguez, Pedro L. Hernández, Humberto García (EAH- Mayabeque), Carlos M. Antella, Ernesto Morales Chirino, Héctor Medina Alfonso (EAH- Artemisa), Ernesto Flores Valdés, Lourdes Valdés González(EIPH-La Habana)



Prospección Geofísica

Se comenzó con la prospección geofísica el 15 de Julio de 2013 a cargo de los expertos de EIPH-La Habana y JICA con el fin de investigar la estrucutra hidrogeológica detallada.

Una contribución importante en esta investigación será la experiencia adquirida en el Proyecto Camagüey ejecutado entre 2008 y 2012.



Calendario

2013/4/1
Resultado 3：Taller sobre método de control de la intrusion salina ②

2013/4/30
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ①

2013/5/7
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ②

2013/5/9
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ③

2013/6/25
Resultado 2：Taller sobre modelación del agua subterránea (Modelo V2D)

2013/7/8
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ④

2013/7/15-23
Resultado 1：Capacitación en uso del software de SIG “Cadcorp SIS”

2013/7/17
Resultado 3：Taller sobre recarga artificial ②

2013/7/19
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑤

2013/7/23
Comité de Ejecución del Proyecto (PEC ＝ CEP)

Taller de Modelación del Agua Subterránea por Dr. Shibasaki, Experto JICA

El modelo de agua subterránea es una herramienta importante y muy útil para el apropiado manejo del agua subterránea.

El Grupo de Modelación del Agua Subterránea tuvo el taller sobre Modelos de Agua Subterránea el 25 de junio de 2013.

En este taller, el Dr. Shibasaki presentó explicaciones sobre el modelo bidimensional vertical (V2D model). Los miembros del grupo deliberaron sobre la estructura del modelo V2D de dirección norte-sur y los resultados del análisis (especialmente la función del Dique Sur).

<Lugar>
- EIPH-LA Habana

<Expertos JICA>
- Naoaki Shibasaki
- Lei Peifeng

<Participantes>
- Lourdes Valdés González (EIPH-La Habana)
- Ernesto Flores Valdés (EIPH-La Habana)
- Andrés Portal Casanova (EIPH-La Habana)
- Ibrahim Plaza Peñalver (GEARH)
- Amadelis Quesada (GEIPI)
- Daniel Medina Pérez (CUJAE)

PEC (Segunda Reunión) 23 Julio 2013

Reconocimiento del terreno 11 Junio 2013

Publicación:
Grupo de Expertos del Proyecto Agua Subterránea de JICA
Centro de Negocios Miramar Edif. Jerusalén, Oficina 408 A
Ave. 3ra esq. A 80, Miramar, Playa, Ciudad de La Habana, Cuba
Tel: (53 7) 2045040

Boletín Informativo Nº 3 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

Monitoreo

El Proyecto instalará medidores automáticos del nivel de aguas subterráneas en 10 pozos (7 existentes y 3 a ser perforados) con el fin de realizar la observación continuada de la variación en los niveles de aguas subterráneas.

Entre Noviembre 2013 y Enero 2014 se han realizado cuatro capacitaciones sobre el método de instalación de los medidores y la recuperación de los datos, con la participación de los profesionales de GEARH y GEIPI.

Los profesionales de EAH-Mayabeque y de EAH-Artemisa serán los protagonistas de las actividades de monitoreo en el futuro.

Los datos recuperados serán puestos a disposición del Grupo SIG/BD para su procesamiento dentro de la base de datos, y serán utilizados por el Grupo de Modelación del Agua Subterránea en el análisis de los resultados de sus modelos.

Adquisición de equipos

El Proyecto aporta los siguientes equipos que se utilizan en diversas actividades (incluye los equipos a ser adquiridos en el Segundo Año).

- Bomba sumergible de pozo: 1 unidad
- Generador eléctrico: 1 unidad
- Equipo de registro electro-fisico: 1 unidad
- Equipo de prospección de resistividad: 1 unidad
- Vehículo: 2 unidades
- Medidor de nivel de agua portátil: 5 unidades
- Medidor de nivel de agua de auto-registro: 10 unidades
- Instrumento de lectura del medidor de nivel de agua de auto-registro: 2 unidades
- Instromento de toma de agua subterránea: 3 unidades
- Medidor de calidad de agua de pozo: 3 unidades
- Kit de análisis de calidad de agua: 1 unidad
- Programa de SIG: 3 unidades
- Programa tridimensional de flujo de agua subterránea y transporte de materiales (FDM): 3 unidades
- Programa tridimensional de flujo de agua subterránea y transporte de materiales (FEM): 3 unidades
- GPS: 3 unidades
- Computadora de escritorio: 6 unidades
- Computadora portátil: 3 unidades
- Impresora de chorro de tinta: 1 unidad
- Impresora láser: 2 unidades
- Fotocopiadora: 1 unidad

Medidor Portátil de la Calidad de Agua de Pozos

El Proyecto aporta 3 unidades del Medidor Portátil de la Calidad de Agua de Pozos.

Se realizaron capacitaciones sobre este medidor portátil de la calidad de aguas el 11 Diciembre 2013 en EAH-Artemisa y el 17 Enero 2014 en Quivicán.

Este equipo será utilizado en el futuro para determinar la calidad del agua de pozos de acuerdo a la profundidad, así como de la calidad de las aguas superficiales.

Construcción de diques subterráneos contínuos en la Isla Miyako
（Fuente：Revista de Diques Subterráneos（Recursos Verdes 03））

【Control de Intrusión Salina】

En el Primer Año se explicó a la C/P los métodos de construcción de los diques subterráneos en el Japón, junto con las fortalezas y debilidades de cada uno. Y en la primera mitad del Segundo Año se realizaron presentaciones y prácticas sobre ① criterios para la selección de los métodos de construcción de diques subterráneos, ② práctica de selección utilizando datos muestras, ③conferencia sobre el diseño del método seleccionado.

Los métodos de construcción de diques subterráneos que fueron presentados son comunes en el Japón. Quizá debido a la escasez de casos de construcción de estructuras subterráneas en Cuba, las fotos de las construcciones despertaron un gran interés de los participantes.

Desde la etapa intermedia del Segundo Año se tiene previsto tomar como base el método de construcción prevaleciente en Cuba con el fin de iniciar el planeamiento y el diseño de las estructuras de control de la intrusión salina, como por ejemplo el dique subterráneo. Debido a la opinión generalizada entre la C/P de que es difícil seleccionar un método en base a la experiencia personal de cada uno, es posible que se tenga que recabar las opiniones del Ministerio de la Construcción.

Aspecto del Taller

Calendario

2013/11/8
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑥

2013/11/15
Comité de Coordinación Conjunta (CCC)

2013/11/21
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑦

2013/12/5
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑧

2013/12/9
Resultado 3：Taller sobre recarga artificial④

2013/12/11
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑨

2013/12/26
Resultado 3：Taller sobre selección de métodos de construcción de diques subterráneos

2014/1/6
Resultado 3：Taller sobre selección de métodos de construcción de diques subterráneos (práctica)

2013/1/10
Resultado 3：Taller sobre diseño de diques subterráneos

2013/1/13
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑩

2013/1/13 ～
Resultado 1：Inicio de capacitación en SIG/BD

2013/1/17
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑪

2013/1/23
Comité Ejecución del Proyecto (CEP)

CCC (Primera Reunión)
15 Noviembre 2013

Publicación:
Grupo de Expertos del Proyecto Agua Subterránea de JICA
Centro de Negocios Miramar Edif. Jerusalén, Oficina 408 A
Ave. 3ra esq. A 80, Miramar, Playa, Ciudad de La Habana, Cuba
Tel: (53 7) 2045040

Boletín Informativo Nº 4 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

Geofísica

Para la prospección geofísica, este Proyecto aportó un equipo de resistividad aparente para prospección geofísica y otro equipo de registro geofísico. El Syscal R1 Plus es el equipo de resistividad aparente, fabricado por Iris Instruments, y se utiliza para la prospección eléctrica vertical. El equipo de registro geofísico es el GV-Logger, fabricado por GeoVista, y puede realizar mediciones de resistividad aparente, electricidad natural, y ganma natural.

Entre el 2 y el 17 de junio de 2014 se realizaron las debidas capacitaciones con fines de efectuar la revisión de los equipos y su funcionamiento. Además, el 18 se realizó en EIPH-La Habana la capacitación sobre el uso del software del equipo.

Estos equipos serán resguardados en EIPH-La Habana, bajo el cuidado y utilización del grupo de prospección geofísica encabezado por Andrés Portal Casanova.

La donación de estos equipos permite prospecciones eléctricas básicas y la obtención de valores de resistividad en el sentido vertical utilizando los pozos perforados. Todo ésto resulta en el análisis más preciso de la estructura hidrogeológica.

Seminario Técnico del 2$^{do.}$ Año

El 20 de junio de 2014 tuvo lugar en el Hotel Chateau Miramar de La Habana el Seminario Técnico del 2$^{do.}$ año, en el que se presentaron los resultados obtenidos durante el 2$^{do.}$ año.

En este Seminario participaron 64 personas por la Parte Cubana (GEIPI y EIPH 32 personas, GEARH y EAH 21 personas, INRH-MINCEX-CITMA-CUJAE-Gobiernos Provinciales y otras oficinas públicas relacionadas 11 personas, y Parte Japonesa 15 personas (JICA 1 persona, Expertos 7 personas, intérpretes, choferes y periodistas 7 personas).

Los temas del Seminario fueron presentaciones de los logros obtenidos dentro del Resultado 1 (Estudios Hidrogeológicos, Monitoreo del Agua Subterránea, SIG/BD), del Resultado 2 (Modelación del Agua Subterránea), del Resultado 3 (Recarga del Agua Subterránea y Tecnología de Control de la Intrusión Salina), del Resultado 4 (Manejo del Agua Subterránea), además de la evolución de la transferencia tecnológica lograda en el proyecto anterior en Camaguey, y las explicaciones del Proyecto CITMA, los cuales dieron lugar a un activo intercambio de opiniones durante las Deliberaciones.

Capacitación en SIG/BD

Se llevaron a cabo reuniones de capacitación en SIG/BD entre el 13 de enero y el 27 de febrero de 2014.

<Objetivos de la Capacitación>

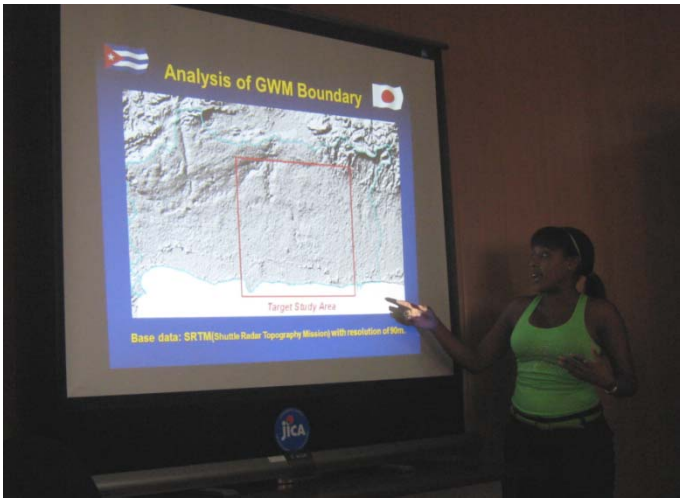
1. Los miembros del Sub-Grupo SIG/BD adquieren los conocimientos básicos sobre el SIG/BD.
2. Los miembros del Sub-Grupo SIG/BD son capaces de utilizar el software del SIG/BD.
3. Bajo el apoyo del Experto JICA, los miembros del Sub-Grpo SIG/BD son capaces de elaborar planos utilizando el SIG.

<Participantes de la Capacitación>

Diez profesionales pertenecientes a EIPH La Habana, GEIPI, GEARH, EAH-Mayabeque y EAH-Artemisa.

<Responsable de la Capacitación>

Masahiko Ikemoto
(Experto en SIG/BD)



Modelación del Agua Subterránea

Se realizaron capacitaciones sobre Modelación del Agua Subterránea entre el 10 y 13 de junio de 2014 en EIPH-La Habana. Se detallan a continuación los detalles de las capacitaciones.

<Participantes de la Capacitación>
Nueve profesionales de EIPH-La Habana, GEIPI, GEARH y EAH-Mayabeque.

<Responsables de la Capacitación>
Lei Peifeng（Modelación del Agua Subterránea 1）,
Naoaki Shibasaki（Modelación del Agua Subterránea 2）

<Detalles de la Capacitación>

- Mañana del Primer Día: Conferencia sobre las bases del agua subterránea.
- Tarde del Primer Día: Conferencia sobre las bases y la historia de la modelación del agua subterránea, seguida de Preguntas y Respuestas.
- Mañana del Segundo Día: Clases de Modelos de Agua Subterránea.
- Tarde del Segundo Día: Conferencia sobre el análisis de la simulación que utiliza MODFLOW. Preguntas y Respuestas.
- Tercer Día: Explicaciones sobre el status de la preparación del modelo tridimensional a escala general.
- Mañana del Cuarto Día: (1) Explicaciones sobre el status de la preparación del modelo tridimensional de áreas extensas. (2) Explicaciones sobre la preparación y métodos de análisis del modelo vertical bidimensional (V2D) preparado el año pasado, y explicaciones sobre los datos necesarios y métodos de análisis para mejorar la precisión del modelo en el futuro.

Tuvieron lugar activos intercambios de opiniones entre los participantes de la capacitación y los instructores, resultando en el esclarecimiento de los problemas pendientes en el modelo. Y EIPH-La Habana ha hecho entrega de nuevas informaciones que son necesarias en la modelación del agua subterránea, y ayudarán a hacer frente a los problemas pendientes esclarecidos.

Calendario

2014/1/13 ～ 2/27
Resultado 1：Inicio de capacitación en SIG/BD

2014/1/30
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑫

2014/2/4
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑬

2014/2/20
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑭

2014/3/12
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑮

2013/3/14
Resultado 1：Taller sobre calidad del agua y monitoreo del agua subterránea ⑯

2014/6/9 ～ 6/17
Resultado 1: Capacitación en el terreno de los equipos de geofísica (equipos de prospección de resistividad aparente, equipos de registro geofísico)

2014/6/10 ～ 6/13
Resultado 2: Capacitación en Modelación del Agua Subterránea

2014/6/16
Inicio de las perforaciones exploratorias

2014/6/18
Resultado 1: Capacitación en el uso del software de análisis geofísicos (para equipos de prospección de resistividad aparente, y para equipos de registro geofísico)

2014/6/20
Seminario Técnico del 2$^{do.}$ año.

2014/6/24
Comité Ejecución del Proyecto (CEP)

Perforaciones exploratorias *(Artemisa)*

CEP (No.4)
24 Junio 2013

Publicación:
Grupo de Expertos del Proyecto Agua Subterránea de JICA
Centro de Negocios Miramar Edif. Jerusalén, Oficina 408 A
Ave. 3ra esq. A 80, Miramar, Playa, Ciudad de La Habana, Cuba
Tel: (53 7) 2045040

Boletín Informativo Nº 5 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

Gira de Estudio en el Japón

Instituto Nacional de Ingeniería Rural, Organización Nacional de Investigación sobre la Agricultura y Alimentos

Ciudad de Akishima en Tokio

En octubre de 2014 llegaron al Japón 5 profesionales cubanos, quienes recibieron capacitación en métodos de control de la intrusión salina y de manejo y conservación del agua subterránea.
El programa de capacitación se indica a continuación.

4 de octubre (sábado)
- Llegada al Japón.

6 de octubre (lunes)
- Explicaciones sobre el cronograma de capacitación y confirmación de su contenido.

7 de octubre (martes)
- [Conferencia] Tecnología más reciente en el estudio y control de la salinización del agua subterránea, (dique subterráneo y método de estudio y control de la lente de agua dulce en islas).

8 de octubre (miércoles)
- [Observación] Técnica de recolección de muestras de perforación en áreas de calizas.

9 de octubre (jueves)
- [Observación] Instalaciones de control de la intrusion salina al agua subterránea en el sur de la principal de Okinawa (dique subterráneo Komesu).

10 de octubre (viernes)
- [Observación] Manejo y operación del dique subterráneo Miyako y del dique existente, sitio de construcción del dique subterráneo.

11 de octubre (sábado)
- [Observación] Geología y naciente de aguas en la Isla Miyako.

14 de octubre (martes)
- [Observación] Fuentes de agua de la ciudad de Akishima en Tokio, y medidas de conservación del agua subterránea.

15 de octubre (miércoles)
- [Observación] daño de agua subterránea en el centro de Tokio (hundimiento).
- [Observación] Sitio de construcciones de muros contínuos bajo tierra.

16 de octubre (jueves)
- [Conferencia] Pecarga del agua subterránea desde el punto de vista del ambiente acuático (historia y perspectivas futuras de la técnica de acumulación del agua de lluvias y su infiltración en el Japón).

17 de octubre (viernes)
- Presentación de los resultados de la capacitación – evaluación de la capacitación.

18 de octubre (sábado)
- Partida del Japón.

Visita a Dique Subterráneo

En las visitas a las islas Miyako y la principal de Okinawa, que al igual que Cuba son islas en donde predominan las calizas, se observaron diques subterráneos existentes y otros en construcción.

Instalación en dique subterráneo Komesu

Museo de dique subterráneo en Miyako

Sitio de construcción de dique subterráneo Nakahara

Técnica de acumulación del agua de lluvias y su infiltración

Las conferencias se refirieron al fortalecimiento de la recarga del agua subterránea desde el punto de vista del ambiente acuático, a las acciones públicas y privadas en el Japón, y técnicas más recientes.

Técnica de muestreo del material de perforación

Observación sobre técnicas de muestreo del material de perforación en áreas de roca caliza.

Perforaciones exploratorias (registro geofísico, medición de la calidad de agua)

Entre el 7 y el 17 de noviembre se realizaron el registro geofísico de pozos y la medición de la calidad de agua de pozos, utilizando los equipos donados, en 3 pozos exploratorios, JICA-1 (Artemisa), así como en JICA-2 y JICA-3 (Mayabeque).

<Participantes de la Capacitación>
EIPH-La Habana: 3 profesionales

<Responsables de la Capacitación>
Takuya Yabuta (Hidrogeólogo)

<Detalles de la Capacitación>

- 7 de noviembre Confirmación de la situación en el sitio (estado de la perforación, nivel de aguas, etc. (JICA-2, JICA-3)
- 11 de noviembre registro de pozos usando el equipo de registro geofísico, y medición de la calidad de agua de pozos usando el medidor de la calidad del agua (JICA-2, JICA-3).
- 17 de noviembre registro de pozos usando el equipo de registro geofísico, y medición de la calidad de agua de pozo usando el medidor de la calidad del agua (JICA-1).

Las actividades descritas permitien comprender la distribución de los valores de resistividad según la profundidad (intervalos de 1 m), y los valores de la coductividad eléctrica (concentración de la sal). Los datos de medición obtenidos en JICA-1 (Artemisa) indican que a los 44 metros de profundidad existe un aumento brusco en los valores de conductividad eléctrica, lo cual sugiere una alta posibilidad de intrusión salina en las cercanías de esta profundidad.

Perforaciones Exploratorias (Aforos)

El 24 de noviembre comenzó el aforo en el pozo JICA-3.
Inicialmente se planeó el aforo utilizando una bomba de ENPC, pero se decidió utilizar los equipos de donación.

Calendario

2014/10/6 ~ 10/17
Capacitación en el Japón

2014/11/5
Inicio de actividades conjuntas de 3er año

2014/11/7 ~ 11/17
Resultado 1：registro geofísico de pozo exploratorio- medición de calidad de agua

2014/11/10
Reunión de representantes

2014/11/18
EAH-Artemisa：discusión de actividades

2014/11/24
Resultado 1：Inicio de aforo en JICA-3 （Suspendido desde 11/26）

2014/11/25
EAH-Mayabeque：discusión de actividades

2014/12/2
Reunión Comité de Ejecución del Proyecto (CEP)

2014/12/5
Resultado 2：EAH-Artemisa: Entrega de datos compilados sobre uso del agua de pozos en agricultura

2014/12/10
Resultado 1：Discusiones sobre monitoreo del nivel de agua subterránea （EAH-Mayabeque）

2014/12/11
Resultado 1：Discusiones sobre monitoreo del nivel de agua subterránea (EAH-Artemisa）

2014/12/16
Resultado 4：Borrador de la Tabla de Contenido del Plan de Manejo del Agua Subterránea, Discusiones sobre puntos del contenido y autores designados

2014/12/18
Resultado 2：Entrega de datos compilados des volumen de agua usado en agricultura en EAH-Mayabeque

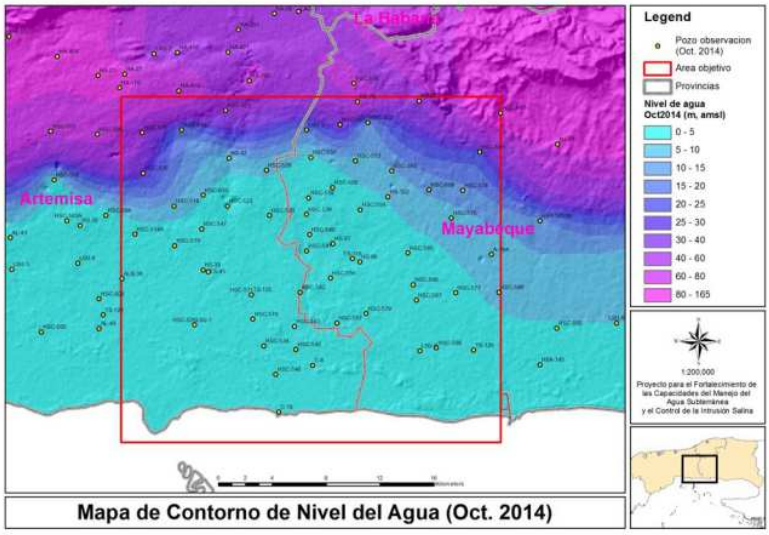
Aforo (JICA-3)

CEP (No.5)
02 Diciembre 2014

Publicación:
Grupo de Expertos del Proyecto Agua Subterránea de JICA
Centro de Negocios Miramar Edif. Jerusalén, Oficina 408 A
Ave. 3ra esq. A 80, Miramar, Playa, Ciudad de La Habana, Cuba
Tel: (53 7) 2045040

Boletín Informativo Nº 6 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

SIG/Base de Datos



Mapa de Contorno de Nivel del Agua (Oct. 2014)

Se describen brevemente las actividades del SIG/Base de Datos en el 3er año del Proyecto.

<Objetivo de la capacitación>
Capacitación de seguimiento sobre SIG dirigida a los técnicos que no pudieron participar suficientemente en la capacitación 2 sobre SIG/BD realizada en el 2do año.

<Temas de capacitación>
Métodos de ordenamiento de datos con el uso de datos reales de monitoreo y métodos de elaboración de planos en el área objeto del Proyecto aprovechando SIG.

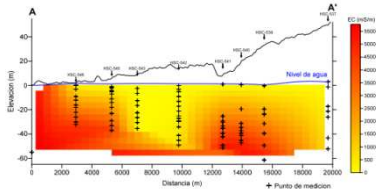
<Instructor>
Masahiko Ikemoto (SIG/BD)

<Fecha>
Capacitación en Mayabeque: 5 días entre el 20 y el 27 de enero de 2015
Capacitación en Artemisa: 5 días entre el 26 de enero y el 19 de febrero de 2015

<Participantes>
Capacitación en Mayabeque:
- EAH Mayabeque: 7 funcionarios
- EIPH La Habana:2 funcionarios

Capacitación en Artemisa
- EAH Artemisa: 2 funcionarios
- EIPH La Habana: 3 funcionarios

Además, los representantes del Sub-Grupo SIG/BD visitaron entre el 8 y el 11 de febrero de 2015 las oficinas correspondientes en Holguín y Camaguey con el fin de observar el manejo de la Base de Datos del Proyecto anterior. Se intercambiaron opiniones con los profesionales de las oficinas mencionadas.



Resultados de la Revisión Intermedia

Se realizó la Revisión Intermedia de este Proyecto entre el 12 y el 28 de enero de 2015. La Comisión de Evaluación Conjunta estuvo integrada la Parte Japonesa por 5 miembros, y la Parte Cubana por 4 miembros, quienes prepararon el Informe de Evaluación Conjunta. Este Informe fue aprobado, junto con las modificaciones de la Matriz de Diseño del Proyecto (PDM), en la reunión del Comité de Coordinación Conjunta de fecha 28 de enero de 2015. Los puntos principales de las modificaciones de PDM son los siguientes.

(1) Meta superior
- **Redacción anterior:** Se maneja adecuadamente el agua subterránea en el área seleccionada de la Costera Sur de las Provincias Mayabeque y Artemisa, tomando en cuenta las influencias del cambio climático.
- **Redacción modificada**: El método de preparación del Plan de Manejo del Agua Subterránea, desarrollado en este Proyecto, es diseminado y utilizado en otras áreas.

(2) Objetivo del Proyecto
- **Redacción anterior**: Se mejoran las capacidades de las instituciones que participan en el Proyecto en la prospección y manejo del agua subterránea en el área objetivo incluyendo el control de la intrusión salina.
- **Redacción modificada**: Se mejoran las capacidades de las instituciones que participan en el Proyecto para el desarrollo del agua subterránea en el área objetivo, incluyendo la detención de la intrusión salina.

(3) Actividad 3-4
- **Redacción modificada**: Elaborar el diseño preliminar para el método adecuado y estudiar su aplicabilidad.
- **Redacción modificada**: (eliminado)

(4) Actividad 4-6
- **Redacción modificada:** Preparar el plan de implementación de obras de recarga de acuíferos y control de intrusión salina.
- **Redacción modificada:** Preparar un plan de introducción de tecnologías referentes a la detención de la intrusión salina desde el punto de vista de largo plazo.

(5) Actividad 4-7
- **Redacción modificada:** Preparar el Plan de Manejo del Agua Subterránea a largo plazo, teniendo en cuenta el efecto del cambio climático, así como las obras de recarga y control de intrusión salina.
- **Redacción modificada:** Preparar un Plan de Manejo del Agua Subterránea a largo plazo, teniendo en cuenta el efecto del cambio climático, así como también los efectos resultantes de las medidas de la detención de la intrusión salina.

Se establecieron además los indicadores, y se indicó el mecanismo de obtención de los mismos.

Discusiones sobre el Diseño de Diques Subterráneos

En la Revisión Intermedia de enero de 2015, tanto la Parte Japonesa como la Parte Cubana reconocieron las dificultades en prevenir la intrusión salina por medio de la construcción de estructuras ejemplificadas por los diques subterráneos. Como resultado lógico se realizó en abril de 2015 una capacitación que resume los métodos de diseño de los diques subterráneos.

- En base a las capacitaciones ya realizadas, los profesionales relevantes de EIPH La Habana han analizado los sitios apropiados para la construcción de diques subterráneos en Cuba, y han sugerido la construcción de tal estructura en la cuenca hidrográfica cuya distribución tiene lugar en Las Tunas, específicamente La Cana.
- Para el sitio arriba mencionado, los profesionales de EIPH La Habana han sugerido los métodos de diseño del dique subterráneo, y el Experto JICA ha presentado sus comentarios, resultando de esta manera en una capacitación eminentemente práctica durante 4 reuniones de capacitación. Los profesionales de EIPH La Habana incorporaron los comentarios del Experto JICA, y prepararon un "Documento Revisado".

<Fechas de Capacitación>
- 15, 17, 22 y 24 de abril

<Participantes>
- Parte Cubana: 5 funcionarios de EIPH La Habana
- Parte Japonesa: Hiroshi Fujita (Experto en Medidas contra la Intrusión Salina)

Seminario Técnico del 3er. Año y Seminario sobre el plan de manejo de agua subterránea

El 24 de junio de 2015 tuvo lugar en el Hotel Chateau Miramar de La Habana el Seminario Técnico del 3er. Año y Seminario sobre el plan de manejo de agua subterránea, en el que se presentaron los resultados obtenidos durante el 3er .año.
En este Seminario participaron 63 personas por la Parte Cubana (GEIPI y EIPH 31 personas, GEARH y EAH 17 personas, INRH-MINCEX-CITMA-CUJAE-Gobiernos Provinciales y otras oficinas públicas relacionadas 15 personas, y Parte Japonesa 9 personas (Expertos 5 personas, intérpretes, choferes y periodistas 4 personas).
Los temas principales a ser presentados en los Seminarios, y los expositores de cada tema se indican a continuación.

- Capacitación en Japón: Ana Lydia Hernández (GEIPI), Ernesto Flores Valdés, Adrián Abilio Lugo Barro (EIPHH), Humberto Garcia Acosta (EAH-M), Ernesto Morales Chirino (EAH-A)
- Contenidos (borrador) y marco del Plan de Manejo de Agua Subterránea: Ibrahim Plaza Peñalver (GEARH)
- Descripción de la Hidrología: Francis Francisco Rodríguea Rodriguez (GEARH)
- Descripción de la Topografía, la Geología, la Hidrogeología y el Agua Subterránea, y Perpectivas de Cambio en la Recarga del Agua Subterránea: Ernesto Flores Valdés, Lourdes Valdés González, Pedro Luis García, Andrés Portal Cassanova (EIPHH)
- Estado Actual y Perspectivas de Cambio en el Volumen de Explotación del Agua Subterránea: Dulce M. Rodríguez Lugo (EAH-M)
- Estado y Problemas Actuales de Nivel del Agua Subterránea: Humberto Garcia Acosta (EAH-M)
- Estado y Problemas Actuales de Calidad del Agua Subterránea: Ernesto Morales Chirino (EAH-A), Orland Laiz Averhoff (EIPHH)
- Pronósticos Meteorológicos, Cambios en el Nivel del Mar y el Volumen de Agua Superficial: Ernesto Flores Valdés (EIPHH)
- Problemas del Agua Subterránea y Medidas que se han tomado en el pasado y sus efectos (1) - Dique Sur -: Carlos Manuel Muro Pedilla (EAH-A)
- Problemas del Agua Subterránea y Medidas que se han tomado en el pasado y sus efectos (2) - Balance de Agua por GEARH -: Dulce M. Rodríguez Lugo (EAH-M)
- Sistema de Monitoreo del Agua Subterránea y SIG/BD: Pedro Luis García, Adrián Abilio Lugo Barro (EIPHH), Humberto Garcia Acosta (EAH-M), Ernesto Morales Chirino (EAH-A)
- Manejo de la Descarga del Agua Subterránea - Modelo de Aguas Subterráneas -: Amadelis Quesada Tores, Lourdes Valdés González (EIPHH)
- Instalaciones para el almacenamiento e infiltración de aguas pluviales y recarga artificial del agua subterránea: Rafael Feitó Olivera, Ernesto Flores Valdés (EIPHH)
- Control de la Intrusión Salina: Juan Alberto Hernandez , Isabel Pineiro Alfonso (EIPHH)

Calendario

2015/1/14, 1/19, 1/26, 2/3, 2/10
Resultado 2: Capacitación en Modelación del Agua Subterránea (en Mayabeque)

2015/1/15, 1/20, 1/27, 2/4, 2/11
Resultado 2: Capacitación en Modelación del Agua Subterránea (en Artemisa)

2015/1/20 ～ 1/23, 1/27
Resultado 1: Capacitación en SIG/BD (en Mayabeque)

2015/1/26, 1/29, 1/30, 2/13, 2/19
Resultado 1: Capacitación en SIG/BD (en Artemisa)

2015/1/26, 2/26, 3/2, 3/9, 3/16, 3/23
Resultado 1: Capacitación en Monitoreo del Agua Subterránea (Calidad del Agua) (en La Habana)

2015/2/2, 2/5, 2/9
Resultado 2: Capacitación en Modelación del Agua Subterránea (en La Habana)

2015/3/4, 3/20
Resultado 1: Capacitación en Monitoreo del Agua Subterránea (Calidad del Agua) (en Artemisa)

2015/3/5, 3/10
Resultado 1: Capacitación en Monitoreo del Agua Subterránea (Calidad del Agua) (en Mayabeque)

2015/4/15, 4/17, 4/22, 4/24
Resultado 3: Discusiones sobre los Métodos de Diseño de Diques Subterráneos

2015/4/28, 5/8, 5/19, 5/26
Resultado 4: Discusiones sobre el Manejo del Agua Subterránea (en La Habana)

2015/4/29, 5/6, 5/13, 5/20, 5/27
Resultado 4: Discusiones sobre el Manejo del Agua Subterránea (en Mayabeque)

2015/4/30, 5/7, 5/14, 5/21, 5/29
Resultado 4: Discusiones sobre el Manejo del Agua Subterránea (en Artemisa)

2015/6/5, 6/29
Resultado 1：Capacitación sobre el análisis de prueba de bombeo (en La-Habana)

2015/6/9, 6/16
Resultado 2: Capacitación en Modelación del Agua Subterránea (en La Habana)

2015/6/10, 6/17
Resultado 2: Capacitación en Modelación del Agua Subterránea (en Mayabeque)

2015/6/11, 6/18
Resultado 2: Capacitación en Modelación del Agua Subterránea (en Artemisa)

2015/6/24
Seminario Técnico correspondiente al Tercer Año, Seminario sobre Manejo del Agua Subterránea

2015/6/25
Comité de Ejecución del Proyecto (CEP = PEC)

2015/6/26
Resultado 3: Capacitación sobre la Recarga de Aguas Subterráneas (en La Habana)

CCC (No.2)
28 Enero 2015

CEP (No.6)
25 Junio 2015

Publicación:
Grupo de Expertos del Proyecto Agua Subterránea de JICA
Centro de Negocios Miramar Edif. Jerusalén, Oficina 408 A
Ave. 3ra esq. A 80, Miramar, Playa, Ciudad de La Habana, Cuba
Tel: (53 7) 2045040

Boletín Informativo Nº 7 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

Análisis de las Pruebas de Bombeo

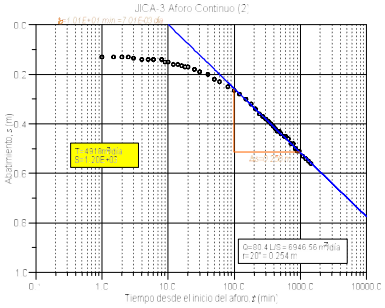
Se realizaron las pruebas de bombeo (aforos) en las perforaciones de prueba.

Estas pruebas de bombeo consisten en un aforo escalonado (10 horas (1 intervalo = 2 horas con 4 intervalos)), un aforo continuo (24 horas) y una prueba de recuperación.

Antes de terminar las perforaciones de prueba, el experto japonés (Dr. Shibasaki) realizó una capacitación sobre el análisis de los aforos (junio, 2015). Los resultados fueron analizados por los ingenieros de la EIPH-Habana que participaron en dicha capacitación.

El método de análisis y las constantes hidráulicas calculadas se muestran a continuación:

- Aforo escalonado: Análisis del gráfico, coeficientes del acuífero, pérdida del pozo, eficiencia, etc.
- Aforo continuo: Métodos Cooper-Jacob y Theis, transmisividad, coeficiente de almacenamiento.
- Prueba de recuperación: Método de recuperación, transmisividad.



Terminación de las perforaciones de prueba

(1) JICA-1
- Ubicación: X=340469, Y=324477
- Diám. y prof. del pozo: 70 m, 20 pulg.
- Sist. de monitoreo: medición automática de nivel (cada hora)

(2) JICA-2
- Ubicación: X=364260, Y=322963
- Diám. y prof. del pozo: 63 m, 20 pulg.
- Sist. de monitoreo: medición automática de nivel (cada hora)

(3) JICA-3
- Ubicación: X=362793, Y=331999
- Diám. y prof. del pozo: 80 m, 20 pulg.
- Sist. de monitoreo: medición automática de nivel (cada hora)

(JICA-1)

(JICA-2)

Aforos (Trabajos de campo)

Luego de la perforación de los nuevos pozos, los ingenieros de la EIPH-Habana realizaron los aforos.
Durante los aforos, además del nivel de agua y el volumen de descarga, se midió de manera periódica los cambios en la calidad del agua (pH, CE).
Para realizar los aforos, se empleó la bomba sumergible (φ = 150 mm, Q = 3.5 m3 / min. H = 60 m, 75 kW 440 V 3-fases 60 Hz) y el generador donados por Japón.

(En EAH-Mayabeque)

Creación del Plan de Manejo del Agua Subterránea

En este momento, los ingenieros de la EIPH-Habana, la EAH-Mayabeque y la EAH-Artemisa se encuentran en el proceso de elaboración del plan de manejo del agua subterránea.

A continuación se muestra el contenido del plan de manejo del agua subterránea (borrador).

1. ELEMENTOS BÁSICOS DE LA PLANIFICACIÓN
   - 1.1 Política Básica
   - 1.2 Objetivo de la Planificación
   - 1.3 Ubicación del Plan (en cuanto a Leyes y Regulaciones)
   - 1.4 Área Objetivo del Plan
   - 1.5 Duración del Plan
2. CONDICIÓN ACTUAL ESTIMADA DEL AGUA SUBTERRÁNEA EN EL ÁREA OBJETIVO
   - 2-1 Descripción Hidrológica
   - 2-2 Descripción de la Topografía, la Geología, la Hidrogeología y el Agua Subterránea
   - 2-3 Uso del Agua Subterránea
   - 2-4 Fluctuación del Nivel del Agua Subterránea
   - 2-5 Calidad del Agua Subterránea
   - 2-6 Caudal del Agua Subterránea
   - 2-7 Balance del Agua Subterránea
   - 2-8 Problemas del Agua Subterránea
3. CAMBIOS EN LAS CIRCUNSTANCIAS QUE RODEAN EL AGUA SUBTERRÁNEA
   - 3.1. Meteorología
   - 3.2. Recarga del Agua Subterránea
   - 3.3. Agua Salada y Agua Superficial
   - 3.4. Uso del Agua Subterránea
4. OBJETIVO DE CONSERVACIÓN DEL AGUA SUBTERRÁNEA
   - 4.1 Conjunto de Objetivos de Conservación
   - 4.2 Valor de los Objetivos de Conservación
5. PREDICCIÓN FUTURA (PRONÓSTICO)
   - 5.1 Descripción del Estudio de Caso
   - 5.2 Condiciones de Análisis de cada Escenario
6. MEDIDAS PARA ALCANZAR LOS OBJETIVOS (MANEJO)
   - 6.1 Idea Básica de las Medidas
   - 6.2 Problemas y Medidas Puntuales
   - 6.3 Clasificación de las Medidas
   - 6.4 Preparación del Sistema de Monitoreo de la Situación del Agua Subterránea, etc.
   - 6.5 Medidas de Preservación del Volumen de Agua Subterránea
   - 6.6 Medidas de Preservación de la Calidad del Agua Subterránea
   - 6.7 Para Justificar las Medidas
   - 6.8 Manejo del Estado de Avance del Plan

El Plan de Manejo del Agua Subterránea debe completarse de acuerdo con el cronograma siguiente.

- Desde ahora hasta finales de diciembre de 2015: Completamiento del análisis de la situación actual
- Desde enero hasta mayo de 2016: Completamiento del análisis predictivo y preparación de las medidas para lograr los objetivos
- Junio de 2016: Completamiento del plan de manejo del agua subterránea (borrador)
- Desde Julio hasta octubre de 2016: Prueba del plan de manejo del agua subterránea (borrador)
- Noviembre de 2016: Completamiento del plan de manejo del agua subterránea

Calendario

2015/10/14
Discusión del Plan de Actividades de 4to año

2015/10/19 – 2016/1/21
Resultado 4: Discusiones sobre el Manejo del Agua Subterránea (en Artemisa)

2015/10/20 - 2016/1/19
Resultado 4: Discusiones sobre el Manejo del Agua Subterránea (en La Habana)

2015/10/21 - 2016/1/20
Resultado 4: Discusiones sobre el Manejo del Agua Subterránea (en Mayabeque)

2015/10/27
Resultado 1: Discusiones sobre el análisis de los aforos (en La Habana)

2015/10/29, 10/30, 11/5, 11/6
Resultado 3: Estudio de campo sobre recarga artificial

2015/11/16 - 12/17
Resultado 2: Capacitación en Modelación del Agua Subterránea (en La Habana)

2015/11/18 – 2016/1/21
Resultado 1: Discusión sobre la Estructura Hidrogeológica (en La Habana)

2015/11/20 - 2016/1/21
Resultado 3: Discusión sobre Recarga Artificial (en La Habana)

2015/11/24
Comité de Ejecución del Proyecto (CEP = PEC)

2015/11/25, 11/30
Resultado 1: Discusión sobre el Monitoreo de las Aguas Subterráneas (en Mayabeque)

2015/11/25 - 12/15
Resultado 2: Capacitación en Modelación del Agua Subterránea (en Mayabeque)

2015/11/27 - 12/16
Resultado 2: Capacitación en Modelación del Agua Subterránea (en Artemisa)

2015/12/3, 12/14
Resultado 1: Discusión sobre el Monitoreo de las Aguas Subterráneas (en Artemisa)

2016/1/22
Comité de Ejecución del Proyecto (CEP = PEC)

CEP (No.7) 24 Noviembre 2015

CEP (No.8) 22 Enero 2016

Publicación:
Grupo de Expertos del Proyecto Agua Subterránea de JICA
Centro de Negocios Miramar Edif. Jerusalén, Oficina 408 A
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Boletín Informativo Nº 8 del Proyecto para el Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina en la República de Cuba

Capacitación en Japón

Introducción sobre la contaminación del agua subterránea en Kokusai Kogyo

Pozo de infiltración de agua de lluvia en Akishima

En la capacitación en Japón participaron cinco miembros de la contraparte cubana, de EIPH, GEIPI y GEARH, desde el 29 de febrero hasta el 11 de marzo de 2016, con el objetivo de desarrollar las capacidades de conservación y manejo del agua subterránea.

A continuación presentamos el programa de actividades de la capacitación:

28 de febrero (domingo)
• Llegada a Japón.
29 de febrero (lunes)
• Explicaciones sobre el cronograma de la capacitación y confirmación de su contenido.
1 de marzo (martes)
• [Conferencia] Subsidencia del suelo y manejo del agua subterránea en la ciudad de Kanazawa.
• [Observación] Subsidencia del suelo y pozos de observación de agua subterránea.
2 de marzo (miércoles)
• [Observación] Sitios de subsidencia en la ciudad de Kanazawa.
• [Conferencia] Simulación de agua subterránea.
3 de marzo (jueves)
• [Conferencia] Sistema de monitoreo y manejo del agua subterránea en la prefectura de Saitama.
• [Observación] Estación de monitoreo al este de Koshigaya.
• [Observación] Conservación del manantial en el santuario Meiji.
4 de marzo (viernes)
• [Conferencia] Introducción sobre la contaminación del agua subterránea.
7 de marzo (lunes)
• [Conferencia y observación] Topografía y geología de la cuenca Aizu, Puente Nippashi, manantial y pozo de observación del agua subterránea en el Parque Shimizu y sitio de experimentación de la recarga artificial de aguas subterráneas a través de un arrozal en la ciudad de Kitakata.
8 de marzo (martes)
• [Conferencia] Presentación de la Red Kitakata Shimizu.
• [Conferencia y observación] El lago Urabandai y el lago Inawashiro.
9 de marzo (miércoles)
• [Conferencia] Introducción al método y las instalaciones de conservación de los niveles de agua subterránea a través del agua de lluvia en Japón.
• [Observación] Instalaciones de conservación de agua subterránea en Akishima, Tokio.
10 de marzo (jueves)
• [Observación]. Museo Histórico de Conducción de Agua de Tokio
11 de marzo (viernes)
• Presentación de los resultados de la capacitación, evaluación de la capacitación.
12 de marzo (sábado)
• Partida de Japón.

Visita a la ciudad de Kitakata

La ciudad de Kitakata se encuentra al norte de la cuenca Aizu en la prefectura de Fukushima. La capacitación en la ciudad Kitakata estuvo a cargo del Profesor Shibasaki y sus estudiantes de la Universidad de Fukushima.

Pozo de observación de agua subterránea

Manantial en el Parque Shimizu

Foto de grupo en la compuerta de JyuRoku-Kyo

Evaluación Final del Proyecto

La evaluación final del Proyecto se llevó a cabo entre el 2 y el 17 de junio de 2016 por cuatro miembros de la parte cubana y cinco de la parte japonesa. Las evaluaciones se efectuaron sobre la base de cinco criterios, a saber, relevancia, efectividad, eficiencia, impacto y sostenibilidad, y los resultados se presentaron en la reunión del Comité de Coordinación Conjunta (CCC) que tuvo lugar el 17 de junio de 2016.

(Hotel Acuario(Marina Hemingway)

Seminario sobre el plan de manejo de agua subterránea

El seminario sobre el plan de manejo de agua subterránea se efectuó el 24 de junio de 2016 en el Hotel Acuario (Marina Hemingway).

Al seminario asistieron 69 participantes de la parte cubana (27 de GEIPI y de EIPH, 24 de GEARH y de las EAH, 7 del INRH y de las DPRH, 11 de CITMA, CUJAE, MINAL, MINAGRI, INSMET, AMA y MINEM, y 1 periodista de Prensa Latina), así como 9 miembros de la parte japonesa (1 de JICA, 4 del Equipo de Expertos, 2 intérpretes, y 2 choferes).

El principal objetivo del seminario era presentar el borrador actual del Plan de Manejo de Agua Subterránea e intercambiar opiniones al respecto.

El seminario comenzó con una presentación del Proyecto a cargo de Shigeki KIHARA (Líder del Equipo de Expertos), la cual estuvo seguida de una presentación sobre la capacitación en Japón por uno de los participantes en la misma. A continuación, los miembros de la contraparte cubana explicaron cada capítulo del borrador del Plan de Manejo de Agua Subterránea.

Seguidamente se muestra el índice del Plan de Manejo de Agua Subterránea (borrador):

Capítulo 1 Elementos básicos de la planificación

Capítulo 2 Condición actual estimada del agua subterránea en el área objetivo

Capítulo 3 Cambios en las circunstancias que rodean el agua subterránea

Capítulo 4 Objetivo De conservación del agua subterránea

Capítulo 5 Predicción futura (Pronóstico)

Capítulo 6 Medidas para alcanzar los objetivos (Manejo)

Calendario

2016/2/29 ~ 3/11
Capacitación en Japón

2016/4/4 ~ 5/11
Capacitación sobre Monitoreo de Agua Subterránea (Calidad del Agua)

2016/4/18 ~ 5/13
Capacitación sobre SID/DB

2016/4/19 ~ 7/6
Discusiones sobre el Plan de Manejo del Agua Subterránea (borrador)

2016/4/26
Reunión general de la edición del Plan de Manejo de Agua Subterránea (borrador)

2016/5/5 ~ 6/23
Capacitación sobre Modelación de Agua Subterránea

2016/5/19 ~ 6/13
Capacitación sobre Recarga de Agua Subterránea

2016/6/1
Clase sobre Prospección Geofísica (CUJAE)

2016/6/2 ~ 6/16
Evaluación Final del Proyecto

2016/6/17
Comité de Coordinación Conjunta (CCC)

2016/6/24
Seminario sobre el Plan de Manejo de Agua Subterránea

2016/7/7
Reunión general de la edición del Plan de Manejo de Agua Subterránea (borrador)

Clase de Prospección Geofísica en CUJAE

Publicación:
Grupo de Expertos del Proyecto Agua Subterránea de JICA
Centro de Negocios Miramar Edif. Jerusalén, Oficina 408 A
Ave. 3ra esq. A 80, Miramar, Playa, Ciudad de La Habana, Cuba
Tel: (53 7) 2045040

5. 議事録

5-1：JCC 議事録（第 1 回～第 4 回）

5-2：IC/R 協議会議事録

5-3：PEC 議事録（第 1 回～第 8 回）

5-1(1)：第 1 回 JCC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team began activities of the 2nd Project Year in November 2013, according to the Plan of Operation (henceforth "PO").

The 1st Meeting of the Joint Coordination Committee (henceforth "JCC") was held to review and evaluate the progress of the Project in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the JICA Experts (henceforth "JICA Side"), the members of JCC had a series of discussions for the successful implementation of the Project.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, November 15, 2013

SK

Mr. Naoki Kamijo
Director General
JICA Mexico Office
Japan International Cooperation Agency
(JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones,
Proyectos a Ingeniería (GEIPI)

Mr. Shigeki Kihara
Leader of Experts/Groundwater
Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation
Agency (JICA)

Eng. Fermín Sarduy Quintanilla
Director General,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Technical Director,
Grupo Empresarial de Investigaciones,
Proyectos e Ingeniería (GEIPI)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Witnessed by

Eng. Abel Salas García
Vice President,
Instituto Nacional de Recursos Hidráulicos
(INRH)

Eng. Vladimir Cabranes Alpizar
Director, International Relation &
Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos
(INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Plan of Activities of the 2nd Year

The Cuban side basically accepted the Plan of Activities of the 2nd year explained by the JICA Side with further clarifications.

(1) 2nd Year Plan of Operation

The 2nd year is scheduled to begin in November 2013 and to end in July 2014.

(2) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

- The geological and hydrogeological data would be updated.
- The geophysical prospection would be continued.
- 3 (three) test wells drilling with well logging and pumping test would be conducted under the responsibility of the Cuban side.
- The plan for the network of observation wells would be prepared.
- GIS/DB would be established, and the collected data would be stored and updated.

(3) Output 2 (The groundwater models are elaborated in the target area.)

- The analysis of the various factors to calculate the water balance and amount of groundwater recharge would be continued.
- The Groundwater Model structure and parameters would be modified / adjusted based on the results of well drilling and updated hydrogeological data.
- The prediction analysis by using the Groundwater Model would be started.

(4) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

- The study of various techniques of groundwater recharge and seawater intrusion control would be continued.
- The suitable methods of construction, considering the natural, social, economic and political conditions of the target area would be examined.

(5) Output 4 (The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.)

- The simulation results of models of groundwater and seawater intrusion would be verified.
- The permissible hydrogeological conditions of the aquifer would be defined.

- The annual pumping plan of each production well based on the results of analysis of groundwater model would be prepared.

(6) Training in Japan

The JICA Side explained that the training in Japan would be held tentatively in October 2014 (the beginning of the 3rd year) inviting 5 (five) Cuban engineers, and the detailed training program is scheduled to be discussed during the 2nd year.

(7) Technical Seminar

The JICA Side explained that the Technical Seminar of the 2nd Year would be held in June 2014.

2. Equipments and Materials

The JICA Side explained the procurement of equipments and materials included in the Project.
The Cuban Side explained the completion of import procedure and the management method of the already arrived equipment and materials.
The JICA Side requested the Cuban Side to continue securing the services of the Public Executor of Donations (EMED), accredited by the Cuban Customs, so as to expedite, in the shortest possible time, the import and release procedures of the products and consumables to be procured in the 2nd year.

3. Coordination with Related Organizations

The Cuban Side presented recent positive results of the coordinated actions with other organizations that are related to this Project.
Both Sides confirmed the collaboration with related organization where GEIPI will play the leading role in this collaboration.

4. Revision of the Project Design Matrix (PDM) and Plan of Operation (PO)

JCC agreed to the revision of PDM and PO proposed by the JICA Side and accepted PDM ver.1.2, which made uniform use of the names of some activities as well as the duration of these activities.

Appendix 1: List of Attendance

Appendix 2: Project Design Matrix (PDM) ver. 1.2

Appendix 3: Plan of Operation (PO) ver. 1.2

Appendix 1

List of Attendance

2013.11.15

Name	Institution	Position	Tel/Email
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Miriam Valdés Pérez	GEIPI	Director General	
Ana Lydia Hernández González	GEIPI	Technical Director, GEIPI	
Ibrahim Plaza Peñalver	GEARH	Specialist in Hydrogeology	
Jorge Fernández Crespo	MINCEX	Official, Director of Trade Policy	
Arturo González Báez	GEIPI	Senior Specialist in Projects and Engineering	
Aimeé Aguirre Hernández	EIPH La Habana	Director General	
Ernesto Flores Valdés	EIPH La Habana	Specialist in Hydrogeology	
Hildelisa Rodríguez Fumero	INRH	Principal Specialist in International Cooperation	
Yaney Abreu Díaz	INRH	Specialist in International Cooperation	
Atsushi Tsukiyama	Embassy of Japan	Secretary	

V/S

SK

Naoki Kamijo	JICA Mexico	Director General	
Eiji Araki	JICA Mexico	Program officer	
Tatsuo Suzuki	JICA Havana	Expert Coordinator in Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Takuya Yabuta	Earth System Science Co., Ltd.	Expert in Hydrogeology	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

Appendix 2 : Project Design Matrix (PDM)

Project Title: The project for Capacity Enhancement of Groundwater and Seawater Intrusion Management

Target Area: The selected areas of "Cuenca Sur" in Mayabeque and Artemisa Provinces

Duration: Four (4) years (48 months) (January 2013 – December 2016)

Target Group: GEIPI, EIPHH, GEARH, EAH-Mayabeque, EAH-Artemisa and INRH (Supervisory organization)

PDM Ver. 1.2: November, 15 in 2013

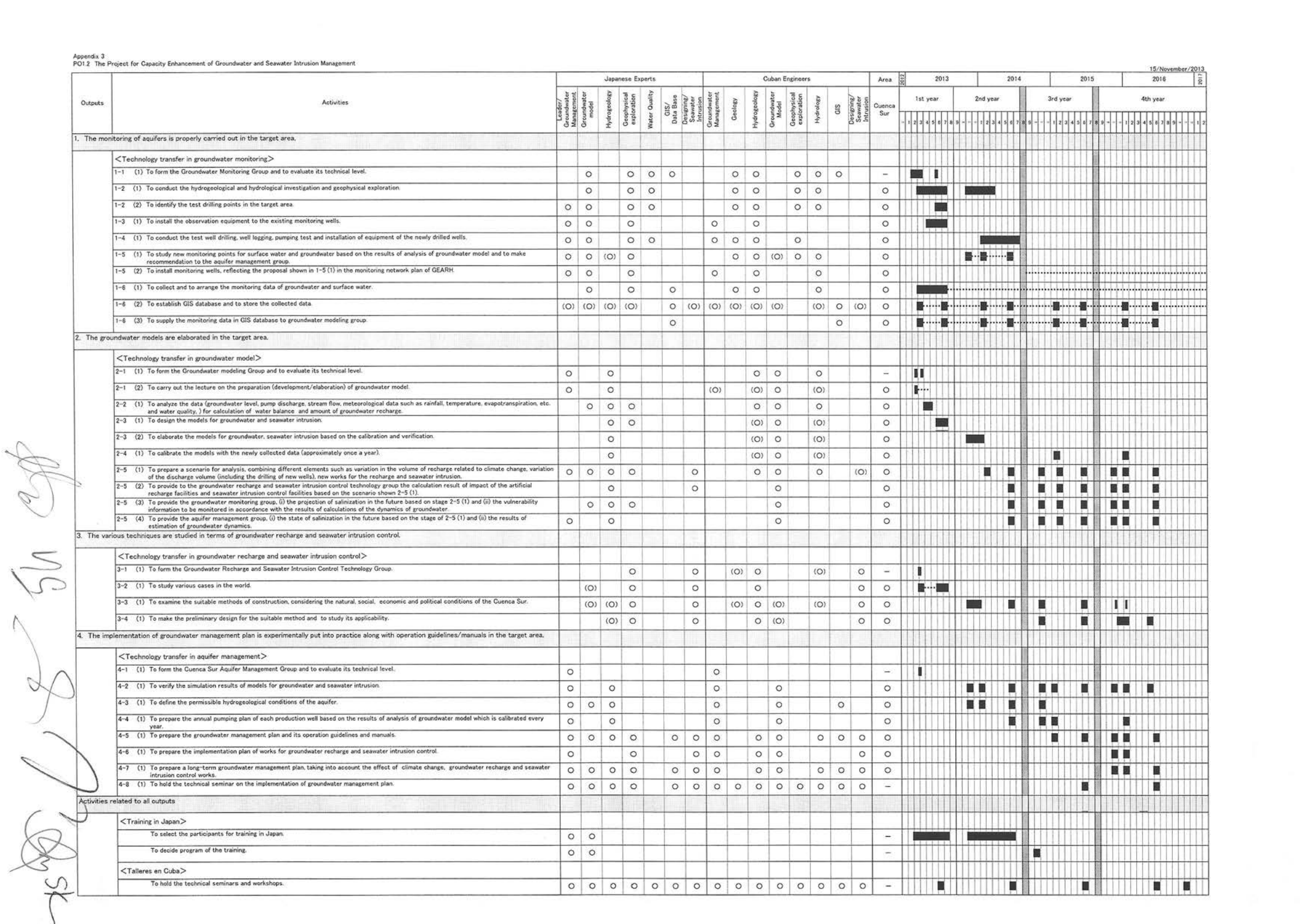
Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumptions
Overall Goal The groundwater is managed in appropriate manner by taking into account the climate change in the selected southern coastal area of Mayabeque and Artemisa Provinces.	The hydrogeological condition, defined by the results of the Project, is sustainably maintained in the target area.	1. Monitoring data on groundwater	
Project Purpose Capacity of the institutions participating in the Project is improved in groundwater development and management including prevention of seawater intrusion in the target area.	1. The necessary personnel is allocated to the groundwater management related organizations based on the operation guidelines/manuals produced by the Project. 2. The counterpart personnel achieve the technologically satisfactory level.	1. Project Report 2. Judgment by Japanese Experts	•The Cuban government policy on groundwater development and management is maintained.
Outputs 1. The monitoring of aquifers is properly carried out in the target area. 2. The groundwater models are elaborated in the target area. 3. The various techniques are studied in terms of groundwater recharge and seawater intrusion control. 4. The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.	1. Monitoring data is accumulated regularly on GIS data base. 2. The groundwater models are calibrated once a year. 3. The Cuban side proposes more than one (1) appropriate measure for groundwater recharge and seawater intrusion control in the target area. 4. The first version of operation guidelines/manuals are prepared and distributed to the related personnel.	1. GIS data base 2. Calibration Report 3. Project Report 4. Project Report, The first version of operation guidelines/manuals.	•Those who are subject to the transfer of technology do not leave their post.

Activities	Inputs		Important Assumptions
1-1 To form the Groundwater Monitoring Group and to evaluate its technical level. 1-2 To conduct the hydrogeological and hydrological investigation and geophysical exploration. 1-3 To install the observation equipment in the existing monitoring well. 1-4 To drill new test wells and to install the observation equipment. 1-5 To establish the observation network. 1-6 To establish GIS data base and to store the collected data. 2-1 To form the Groundwater Modeling Group and to evaluate its technical level. 2-2 To analyze the various factors to calculate water balance and amount of groundwater recharge. 2-3 To elaborate the models for groundwater and seawater intrusion. 2-4 To calibrate the models with the newly collected data (approximately once a year). 2-5 To conduct the prediction analysis for the groundwater flow mechanism and seawater intrusion. 3-1 To form the Groundwater Recharge and Seawater Intrusion Control Technology Group. 3-2 To study various cases in the world. 3-3 To examine the suitable methods of construction, considering the natural, social, economic and political conditions of the target area. 3-4 To make the preliminary design for the suitable method and to study its applicability. 4-1 To form the Aquifer Management Group and evaluate their technical skill. 4-2 To verify the simulation results of models for groundwater and seawater intrusion. 4-3 To define the permissible hydrogeological conditions of the aquifer. 4-4 To prepare the annual pumping plan of each production well based on the results of analysis of groundwater model which is calibrated every year. 4-5 To prepare the groundwater management plan and its operation guidelines and manuals. 4-6 To prepare the implementation plan of works for groundwater recharge and seawater intrusion control. 4-7 To prepare a long-term groundwater management plan, taking into account the effect of climate change, groundwater recharge and seawater intrusion control works. 4-8 To hold the technical seminars on the implementation of groundwater management plan.	**[Japanese side]** 1. Experts ・ Leader / Groundwater Management ・ Groundwater Model ・ Hydrogeology ・ Geophysical Exploration ・ Water Quality ・ GIS/Data Base ・ Designing/Seawater Intrusion ・ Coordinator/Training Program 2. Equipment ・ A set of groundwater monitoring ・ GPS ・ PC ・ Software —Software for seawater intrusion analysis —Software for groundwater model —GIS ・ Project Vehicle(s) with spare parts 3. Training in Japan 4. Technical seminars (cost for hall rental, printed materials, meal and accommodation allowance for Cuban participants)	**[Cuban side]** 1. Human resources ・ Project Director ・ Project Manager ・ Deputy Project Manager ・ Chief Administrator ・ Deputy Administrator ・ Engineers ・ Technicians ・ Administrative staff ・ Driver(s) 2. Facilities ・ Offices for JICA experts (Habana and Quivican) ・ Storage for equipment (Havana and Quivican) 3. Activity cost ・ Test well drilling cost (materials, construction) ・ Workshops 4. Local Cost ・ Administration cost for JICA expert office (electricity and water) ・ C/P per diem including accommodation expenses	●The Cuban side is actively involved in the project. ●Customs procedures and transport of equipment do not suffer significant delays. <Pre-conditions> ●Counterpart personnel are assigned appropriately in the related organizations.

Appendix 3
PO1.2 The Project for Capacity Enhancement of Groundwater and Seawater Intrusion Management

15/November/2013

Outputs	Activities	Japanese Experts							Cuban Engineers								Area
		Leader/ Groundwater Management	Groundwater model	Hydrogeology	Geophysical exploration	Water Quality	GIS/ Data Base	Designing/ Seawater Intrusion	Groundwater Management	Geology	Hydrogeology	Groundwater Model	Geophysical exploration	Hydrology	GIS	Designing/ Seawater Intrusion	Cuenca Sur
1. The monitoring of aquifers is properly carried out in the target area.																	
	<Technology transfer in groundwater monitoring>																
	1-1 (1) To form the Groundwater Monitoring Group and to evaluate its technical level.		○		○	○	○			○	○		○	○	○		–
	1-2 (1) To conduct the hydrogeological and hydrological investigation and geophysical exploration.		○		○	○				○	○		○	○			○
	1-2 (2) To identify the test drilling points in the target area.	○	○		○	○				○	○		○	○			○
	1-3 (1) To install the observation equipment to the existing monitoring wells.	○	○		○				○		○						○
	1-4 (1) To conduct the test well drilling, well logging, pumping test and installation of equipment of the newly drilled wells.	○	○		○	○			○	○	○		○				○
	1-5 (1) To study new monitoring points for surface water and groundwater based on the results of analysis of groundwater model and to make recommendation to the aquifer management group.	○	○	(○)	○					○	○	(○)	○	○			○
	1-5 (2) To install monitoring wells, reflecting the proposal shown in 1-5 (1) in the monitoring network plan of GEARH.	○	○		○				○		○			○			○
	1-6 (1) To collect and to arrange the monitoring data of groundwater and surface water.		○		○		○			○	○			○			○
	1-6 (2) To establish GIS database and to store the collected data.	(○)	(○)	(○)	(○)		○	(○)	(○)	(○)	(○)	(○)		(○)	○	(○)	○
	1-6 (3) To supply the monitoring data in GIS database to groundwater modeling group.						○								○		○
2. The groundwater models are elaborated in the target area.																	
	<Technology transfer in groundwater model>																
	2-1 (1) To form the Groundwater modeling Group and to evaluate its technical level.	○		○							○	○		○			–
	2-1 (2) To carry out the lecture on the preparation (development/elaboration) of groundwater model.	○		○					(○)		(○)	○		(○)			○
	2-2 (1) To analyze the data (groundwater level, pump discharge, stream flow, meteorological data such as rainfall, temperature, evapotranspiration, etc. and water quality,) for calculation of water balance and amount of groundwater recharge.		○	○	○						○	○		○			○
	2-3 (1) To design the models for groundwater and seawater intrusion.			○	○						(○)	○		(○)			○
	2-3 (2) To elaborate the models for groundwater, seawater intrusion based on the calibration and verification.			○							(○)	○		(○)			○
	2-4 (1) To calibrate the models with the newly collected data (approximately once a year).			○							(○)	○		(○)			○
	2-5 (1) To prepare a scenario for analysis, combining different elements such as variation in the volume of recharge related to climate change, variation of the discharge volume (including the drilling of new wells), new works for the recharge and seawater intrusion.	○	○	○	○			○			○	○		○		(○)	○
	2-5 (2) To provide to the groundwater recharge and seawater intrusion control technology group the calculation result of impact of the artificial recharge facilities and seawater intrusion control facilities based on the scenario shown 2-5 (1).			○				○				○					○
	2-5 (3) To provide the groundwater monitoring group, (i) the projection of salinization in the future based on stage 2-5 (1) and (ii) the vulnerability information to be monitored in accordance with the results of calculations of the dynamics of groundwater.		○	○	○							○					○
	2-5 (4) To provide the aquifer management group, (i) the state of salinization in the future based on the stage of 2-5 (1) and (ii) the results of estimation of groundwater dynamics.	○		○								○					○
3. The various techniques are studied in terms of groundwater recharge and seawater intrusion control.																	
	<Technology transfer in groundwater recharge and seawater intrusion control>																
	3-1 (1) To form the Groundwater Recharge and Seawater Intrusion Control Technology Group.				○			○		(○)	○			(○)		○	–
	3-2 (1) To study various cases in the world.		(○)		○			○			○					○	○
	3-3 (1) To examine the suitable methods of construction, considering the natural, social, economic and political conditions of the Cuenca Sur.		(○)	(○)	○			○		(○)	○	(○)		(○)		○	○
	3-4 (1) To make the preliminary design for the suitable method and to study its applicability.			(○)	○			○			○	(○)				○	○
4. The implementation of groundwater management plan is experimentally put into practice along with operation guidelines/manuals in the target area.																	
	<Technology transfer in aquifer management>																
	4-1 (1) To form the Cuenca Sur Aquifer Management Group and to evaluate its technical level.	○							○								–
	4-2 (1) To verify the simulation results of models for groundwater and seawater intrusion.	○		○					○			○					○
	4-3 (1) To define the permissible hydrogeological conditions of the aquifer.	○	○	○					○			○			○		○
	4-4 (1) To prepare the annual pumping plan of each production well based on the results of analysis of groundwater model which is calibrated every year.	○		○					○			○					○
	4-5 (1) To prepare the groundwater management plan and its operation guidelines and manuals.	○	○	○	○		○	○	○		○	○		○	○	○	○
	4-6 (1) To prepare the implementation plan of works for groundwater recharge and seawater intrusion control.	○			○			○	○		○	○				○	○
	4-7 (1) To prepare a long-term groundwater management plan, taking into account the effect of climate change, groundwater recharge and seawater intrusion control works.	○	○	○	○		○	○	○		○	○		○	○	○	○
	4-8 (1) To hold the technical seminar on the implementation of groundwater management plan.	○	○	○	○		○	○	○	○	○	○	○	○	○	○	–
Activities related to all outputs																	
	<Training in Japan>																
	To select the participants for training in Japan.	○	○														–
	To decide program of the training.	○	○														–
	<Talleres en Cuba>																
	To hold the technical seminars and workshops.	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	–



5-1(2)：第 2 回 JCC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

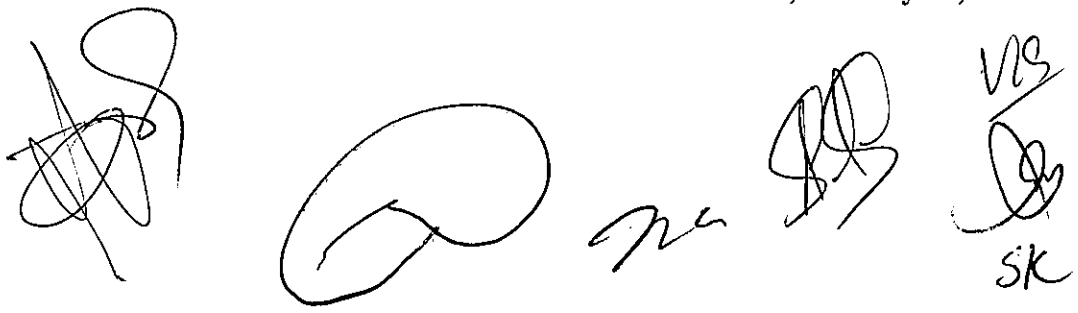
The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities of the 3rd Project Year, according to the Plan of Operation (henceforth "PO").

The 2nd Meeting of the Joint Coordination Committee (henceforth "JCC") was held to review and evaluate the progress of the Project in the Salón Burbujas of Hotel Chateau Miramar, Havana.

Based on i) the explanation of the activities by the Project Team composed of JICA Experts (henceforth "JICA Side") and the Cuban C/P engineers and ii) the Evaluation Report explained by the Joint Mid-term Review Team, the members of JCC had a series of discussions for the successful implementation of the Project.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, January 28, 2015



Mr. Naoki Kamijo
Director General
JICA Mexico Office
Japan International Cooperation Agency
(JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones,
Proyectos a Ingeniería (GEIPI)

Mr. Shigeki Kihara
Leader of Experts/Groundwater
Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency
(JICA)

Eng. Dixie Castillo Díaz
Director General,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Technical Director,
Grupo Empresarial de Investigaciones,
Proyectos e Ingeniería (GEIPI)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Witnesses

Mr. Ejiri Yukihiko
Leader,
Mid-Term Review Team
Japan International Cooperation Agency
(JICA)

Witnesses

Eng. Abel Salas García
Vice President,
Instituto Nacional de Recursos Hidráulicos
(INRH)

Eng. Vladimir Cabranes Alpizar
Director, International Relations &
Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos
(INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Improvements of the Project

The members of JCC basically accepted the improvements of the Project explained by the Project Team with further clarifications.

(1) Assignment of Japanese experts

The assignment of Japanese experts in Cuba was scheduled throughout the year.

(2) Organization by the Cuban Side

Because the present assistant to the Project Administrator will take an official trip for about one year, a new assistant to the Project Administrator was appointed.

The implementation system of geophysical survey (EIPH-La Habana) was strengthened by the addition of a young engineer.

(3) Activity in Project Site

The training activity plan that is performed in EAH-Mayabeque and EAH-Artemisa is increasing, targeting the technical personnel in the Project Site offices.

(4) Groundwater Management Plan

Preparation of the Groundwater Management Plan, which will take the lead in the future, is progressing as follows.

- The composition (Table of Contents) of the Groundwater Management Plan was discussed with the Cuban Side.
- The writing person in charge of each item of the Table of Contents was selected.

2. Revision of Project Design Matrix (henceforth "PDM") and PO

Based on the recommendation of the Joint Mid-term Review Team, PDM was revised as the 2nd version (PDM_{2-1}) on January 28, as described below. PO is also revised according to the modification of PDM. The members of JCC approved these revisions.

(1) Overall Goal

Old edition: The groundwater is managed in appropriate manner by taking into account the climate change in the selected southern coastal area of Mayabeque and Artemisa Provinces.

New edition: The preparation method of Groundwater Management Plan, developed in this Project, is disseminated and utilized in other areas.

(2) Objectively Verifiable Indicators for Overall Goal

Old edition: The hydrogeological condition, defined by the results of the Project, is sustainably maintained in the target area.

New edition: The preparation of Groundwater Management Plan is started in more than one area that is different from the objective area of this Project.

(3) Means of verification for Overall Goal

Old edition: Monitoring data on groundwater.

New edition: GEARH Reports.

(4) Project Purpose

Old edition: Capacity of the institutions participating in the Project is improved in groundwater development and management including prevention of seawater intrusion in the target area.

New edition: Capacity is improved in the institutions[1)] participating in the Project for groundwater development and management in the objective area, including limitations imposed on saline intrusion.

(5) Objectively Verifiable Indicators for Project Purpose

Old edition: 1. The necessary personnel is allocated to the groundwater management related organizations based on the operation guidelines/manuals produced by the Project. 2. The counterpart personnel achieve the technologically satisfactory level.

New edition: The control of water volume extracted is implemented on the basis of Groundwater Management Plan.

(6) Means of verification for Project Purpose

Old edition: 1. Project Report. 2. Judgment by Japanese Experts.

New edition: Monitoring data of groundwater.

(7) Objectively Verifiable Indicators for Output 1

Old edition: Monitoring data is accumulated regularly on GIS data base.

New edition: The observation data of the objective area are periodically filed in the database of GIS by the Groundwater Monitoring Group.

(8) Objectively Verifiable Indicators for Output 2

Old edition: The groundwater models are calibrated once a year.

New edition: The Groundwater Modeling Group undertakes, once a year, the calibration (correction・renewal) of the groundwater models in the objective area.

(9) Objectively Verifiable Indicators for Output 3

Old edition: The Cuban side proposes more than one (1) appropriate measure for groundwater recharge and seawater intrusion control in the target area.

New edition: Results of the studies on technology of aquifer recharge and saline intrusion control are incorporated into the Groundwater Management Plan.

(10) Means of verification for Output 3

Old edition: Project Report.

New edition: Groundwater Management Plan.

(11) Objectively Verifiable Indicators for Output 4

Old edition: The first version of operation guidelines/manuals are prepared and distributed to the related personnel.

New edition: Version 1 of the Implementation Instructions (Guidelines and Manuals) is established and utilized.

(12) Means of verification for Output 4

Old edition: Project Report, The first version of operation guidelines/manuals.

New edition: One copy of the first version of the Implementation Instructions (Guidelines and Manuals) of the Groundwater Management Plan.

(13) Activity 3-4

Old edition: To make the preliminary design for the suitable method and to study its applicability.

New edition: (deletion)

(14) Activity 4-6

Old edition: To prepare the implementation plan of works for groundwater recharge and seawater intrusion control.

New edition: To prepare a plan to introduce technologies related to the saline intrusion control from the long-term viewpoint.

(15) Activity 4-7

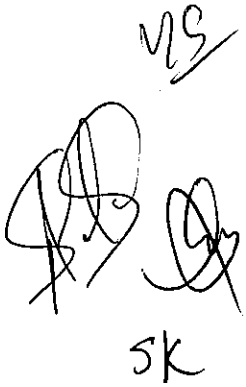
Old edition: To prepare a long-term groundwater management plan, taking into account the effect of climate change, groundwater recharge and seawater intrusion control works.

New edition: To prepare a long-term Groundwater Management Plan, taking into account the effect of climate change, as well as the effects resulting from the measures to control saline intrusion.

Appendix 1: List of Attendance

Appendix 2: Project Design Matrix (PDM) ver. 2.1

Appendix 3: Plan of Operation (PO) ver. 2.1



Appendix 1

List of Attendance

2015.1.28

Name	Institution	Position	Tel/Email
Abel Salas Garcia	INRH	Vice President	
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Miriam Valdez Pérez	GEIPI	Director General	
Ana Lydia Hernández González	GEIPI	Technical Director	
Arturo González Báez	GEIPI	Senior Specialist in Projects and Engineering	
Dixie Castillo Diaz	GEARH	Director General	
Ibrahim Plaza Peñalver	GEARH	Specialist in Hydrogeology	
Aimeé Aguirre Hernández	EIPH-La Habana	Director General	
Annia Morales Hondal	EIPH-La Habana	Director for Applied Research	
Osvaldo Martinez Torres	EAH-Mayabeque	Director General	
Dulce M. Rodríguez Lugo	EAH-Mayabeque	Technical Director	
Jesús Mayoral García	EAH-Artemisa	Director General	
Carlos Manuel Antela	EAH-Artemisa	Technical Director	

Argelio Fernandez	INRH		
Carlos A. Luaces	DPRH La Habana		
Maria A. Garcia	INRH		
Yenisett Figueredo	INRH.	Specialist in International Relations	
Ivón Martínez Geniz	MINCEX	Officer, Asia and Oceania Commercial Policy Division	
Jun Komase	Embassy of Japan	Secretary	
Naoki Kamijo	JICA Mexico	Director General	
Eiji Araki	JICA Mexico	Program officer	
Masami Shukunobe	JICA Havana	Expert Coordinator in Cooperation	
Yukihiko Ejiri	JICA	Leader, Mid-Term Review Team	
Yuto Yanagawa	JICA	Planning of survey, Mid-Term Review Team	
Yousuke Sasaki	Sowa Consultants Inc.	Technical adviser, Mid-Term Review Team	
Satoshi Nagashima	Icons Inc.	Evaluation analysis, Mid-Term Review Team	
Sachiyo Sakurai	JICE	Interpreter, Mid-Term Review Team	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Experts Leader / Groundwater Management	
Hirokatsu Utagawa	Kokusai Kogyo Co., Ltd.	Expert, Sub-leader / Water Quality	
Lei Peifeng	Kokusai Kogyo Co., Ltd.	Expert, Groundwater Model 1	
Masahiko Ikemoto	Kokusai Kogyo Co., Ltd.	Expert in GIS/DB	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

Appendix 2

PDM_{2-1}

Name of the Project: "Technical Cooperation Project on Capacity Enhancement of Groundwater Management and Seawater Intrusion Control Technology"
Objective Area: Selected area of the Cuenca Sur in the Provinces of Mayabeque and Artemisa (Part of the area of Cuenca Sur, identified by the Cuban Side as **HS-3** and **HS-4**)
Objective Group: GEIPI, EIPHH, GEARH, EAH-Mayabeque, EAH-Artemisa and INRH (supervising entity)

Period: Four (4) years (January 2013 ~December 2016)
PDM 2.1: 28 January 2015

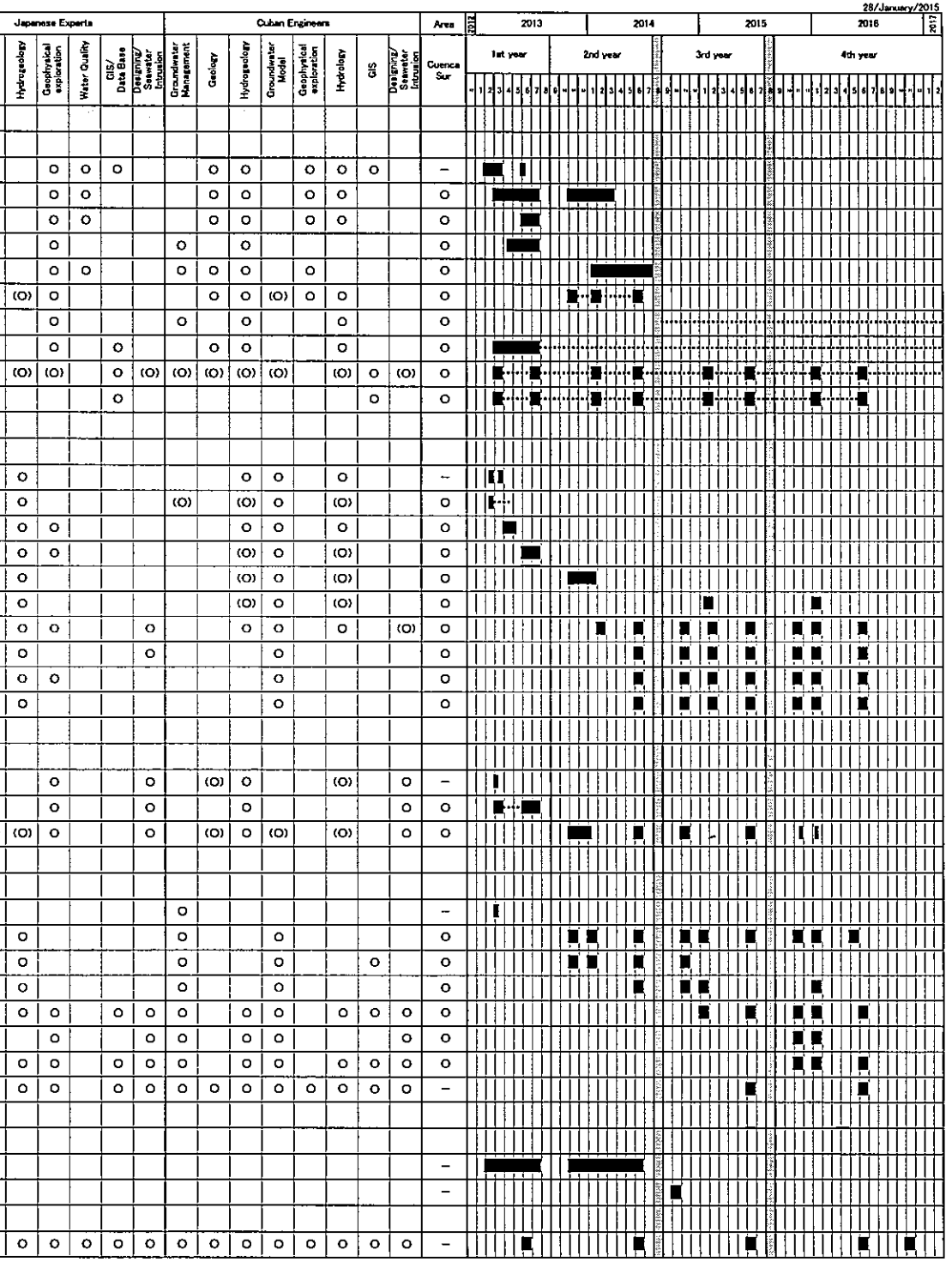
Narrative Summary	Objectively Verifiable Indicators	Means of verification	Important Assumptions
Overall Goal The preparation method of Groundwater Management Plan, developed in this Project, is disseminated and utilized in other areas.	The preparation of Groundwater Management Plan is started in more than one area that is different from the objective area of this Project.	GEARH Reports	
Project Purpose Capacity is improved in the institutions[1)] participating in the Project for groundwater development and management in the objective area, including limitations imposed on saline intrusion.	The control of water volume extracted is implemented on the basis of Groundwater Management Plan.	Monitoring data of groundwater	• The Cuban government policy on groundwater development and management is maintained.
Outputs 1. The monitoring of aquifers is properly carried out in the target area.	1. The observation data of the objective area are periodically filed in the database of GIS by the Groundwater Monitoring Group.	1. GIS data base	• Those who are responsible for technology transfer do not leave their posts, nor are transferred to other posts..
2. The groundwater models are elaborated in the target area.	2. The Groundwater Modeling Group undertakes, once a year, the calibration (correction・renewal) of the groundwater models in the objective area.	2. Calibration Report	
3. The various techniques are studied in terms of groundwater recharge and seawater intrusion control.	3. Results of the studies on technology of aquifer recharge and saline intrusion control are incorporated into the Groundwater Management Plan.	3. Groundwater Management Plan	
4. The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.	4. Version 1 of the Implementation Instructions (Guidelines and Manuals) is established and utilized.	4. One copy of the first version of the Implementation Instructions (Guidelines and Manuals) of the Groundwater Management Plan	

Activities	Inputs		Important Assumptions
1-1. To form the Groundwater Monitoring Group and to evaluate its technical level. 1-2. To conduct the hydrogeological and hydrological investigation and geophysical exploration. 1-3. To install the observation equipment in the existing monitoring well. 1-4. To drill new test wells and to install the observation equipment. 1-5. To establish the observation network. 1-6. To establish GIS data base and to store the collected data. 2-1 To form the Groundwater Modeling Group and to evaluate its technical level. 2-2 To analyze the various factors to calculate water balance and amount of groundwater recharge. 2-3 To elaborate the models for groundwater and seawater intrusion. 2-4 To calibrate the models with the newly collected data (approximately once a year). 2-5 To conduct the prediction analysis for the groundwater flow mechanism and seawater intrusion. 3-1 To form the Groundwater Recharge and Seawater Intrusion Control Technology Group. 3-2 To study various cases in the world. 3-3 To examine the suitable methods of construction, considering the natural, social, economic and political conditions of the target area. 4-1 To form the Aquifer Management Group and evaluate their technical skill. 4-2 To verify the simulation results of models for groundwater and seawater intrusion. 4-3 To define the permissible hydrogeological conditions of the aquifer. 4-4 To prepare the annual pumping plan of each production well based on the results of analysis of groundwater model which is calibrated every year. 4-5 To prepare the groundwater management plan and its operation guidelines and manuals. 4-6 To prepare a plan to introduce technologies related to the saline intrusion control from the long-term viewpoint. 4-7 To prepare a long-term Groundwater Management Plan, taking into account the effect of climate change, as well as the effects resulting from the measures to control saline intrusion. 4-8 To hold the technical seminars on the implementation of groundwater management plan.	**[Japanese side]** 1. Experts ・ Leader / Groundwater Management ・ Groundwater Model ・ Hydrogeology ・ Geophysical Exploration ・ Water Quality ・ GIS/Data Base ・ Designing/Seawater Intrusion ・ Coordinator/Training Program 2. Equipment ・ A set of groundwater monitoring ・ GPS ・ PC ・ Software —Software for seawater intrusion analysis —Software for groundwater model —GIS ・ Project Vehicle(s) with spare parts 3. Training in Japan 4. Technical seminars (cost for hall rental, printed materials, meal and accommodation allowance for Cuban participants)	**[Cuban side]** 1. Human resources ・ Project Director ・ Project Manager ・ Deputy Project Manager ・ Chief Administrator ・ Deputy Administrator ・ Engineers ・ Technicians ・ Administrative staff ・ Driver(s) 2. Facilities ・ Offices for JICA experts (Habana and Quivican) ・ Storage for equipment (Havana and Quivican) 3. Activity cost ・ Test well drilling cost (materials, construction) ・ Workshops 4. Local Cost ・ Administration cost for JICA expert office (electricity and water) ・ C/P per diem including accommodation expenses	● The Cuban side is actively involved in the project. ● Customs procedures and transport of equipment do not suffer significant delays. <Pre-conditions> ● Counterpart personnel are assigned appropriately in the related organizations.

Appendix 3
PO2.1 The Project for Capacity Enhancement of Groundwater and Seawater Intrusion Management

28/January/2015

Outputs	Activities	Japanese Experts: Leader/ Groundwater Management	Groundwater model	Hydrogeology	Geophysical exploration	Water Quality	GIS/ Data Base	Designing/ Seawater Intrusion	Cuban Engineers: Groundwater Management	Geology	Hydrogeology	Groundwater Model	Geophysical exploration	Hydrology	GIS	Designing/ Seawater Intrusion	Area: Cuenca Sur
1. The monitoring of aquifers is properly carried out in the target area.																	
	<Technology transfer in groundwater monitoring>																
	1-1 (1) To form the Groundwater Monitoring Group and to evaluate its technical level.		O		O	O	O			O	O		O	O	O		–
	1-2 (1) To conduct the hydrogeological and hydrological investigation and geophysical exploration.		O		O	O				O	O		O	O			O
	1-2 (2) To identify the test drilling points in the target area.	O	O		O	O				O	O		O	O			O
	1-3 (1) To install the observation equipment to the existing monitoring wells.	O	O		O				O		O						O
	1-4 (1) To conduct the test well drilling, well logging, pumping test and installation of equipment of the newly drilled wells.	O	O		O	O			O	O	O		O				O
	1-5 (1) To study new monitoring points for surface water and groundwater based on the results of analysis of groundwater model and to make recommendation to the aquifer management group.	O	O	(O)	O					O	O	(O)	O	O			O
	1-5 (2) To install monitoring wells, reflecting the proposal shown in 1-5 (1) in the monitoring network plan of GEARH.	O	O		O				O		O			O			O
	1-6 (1) To collect and to arrange the monitoring data of groundwater and surface water.		O		O		O			O	O			O			O
	1-6 (2) To establish GIS database and to store the collected data.	(O)	(O)	(O)	(O)		O	(O)	(O)	(O)	(O)	(O)		(O)	O	(O)	O
	1-6 (3) To supply the monitoring data in GIS database to groundwater modeling group.						O								O		O
2. The groundwater models are elaborated in the target area.																	
	<Technology transfer in groundwater model>																
	2-1 (1) To form the Groundwater modeling Group and to evaluate its technical level.	O		O							O	O		O			–
	2-1 (2) To carry out the lecture on the preparation (development/elaboration) of groundwater model.	O		O					(O)		(O)	O		(O)			O
	2-2 (1) To analyze the data (groundwater level, pump discharge, stream flow, meteorological data such as rainfall, temperature, evapotranspiration, etc. and water quality,) for calculation of water balance and amount of groundwater recharge.		O	O	O						O	O		O			O
	2-3 (1) To design the models for groundwater and seawater intrusion.			O	O						(O)	O		(O)			O
	2-3 (2) To elaborate the models for groundwater, seawater intrusion based on the calibration and verification.			O							(O)	O		(O)			O
	2-4 (1) To calibrate the models with the newly collected data (approximately once a year).			O							(O)	O		(O)			O
	2-5 (1) To prepare a scenario for analysis, combining different elements such as variation in the volume of recharge related to climate change, variation of the discharge volume (including the drilling of new wells), new works for the recharge and seawater intrusion.	O	O	O	O			O			O	O		O		(O)	O
	2-5 (2) To provide to the groundwater recharge and seawater intrusion control technology group the calculation result of impact of the artificial recharge facilities and seawater intrusion control facilities based on the scenario shown 2-5 (1).			O				O				O					O
	2-5 (3) To provide the groundwater monitoring group, (i) the projection of salinization in the future based on stage 2-5 (1) and (ii) the vulnerability information to be monitored in accordance with the results of calculations of the dynamics of groundwater.		O	O	O							O					O
	2-5 (4) To provide the aquifer management group, (i) the state of salinization in the future based on the stage of 2-5 (1) and (ii) the results of estimation of groundwater dynamics.	O		O								O					O
3. The various techniques are studied in terms of groundwater recharge and seawater intrusion control.																	
	<Technology transfer in groundwater recharge and seawater intrusion control>																
	3-1 (1) To form the Groundwater Recharge and Seawater Intrusion Control Technology Group.				O			O		(O)	O			(O)		O	–
	3-2 (1) To study various cases in the world.		(O)		O			O			O					O	O
	3-3 (1) To examine the suitable methods of construction, considering the natural, social, economic and political conditions of the Cuenca Sur.		(O)	(O)	O			O		(O)	O	(O)		(O)		O	O
4. The implementation of groundwater management plan is experimentally put into practice along with operation guidelines/manuals in the target area.																	
	<Technology transfer in aquifer management>																
	4-1 (1) To form the Cuenca Sur Aquifer Management Group and to evaluate its technical level..	O							O								–
	4-2 (1) To verify the simulation results of models for groundwater and seawater intrusion.	O		O					O			O					O
	4-3 (1) To define the permissible hydrogeological conditions of the aquifer.	O	O	O					O			O			O		O
	4-4 (1) To prepare the annual pumping plan of each production well based on the results of analysis of groundwater model which is calibrated every year.	O		O					O			O					O
	4-5 (1) To prepare the groundwater management plan and its operation guidelines and manuals.	O	O	O	O		O	O	O		O	O		O	O	O	O
	4-6 (1) To prepare a plan to introduce technologies related to the saline intrusion control from the long-term viewpoint.	O			O			O	O		O	O				O	O
	4-7 (1) To prepare a long-term Groundwater Management Plan, taking into account the effect of climate change, as well as the effects resulting from the measures to control saline intrusion.	O	O	O	O		O	O	O		O	O		O	O	O	O
	4-8 (1) To hold the technical seminar on the implementation of groundwater management plan.	O	O	O	O		O	O	O	O	O	O	O	O	O	O	–
Activities related to all outputs																	
	<Training in Japan>																
	To select the participants for training in Japan.	O	O														–
	To decide program of the training.	O	O														–
	<Talleres en Cuba>																
	To hold the technical seminars and workshops.	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	–



5-1(3)：第 3 回 JCC 議事録

MINUTA DE DISCUSIONES
ENTRE
LA AGENCIA DE COOPERACIÓN INTERNACIONAL DEL JAPÓN (JICA)
Y
INSTITUTO NACIONAL DE RECURSOS HIDRÁURICOS (INRH)
Y SUS ORGANIZACIÓNES AFILIADAS

SOBRE
EVALUACIÓN FINAL

PARA

EL PROYECTO PARA FORTALECIMIENTO DE LAS CAPACIDADES DEL MANEJO DEL AGUA SUBTERRÁNEA
Y
EL CONTROL DE INTRUSIÓN SALINA

El Equipo de Evaluación Final (en adelante denominado como "el Equipo") organizado por la Agencia de Cooperación Internacional del Japón (en adelante denominada "JICA") y encabezado por el Ing. Akihiro MIYAZAKI, director del 2° Equipo del Recursos Hídricos del Grupo de Recursos Hídricos del Departamento de Medio Ambiente Global de JICA visitó la República de Cuba desde el 1° hasta el 18 de junio de 2016 con el propósito de evaluar la implementación de cooperación técnica y los logros del Proyecto para Fortalecimiento de las Capacidades del Manejo del Agua Subterránea y el Control de la Intrusión Salina (en adelante denominado como "el Proyecto"). En respuesta a la solicitud hecha por el Gobierno de la República de Cuba (en adelante denominado GOC) ante el gobierno de Japón (en adelante denominado como GOJ).

Durante la estancia del Equipo en Cuba, se llevó a cabo un intercambio de visión y opiniones entre el Equipo y las autoridades competentes del GOC a través de una serie de discusiones.

Como resultado de las discusiones, ambas partes acordaron sobre los asuntos mencionados en el documento adjunto.

La Habana, 17 de junio de 2016
Año 58 de la Revolución

Ing. Akihiro MIYAZAKI
Líder,
Equipo de Evaluación Final,
Japan International Cooperation Agency (JICA)

Ing. Rosemaire Ricardo Batista
Directora,
Relaciones Internacionales y Comercio Exterior,
Instituto Nacional de Recursos Hidráulicos (INRH)

5-1(4)：第 4 回 JCC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities during the 4th Project Year according to the Plan of Operation (henceforth "PO").

The 4th meeting of the Joint Coordination Committee (henceforth "JCC") was held to review and evaluate the Project in the Salón Dorado of Hotel Capri, Havana, on December 12, 2016.

Based on the Draft Final Report (DF/R) explained by the JICA Expert Team and the Cuban C/P engineers, the members of JCC had a series of discussions aimed at the evaluation of results of the project. In the course of the discussions, the members of JCC confirmed the official handover of equipments from JICA to the Cuban authorities (henceforth "Cuban Side"), and the future personnel training plan and equipment maintenance plan by the Cuban Side, after the termination of the project.

As a result of the discussions, JICA and the Cuban Side agreed to the matters mentioned in the attached documents.

Havana, December 12, 2016

INRH
Instituto Nacional
de Recursos Hidráulicos
DIRECCIÓN DE RELACIONES
INTERNACIONALES Y COMERCIO EXT.

SK

Eng. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency (JICA)

Eng. Miriam Valdés Pérez
Assistant to the President,
Instituto Nacional de Recursos Hidráulicos (INRH)

Eng. Rigoberto Morales Palacios
Director General,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Director of Science and Technology,
Instituto Nacional de Recursos Hidráulicos (INRH)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Witnessed by

Lic. Shoji Ozawa
Representative
Japan International Cooperation Agency (JICA)

Witnessed by

Eng. Rosemaire Ricardo Batista
Director, International Relations & Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos (INRH)

INRH
Instituto Nacional de Recursos Hidráulicos
DIRECCIÓN DE RELACIONES INTERNACIONALES Y COMERCIO

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. **Report of Project Achievement**

The JICA Expert Team and the Cuban C/P engineers explained the outline of the DF/R. JCC confirmed the achievement of project activities (achievement situation of each output), and achievement expectation of the Overall Goal and Project Purpose (Detailed in Appendix 2).

Overall Goal: The preparation method of Groundwater Management Plan, developed in this Project, is disseminated and utilized in other areas.

Project Purpose: Capacity is improved in the institutions[1)] participating in the Project for groundwater development and management in the objective area, including limitations imposed on saline intrusion.

Output 1: The monitoring of aquifers is properly carried out in the target area.

Output 2: The groundwater models are elaborated in the target area.

Output 3: The various techniques are studied in terms of groundwater recharge and seawater intrusion control.

Output 4: The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.

The questions on the DF/R asked by the attendance in the JCC meeting, the answers given by the JICA Experts, and the comments on the DF/R were duly registered for the subsequent incorporation into the Final Report.

2. **Compliance with and/or expectations to comply with the recommendations made in the terminal evaluation of the project**

The compliance with and/or the expectations to comply with the recommendations (upon completion of the project and after the project) made in the terminal evaluation in June 2016 were confirmed between the Japanese Side and the Cuban Side (Detailed in Appendix 3).

Upon completion of the project

(1) Promotion of the preparation of the Groundwater Management Plan

(2) Coordination with the interested parties with a view to the implementation of the Groundwater Management Plan

(3) Improvement of a more suitable environment aiming at spreading the techniques for drawing

SK

the Groundwater Management Plan to other areas

(4) Use of the groundwater simulation model

(5) Clarification on the acquisition process of spare parts of donated equipment

After the project

(1) Political and institutional aspects

(2) Technical and organizational aspects

(3) Financial aspects

3. Confirmation of Outputs (Distribution of Groundwater Management Plan with the operation guideline/manual, Donation of Equipments)

3-1. Distribution of Groundwater Management Plan with the operation guideline/manual

The JICA Expert Team presented explanations concerning the Groundwater Management Plan with the operation guideline/manual created in this Project. JICA and the Cuban Side confirmed the number of Groundwater Management Plan to be distributed by organization, as well as to individual professionals who work for the different organizations (Appendix 4).

3-2. Donation of Equipment

The JICA Expert Team referred to the equipments brought into Cuba by the project, along with a brief explanation concerning the said equipments. Upon completion of the project, the said equipment were donated to Cuba, according to the pertinent document (Certificate of Donation of Equipment) signed by INRH, GEIPI, GEARH and JICA. The list of equipment clarified the responsible office and the person in charge of each of the equipments. For the proper management and continued use of equipments under optimal conditions, the list of names and addresses of customer service and supplier of consumables for the equipments were attached to the above document (Appendix 5, 6).

4. Activity Plan after Completion of the Project by the Cuban Side

INRH, GEARH and GEIPI made a presentation of the schedule of training activities and the preparation of groundwater management plan after completion of the project, based on the achievement expectation of the Overall Goal, and taking into account the recommendations made in the terminal evaluation of the project (Appendix 7).

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Appendix 1: List of Attendance in the 4th Meeting of JCC

Appendix 2: Achievement of Outputs and Project Purpose

Appendix 3: Compliance with and/or Expectations to Comply with the Recommendations made in the Terminal Evaluation of the Project

Appendix 4: Distribution List of Groundwater Management Plan

Appendix 5: Certificate of Donation of Equipments (including List of equipment location and responsible persons)

Appendix 6: List of names and addresses of customer service and supplier of consumables for the Equipments

Appendix 7: Activity Plan after Completion of the Project by the Cuban Side

SK

Appendix 1

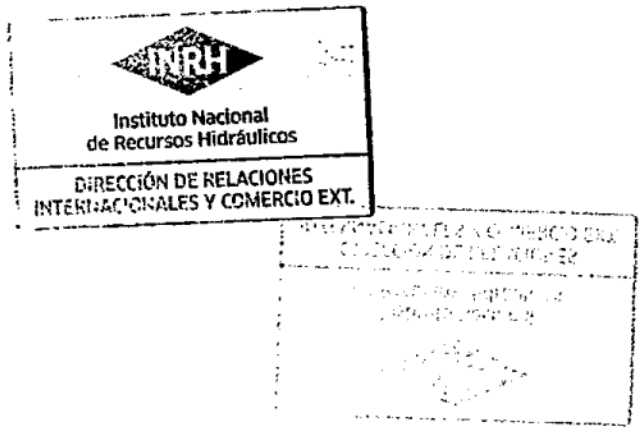
List of Attendance

2016.12.12

Name	Institution	Position	Tel/Email
Rosemaire Ricardo Batista	INRH	Director of Foreign Affair and Collaboration Division	
Ana Lydia Hernández González	INRH	Director of Management, Innovation, and Technology	
Yusniel Peña Peña	INRH	Internationnal Collaboration Specialist	
Bernardo Rodríguez Fernández	GEIPI	Director General	
Sebastian Crespo Delgado	GEIPI	Technical Director of the Business Group Research and Engineering project	
Hildelisa Jiménez Ponce de León	GEIPI	Senior Specialist	
Aymée Aguirre Hernández	EIPH-La Habana	Director General	
Annia Morales Hondal	EIPH-La Habana	Director for Applied Research	
Rigoberto Morales Palacios	GEARH	Director General	
Lazaro Gonzalez Martinez	GEARH	Technical Director	

SK

Ibrahim Plaza Peñalver	GEARH	Senior Specialist in Hydrogeology	
Danielis Amaury Romero	EAH-Mayabeque	Technical Director	
Dulce M. Rodríguez Lugo	EAH-Mayabeque	Senior Specialist	
Carlos Manuel Antela Acosta	EAH-Artemisa	Technical Director	
Ernesto Morales Chirino	EAH-Artemisa	Specialist	
Loida Rivera Fabré	MINCEX	Deputy Director, Asia and Oceania Commercial Policy Division	
Felix Colina Hernandez	MINCEX	Specialist, Asia and Oceania Commercial Policy Division	
Jun Komase	Embassy of Japan	Chief of the Cooperation for Development Section	
Shoji Ozawa	JICA Cuba	Representative	
Tetsuya Kawakami	JICA	Officer	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	



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Appendix 2

Achievement of Outputs and Project Purpose

(1) Output 1: The monitoring of aquifers is properly carried out in the target area.

To achieve Output 1, the following activities were executed.

- To form the groundwater monitoring group and to evaluate its technical level.
- To conduct the hydrogeological and hydrological investigation and geophysical exploration.
- To install the observation equipment in the existing monitoring well.
- To drill new test wells and to install the observation equipment.
- To establish the observation network.
- To establish GIS data base and to store the collected data.

The activity results are as follows.

- After the 1st year, hydrogeological, hydraulic data and various measurements are collected and ordered to be entered into a GIS database, basic maps are elaborated and field studies are carried out (hydrogeological, geophysical and hydraulic surveys).
- A system of continuous and periodic collection of groundwater observation data has been established in the study area through continuous observation of groundwater level with the automatic recorder installed in 7 existing wells in the first half of the 2nd year, and the monthly measurement of water quality that started on the second half of the 2nd year with the use of the multiparameter water level meter of water quality. Precision control will be essential from now on.

  The main engineers in charge of GIS/DB of EIPH-Habana, EAH-Mayabeque and EAH-Artemisa have acquired technical skills on mapping using GIS programs. In addition, a database developed mainly by EAH-Mayabeque has been completed and the 3 provincial companies share it.
- A system has been established that allows the 3 provincial companies to share the observed monthly groundwater quality and level data in EAH-Mayabeque and EAH-Artemisa and the analysis of measurement results (e.g. distribution map of electrical conductivity) is carried out after the measurement as programmed.
- The GIS/DB subgroup elaborated the Monitoring Activity Plan (draft).
- While the activities of the first period of 4th year were being developed, errors were detected in the EAH-Artemisa database. It is assumed that bad data was entered during the time of data sharing or that a wrong modification was made during further work. It is necessary to reanalyze the database management method.
- The data on groundwater level and quality in the database have continued to accumulate, and the monitoring plan (draft) for the GIS/DB subgroup has been revised in the midterm of the 4th year.

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- In the trial period of the groundwater management plan (draft) since August 2016, constant and periodic observation of the level and quality of groundwater continues and the data obtained have been entered into the database and shared with 3 entities: EIPH-Habana, EAH-Mayabeque and EAH-Artemisa, following the plan of activities (draft) prepared by the GIS/DB subgroup. On the methods of obtaining observational data and their ordering, problematic points will continue to be extracted with a view to improving and consolidating precision level control methods.

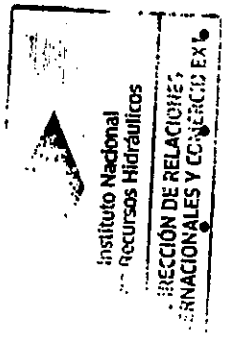
(2) Output 2: The groundwater models are elaborated in the target area.

To achieve Output 2, the following activities were executed.

- To form the groundwater modeling group and to evaluate its technical level.
- To analyze the various factors to calculate water balance and amount of groundwater recharge.
- To elaborate the models for groundwater and seawater intrusion.
- To calibrate the models with the newly collected data (approximately once a year).
- To conduct the prediction analysis for the groundwater flow mechanism and seawater intrusion.

The activity results are as follows.

- In the 1st year a summary regional model and a two-dimensional cross-section preliminary model were prepared.



Between mid and the end of the 2nd year, the abovementioned summary model was modified to complete the primary model.

At the end of the 2nd year the data on the volume pumped from 2011 to 2013 were rectified, which were collected in the province of Mayabeque.

In the first half of the 3rd year, EAH-Mayabeque and EAH-Artemisa re-ordered the pumped volume data. Using the above data, the abovementioned primary model is being modified.

- From the 3rd year on in EAH-Mayabeque and EAH-Artemisa, training on groundwater models is provided with the purpose of improving the technical level of the engineers of both institutions, so that they can use groundwater models established for groundwater management.
- The content of the training on the groundwater model provided in the final period of the 3rd year was more practical. Members of the Groundwater Modeling Group continued the interpolation test of the model even during the absence of Japanese experts.
- Through training on groundwater models in the first period of the 4th year

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(modification of the 3rd year model) and/or the practice of the calculation of the forecast of Output 4, the main engineers of EIPH-Habana, EAH- Mayabeque and EAH-Artemisa roughly understand the basic method for developing groundwater models and the method for rectifying model problems. From now on, we will deepen into the understanding of groundwater models through work to complete the current model and the estimation work.

- As part of the activities of the midterm of the 4th year, important modifications of the model of the 3rd year were made, completing the detailed three-dimensional model. Using this model, the calculation and predictive analysis on the groundwater level and transport of materials was carried out. Likewise, the results of calculation and analysis were summarized in Chapter 5 "Future estimation" of the Groundwater Management Plan (draft).
- In the trial period of the groundwater management plan (draft) as of August 2016, with the use of this model, engineers from the Cuban side have been deepening their understanding of the model through a practice of predictive analysis and a long-term predictive analysis (up to 2100) following a new scenario.

(3) Output 3: The various techniques are studied in terms of groundwater recharge and seawater intrusion control.

To achieve Output 3, the following activities were executed.

- To form the groundwater recharge and seawater Intrusion control technology group.
- To study various cases in the world.
- To examine the suitable methods of construction, considering the natural, social, economic and political conditions of the target area.

The activity results are as follows.

- Following the 1st year, training was provided on examples and methods of artificial groundwater recharge and technical measures against seawater intrusion.
- In the first half of the 2nd year, regarding technical measures against seawater intrusion, training was given on the selection of construction and design methods.
- In the second half of the 2nd year, the construction technique in Cuba was verified to analyze feasible measures.
- In determining the hydrogeological conditions of the target area, it was concluded that it would be difficult to prevent the salinization of groundwater with works against seawater intrusion. The procedure of such studies is summarized in the groundwater management plan.
- On the other hand, through the training in Japan and in the 2nd year and learning with

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the translation into Spanish of the *Technical Reference for Effective Groundwater Development* manual that includes a series of items to analyze for the design, delivered in the first period of the 3rd year, EIPH-Havana technicians have intensified both the level of understanding of the measures for the construction of works recommended for the water table in the area of La Cana, Las Tunas Province, for the construction of underground dam and have also prepared a summary analysis document of the design guidelines for underground dams in the said water table.

- The artificial groundwater recharge plan of the past (prepared in 1990) was reviewed as part of the activities of the first period of the 4th year and the possible recharge points and the recharge method were re-analyzed. Also, the rainfall infiltration facilities that took into the future urbanization of the target area were studied.
- As part of the activities of mid-term of the 4th year, the approximate design of artificial groundwater recharge facilities, the calculation of the approximate cost and the preparation of the plan for the introduction of infiltration and water storage facilities, the outputs obtained were summarized in section 6-5: *Measures to maintain the quality of groundwater*, of the Groundwater Management Plan (draft) are summarized.
- When this plan is concluded in the future, a more detailed design will be required, including the necessary expenses and experiments in the storage facilities and rainwater infiltrators.

Output 4: The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.

achieve Output 4, the following activities were executed.

- To form the aquifer management group and evaluate their technical skill.
- To verify the simulation results of models for groundwater and seawater intrusion.
- To define the permissible hydrogeological conditions of the aquifer.
- To prepare the annual pumping plan of each production well based on the results of analysis of groundwater model which is calibrated every year.
- To prepare the groundwater management plan and its operation guidelines and manuals.
- To prepare a plan to introduce technologies related to the saline intrusion control from the long-term viewpoint.
- To prepare a long-term Groundwater Management Plan, taking into account the effect of climate change, as well as the effects resulting from the measures to control saline intrusion.
- To hold the technical seminars on the implementation of groundwater management

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plan.

The activity results are as follows.

- Following the 1st year, the laws and manuals existing in Cuba, related to groundwater management are obtained and ordered, and the groundwater management methods and their results are analyzed.
- It was planned to develop the activities from 4-2 to 4-4 in the second half of the 2nd year, according to the consequences from Output 1 to Output 3. However, due to the delay in the activities of the other Output, the beginning of these activities was moved to the 3rd year.
- Between the first period and the mid-term period of the 3rd year, the groundwater management plan index (draft), the main items and those responsible for writing them were determined.
- In the final period of the 3rd year, Chapter 1 *Basic Groundwater Management Plan Items,* Chapter 2 *Current Groundwater Condition*, Chapter 3 *Change of Circumstances Surrounding Groundwater* and Chapter 4 *Groundwater Conservation Target* were re-ordered and summarized, following the (draft) index of such Groundwater Management Plan. On Chapter 5 *Future Estimation* and Chapter 6 *Measures to Achieve the Objectives*, we have begun to analyze the basic concept.

  During the activities carried out from October to December 2015, mainly figures and tables from Chapter 2 *Current Groundwater Condition* and Chapter 4 *Groundwater Conservation Objective* were created.

  In January 2016, preparations began to study Chapter 3 *Changes of Circumstances Surrounding Groundwater.*
- The main activity of the mid-term period of 2016 was the elaboration of Chapter 6: *Measures to Achieve the Objective*, of the Groundwater Management Plan (draft), whose final revision was elaborated on July 15. In addition, at the joint drafting meeting on 7 July, the guidelines and manuals were determined and attached to the plan.
- In the trial period as of August 2016, discussions and training were held according to the entities that use groundwater, in addition to INRH affiliated institutions, taking into account that the full operation of the Groundwater Management Plan was not harmed. Moreover, using the detailed 3D model, established in Output 2, a predictive analysis was made adopting an estimate of sea level rise up to 2100 published by CITMA, and a long term groundwater management plan was developed.

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(5) Project purpose: Capacity is improved in the institutions[1)] participating in the Project for groundwater development and management in the objective area, including limitations imposed on saline intrusion.

The above-mentioned project purpose is to be attained by achieving Outputs 1-4. The indicator to measure such achievements is the following.

- The control of water volume extracted is implemented on the basis of Groundwater Management Plan.

INRH and GEARH began to implement the measure proposed in the groundwater management plan.

(6) Overall Goal: The preparation method of Groundwater Management Plan, developed in this Project, is disseminated and utilized in other areas.

The indicator to measure such achievements is the following.

- The preparation of Groundwater Management Plan is started in more than one area that is different from the objective area of this Project.

To achieve this overall goal, INRH, GEIPI and GEARH plan the activities shown in Appendix 7.

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Appendix 3

Compliance with and/or Expectations to Comply with the Recommendations made in the Terminal Evaluation of the Project

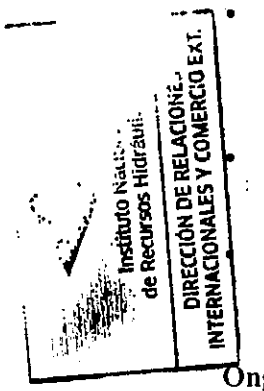
1. Upon Completion of the Project

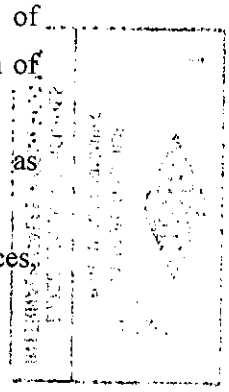
(1) Boosting the elaboration of the Groundwater Management Plan

Once the establishment of the groundwater model and the predictive analysis with its use were finished by early July, the corresponding results were presented by EIPH-Havana's engineers at the meeting to jointly draft the Groundwater Management Plan, held on July 7. The final document of this Groundwater Management Plan is being prepared, along with the delivery timetable as below, so that it can be previously approved by INRH (URA) and subsequently by the Technical National Committee, as national political opinion.

Completed tasks.

- The Groundwater Management Plan was approved in the target areas by the working group of the Project in the appointed date.
- The approved Groundwater Management Plan was submitted to the Direction of Rational Use of Water of the INRH, on part of GEIPI and GEARH in the month of July, 2016.
- The collection of results of the Groundwater Management Plan was complied as planned in the execution of the Project.
- The Groundwater Management Plan continues in Artemisa and Mayabeque provinces, including the control and management of the surface water.





Ongoing tasks

- The Direction of Rational Use of Water of the INRH will submit to the direction of the Project on December 15th, the opinion resulting from the review of the Groundwater Management Plan.
- GEIPI will submit to the Advisory Technical Council of INRH, the Groundwater Management Plan for approval, and will propose that it is carried out in the month of January, 2017.
- Once it is approved by the Advisory Technical Council of INRH, the Groundwater Management Plan will be set out as Methodology, with a control and audit system that ensures its provisions at national level, in GEIPI and GEARH.
- The collection of results from the Groundwater management Plan continues systematically and the technical staff is enabled to carry on with this activity besides the equipment, as well as funding is covered in the budget for the 2017 Plan of GEIPI and

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GEARH.

(2) Coordination with the interested parties with a view toward the implementation of the Groundwater Management Plan

During the meeting held on June 24, 2016 the discussions of the Groundwater Management Plan took place, with the attendance of the interested parties. However, it cannot be said that those discussions have been enough. C/P entities intended to also talk to the parties involved at the time of carrying out the trials of the above-mentioned plan, from mid-July to October, during the period of absence of the Japanese experts. Nevertheless, another round of discussions will be held with the said parties as part of the activities to take place with these experts, from November to December 2016.

(3) Improvement of an even most suitable environment with a view to the dissemination of the technique to elaborate the Groundwater Management Plan for other areas.

As a continuation of the seminary on groundwater management held in June, another final technical seminar will take place in November, inviting engineers from other areas, with the purpose of spreading more extensively the Groundwater Management Plan, as well as confirming the budget plan for next year with INRH, GEIPI and GEARH, and offering the necessary support from the Japanese experts, if any technical advice is needed for the future activities.

Likewise, the relevant activities were carried out in coordination with the engineers from both parties, Japan and Cuba, from November to December, so that the approval on behalf of INRH and the National Technical Committee, indicated in the item above (1), can be carried out according to the plan.

(4) Use of the groundwater simulation model

As it has been mentioned in the previous item (I), EIPH-Havana's engineers have learned about the groundwater model, drawn up in the present Project, being able to later explain it other engineers. In an attempt to further improve the technical ability of the Cuban experts, the activities with the Japanese experts planned for November and December related with the groundwater model will be boosted. This will be also useful to reassess the technical ability of the members of the group of the elaboration of the groundwater model, a diagnosis of the state of the technical transfer of the staff from EIPH-Havana, to the staff from EAH-Mayabeque and EAH-Artemisa. If there are areas that will require future assistance, a system was created by which this can be coordinated with researchers from ISPJAE (CUJAE).

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(5) **Clarification on the of the acquisition process for the spare parts of the donated equipment**

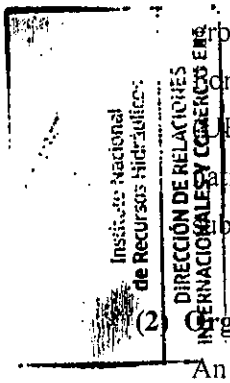
According to the guidance provided during the Final Evaluation of the Project, it was clarified the acquisition process (entity and person responsible for guaranteeing the budget, budgetary measures, steps of acquisition, list of suppliers, etc.) in order to attach the corresponding document to the Minutes of Meeting that will be signed upon completion of the present Project and to exchange information on the suppliers between the sections of acquisition and management by the C/ P entities.

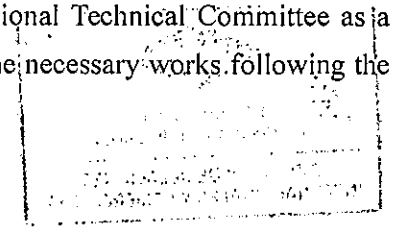
2. After the Project

(1) Political and institutional aspect

As it is foreseen that the current national water policy will be in force for some time, the rational use of water and the risk control in water quality through the groundwater management are constant priority topics. If the national policy based on a groundwater management plan is applied, it can be expected to accelerate the elaboration of a groundwater management plan in other areas.

For the groundwater management plan elaborated in the Project to be approved by INRH (CURA) as a plan for the target area and also for the National Technical Committee as a national policy standard, it will be essential to carry out the necessary works following the submitted timetable as mentioned above.





(2) Organizational and technical aspect

An organizational reform in the entities related to water resources is planned, but the tasks assigned to each entity will be transferred without undergoing any changes to the corresponding divisions, thus not hampering sustainability. Nevertheless, in the event of a conflict derived from the organizational reform, it would be desirable to tackle it rapidly in accordance with the national policy for the water sector.

The capacity of organizational implementation and also the collaboration system between the related entities have improved through the Project. In order to facilitate the technical spreading to other areas, the technicians participating in the Project are expected to perform the role of instructors and trainings are to be organized as scheduled in 3 training institutions dependent on INRH.

On the other hand, as to the use of the groundwater model in the area of the Project and to the setting up of the new model in other areas, it is undeniable that there is still not enough experience. Like for the implementation period of the Project, it is desirable that the model be set and updated in coordination with researchers from ISPJAE (CUJAE).

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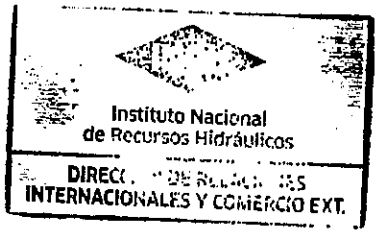
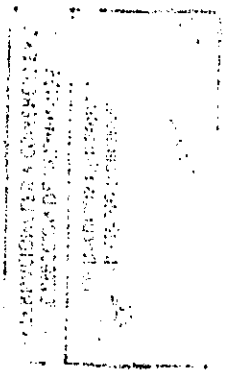
The equipment and materials donated in the Project have been properly administered by the person responsible on each team. From now on, they will need to acquire spare parts and reagents on their own. In order to do so, they are expected to make a good use of the list of suppliers for equipment and materials and their contact information, drawn up in the Project. In case of the elaboration of a new groundwater management plan in other areas, it will be necessary to acquire new equipment and materials. It is essential to analyze equipment and materials with specifications suitable for the objective and to select them taking into account the relation with the equipment and materials in use and future maintenance.

(3) Financial aspect

As for the financial aspect, a budget has been assigned to date that has been sufficient and it is expected to continue like this from now on.

It is necessary to undertake budgetary measures to elaborate groundwater management plans in new areas, to organize the aforementioned trainings and to acquire equipment and materials.





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Distribution List of Groundwater Management Plan

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39	Jorge Luís Fajardo Yero	Dtor. General EAH Granma		X
40	Yulian Omar Rodríguez	Dtra. General EAH Sgto. Cuba.	X	
41	Francisco O. Cuscó, Matos	Dtor. General EAH Guantánamo.		X
42	Dulce M. Rodríguez Lugo	Especialista EAH Mayabeque.	X	
43	Humberto García Acosta	Especialista EAH Mayabeque.		X
44	Ernesto Morales Chirino	Especialista EAH Artemisa.		X

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Appendix 5

Certificate of Donation of Equipments

On the basis of the Agreement on Technical Cooperation between the Government of the Republic of Cuba and the Government of Japan, signed on October 14, 2009, as well as the Record of Discussion signed on September 28, 2012 between Japan International Cooperation Agency (JICA), the Ministry for Foreign Trade and Investment (MINCEX), the National Institute of Hydraulic Resources (INRH), the Business Group of Research, Projects and Engineering (GEIPI) and the Business Group of Water Resources Management (GEARH), the Government of Japan grants to INRH/GEIPI/GEARH, as a donation, the equipments that are described in the attached document (whose cost ascends US $ 295108.11 (USD)).

This donation is made under the framework of the ***Project for Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba***, whose purpose is improving the capacity of the INRH (including GEIPI and GEARH) of groundwater exploitation and management.

INRH Instituto Nacional de Recursos Hidráulicos

DIRECCIÓN DE RELACIONES INTERNACIONALES Y COMERCIO EXT.

CLAUSES

FIRST. – The donated equipment will be used by the beneficiary institution, solely and exclusively within the specific activities of the Project for Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba.

SECOND. – If the beneficiary institution shall make any changes in the location of the equipment or decides to eliminate a component (end of useful life) from such donated equipment, a notice on the aforementioned situation will have to be sent in advance to JICA.

THIRD. – The donation's beneficiary institution will carry out the maintenance, monitoring and/or corresponding repairs of the equipment. The cost of maintenance, monitoring and/or repairs will be paid by the beneficiary of the donation.

SK

BY THE DONOR AGENCY

Mr. Shoji Ozawa
Representative,
Japan International Cooperation Agency (JICA)

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency (JICA)

BY THE ENTITY BENEFICIARY OF THE DONATION

Eng. Rosemaire Ricardo Batista
Director, International Relations & Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos (INRH)

INRH
Instituto Nacional
de Recursos Hidráulicos
DIRECCIÓN DE RELACIONES
INTERNACIONALES Y COMERCIO EXT.

Eng. Miriam Valdés Pérez
Assistant to the President,
Instituto Nacional de Recursos Hidráulicos (INRH)

Havana, Cuba, December 12, 2016

List of equipment donated to INRH/GEIPI/GEARH for the ***Project for Capacity Enhancement of Groundwater t and Seawater Intrusion Management***

No.	Item	Amount	Enterprise	Person in charge
1	Submersible pump	1	GEIPI (ENPC)	Ing Reynaldo Zapata Beltrán (Director de Equipos de Empresa Nacional de Perforación y Construcción)
2	Electric generator	1	GEIPI (ENPC)	Ing Reynaldo Zapata Beltrán (Director de Equipos de Empresa Nacional de Perforación y Construcción)
3	Geophysical logging equipment	1	EIPH-Habana	Ing. Andrés Portal Casanova
4	Electric prospecting, equipment	1	EIPH-Habana	Ing. Andrés Portal Casanova
5	Portable water level meter	3	EIPH-Habana	Ing. Orlando Laiz Averhoff
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
6	Automatic water level meter	6	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		4	EAH-Artemisa	Ing. Carlos Manuel Antela
7	Automatic water level meter reader	1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
8	Groundwater sampler and accesories	1	EIPH-Habana	Ing. Orlando Laiz Averhoff
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
9	Water quality meter for well and accesories	1	EIPH-Habana	Ing. Orlando Laiz Averhoff
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
10	Water quality analysis kit	1	EAH-Mayabeque (Quivican)	Ing. Dulce M. Rodríguez Lugo
11	GIS software	1	EIPH-Habana	Ing. Pedro Luis García
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela

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No.	Item	Amount	Enterprise	Person in charge
12	3-D groundwater flow and material transport software (FEM)	1	EIPH-Habana	Ing. Ernesto Flores Valdés
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
13	3-D groundwater flow and material transport software (FDM)	1	EIPH-Habana	Ing. Ernesto Flores Valdés
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
14	GPS	1	EIPH-Habana	Ing. Ernesto Flores Valdés
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
15	Desktop PC and related equipment and materials	1	EIPH-Habana	Ing. Ernesto Flores Valdés
		1		Tec. Adrián A. Lugo
		1		Ing. Pedro Luis García
		1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
		1	GEARH	Ing. Lázaro Gonzalez
16	Laptop PC	1	EAH-Mayabeque	Ing. Danieli Amaury Romero Artiles
		1	EAH-Artemisa	Ing. Carlos Manuel Antela
		1	EIPH-Habana	Ing. Andrés Portal Casanova
17	Vehicle	1	EIPH-Habana. (Dirección de Investigaciones)	Ing. Annia Morales Hondal
		1	GEARH (Dirección Técnica)	Ing. Ibrahim Plaza Peñalver
18	Accesories (Vehicle)	1	EIPH-Habana. (Dirección de Investigaciones)	Ing. Annia Morales Hondal
		1	GEARH (Dirección Técnica)	Ing. Ibrahim Plaza Peñalver
19	Color printer	1	GEARH (Dirección Técnica)	Ing. Ibrahim Plaza Peñalver
20	Printer	1	EAH-Artemisa	Ing. Carlos Manuel Antela
		1	EAH-Mayabeque (Quivican)	Ing. Dulce M. Rodríguez Lugo

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No.	Item	Amount	Enterprise	Person in charge
21	Photocopier	1	EIPH-Habana. (Dirección de Investigaciones)	Ing. Annia Morales Hondal

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No.	Equipment	Model/Specification	Quantity	Manufacturer/ Distributing agent	Address	TEL	FAX	E-mail/Web
1	Submersible pump	SP215-[illegible], altura manométrica 60m, caudal 60litro/min, 3 fases, CA440V	1	Grundfos	Bombas Grundfos de México, S.A. de C.V. BoulevardLC #15, Parque Industrial Stiva-Aeropuerto, Apodaca, Nuevo León, México	+81-8144-4000	+81-8144-4000	http://mx.grundfos.com/nav/contact/servicio.html
2	Electric Generator	DCA-220SPK3, 200/220kVA	1	Denyo Co.,Ltd	2-8-5, Nihonbashi-horidomecho, Chuo-ku, Tokio 103-8566, Japón	+81-3-6861-0055	+81-3-6861-1188	http://www.denyo.co.jp/english/
3	Geophysical logging equipment	GV-Logger, Medición de resistividad, PE y ganma natural	1	Geo Vista	Unit 10, Cae Ffwt Business Park, Glan Conwy, Conwy, LL28 5SP Reino Unido	+44-1492-573399	-	http://geovista.co.uk/ geovista@geovista.co.uk
4	Electric resistivity survey equipment	SYSCAL R1, Prospección eléctrica vertical	1	IRIS Instruments	1, avenue Buffon B.P. 16007 - 45060 Orléans cedex 3, Francia	+33-238638100	+33-238638182	iris@iris-instruments.com wwwiris-instruments.com
5	Vehicle	NISSAN NP300, CD, T/M, Diesel, 4WD, Camioneta	2	META	Mariano Escobedo No. 208, Col. Anáhuac. Polanco, Miguel Hidalgo, DF. México, 11320	+55-5263-9000	+55-5545-3583	contacto@nissanmeta.com.mx
6	Portable water level meter	ALFA WL-Type3, 100 m	5	ALFA	Yanagibaba Higashi, Oshikoji-dori, Chuo-ku, Kyoto, Japan 604-0956	+81-75-254-8686	+81-75-254-8688	-
7	Automatic water level meter and its accessories	S&DL mini 4800, Nivel de agua	10	OYO Corporation	7 Kanda-Mitoshiro-cho, Chiyoda-ku, Tokio 101-8486 Japón	+81-3-5577-4501	-	https://www.oyo.co.jp/english/
		S&DL mini 4800, Barómetro de nivel de agua de auto-registro y cables	10					
		S&DL, Instrumento de lectura del medidor (USB)	2					
8	Groundwater sampler and its accessories	φ50 mm, 600 mL	3	Tec International Inc.	1-15-15, Kudan Kita, Chiyoda-ku, Tokio 102-0073 Japón	+81-3-6261-5670	+813-6261-5794	customer@tec-inter.co.jp/ http://www.tec-inter.co.jp/top.html
		130 m de cable, torno	3					
9	Portable water quality meter for well and its accessories	pH, CE, DO, Temp, TDS, etc.	3	DKK-TOA Corporation	29-10, 1-Chome, Takadanobaba, Shinjuku-ku, Tokio 169-8648 Japón	+81-3-3202-0211	+81-3-3202-0220	http://www.toadkk.co.jp/english/ intsales@dkktoa.com
		100m de cable: 2, 150m de cable: 1	3					
10	Portable water analysis meter	PG C30, espectrofotómetro de fotos portátil	1	PG Instruments Limited	Woodway lane, Alma park, Leicestershire LE17 5BH Reino Unido	+44-1455 220131	-	http://www.pginstruments.com/
11	GIS software	Cadcorp SIS7	3	Cadcorp	Sterling Court, Norton Road, Stevenage, Hertfordshire, Reino Unido	+44-1438-747996	+44-1438-747997	https://www.cadcorp.com/
12	3D Groundwater flow analysis and material transport software (1)	FEFLOW FM3	3	DHI Canada	336 Eagle Street North, Unit 1A2, Cambridge, ON N3H 1C2, Canadá	+1-519-650-4545	+1-215-504-8498	http://worldwide.dhigroup.com/ca
13	3D Groundwater flow analysis and material transport software (2)	Processing Modflow 8 and Seer3D 2	3	Simcore Software	12 Pebblewood, Irvine, CA 92604 CA, EEUU	-	-	http://www.simcore.com/
14	GPS	Xplova G3	3	Xplova	8F, 88, Sec. 1, Xintai 5th RD.,Xizhi, New Taipei City 221, Taiwán	+886-2-6616-9221	+886-2-6616-9225	http://www.xplova.com/ service@xplova.com
15	Personal computer (Desktop)	HP Z220 RAM 4GB, HDD 1TB, DVD+RW	6	Super BBS Comuputadoras	Melchor Ocampo No. 193 Local J-05 Col. Veronica Anzures. C.P. 11300. México D.F.	+52-5260-1042	-	http://www.superbbs.com.mx
					Jaime Balmes No.11 Locales 49 y 50 P.B. Col. Los Morales c:P:11510 México D.F.	+52-5580-0130	-	
16	Personal computer (Laptop)	HP Probook 4540S INTEL CORE I5-3210M, RAM 4GB, HDD 500GB, DVD+RW	3	Super BBS Comuputadoras	Melchor Ocampo No. 193 Local J-05 Col. Veronica Anzures. C.P. 11300. México D.F.	+52-5260-1042	-	http://www.superbbs.com.mx
					Jaime Balmes No.11 Locales 49 y 50 P.B. Col. Los Morales c:P:11510 México D.F.	+52-5580-0130	-	
17	Accessories for personal computer	UPS	6	Super BBS Comuputadoras	Melchor Ocampo No. 193 Local J-05 Col. Veronica Anzures. C.P. 11300. México D.F.	+52-5260-1042	-	http://www.superbbs.com.mx
					Jaime Balmes No.11 Locales 49 y 50 P.B. Col. Los Morales c:P:11510 México D.F.	+52-5580-0130	-	
18	Color printer	Canon PIXIMA PRO100	1	Canon Cuba	3er D #15215 / 152 y Rto autico Playa, La Habana	7831-0740	5264-4051	-
19	Printer (Black and white)	Canon IR LBP3480	2	Canon Cuba	3er D #15215 / 152 y Rto autico Playa, La Habana	7831-0740	5264-4051	-
20	Photocopier	Canon IR 1025N, A3	1	Canon Cuba	3er D #15215 / 152 y Rto autico Playa, La Habana	7831-0740	5264-4051	-

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Tel.: (53) 78643302 / 78641954 geipi@geipi.hidro.cu

Plan of activities after the conclusion of the project by the Cuban side.

The Grupo Empresarial de Investigaciones, Proyectos e Ingeniería - *Business Group of Research, Projects and Engineering* (GEIPI) of the National Institute of Water Resources (INRH), with the aim of ensuring the continuity of the project beyond its limits and having taken into consideration the recommendations of the JICA's Evaluation Committee, has drawn up a comprehensive training plan that will start to be carried out as of April 2017 and it will last until 2018, where the specialists who participated in the project will serve as trainers for the specialists of the rest of our Enterprises and together with the specialists who participated in the previous project will serve as advisers in future works that we will be undertaken in subjects such as:

1. Geophysical exploration
2. Pumping tests
3. Geographic Information Systems
4. Mathematical modeling of aquifers
5. Aquifer management plans

Finally, the closing seminar held on November 25, demonstrated the feasibility of this method of dissemination of the knowledge acquired, consolidating the technical team of the GEIPI, in charge of spreading it in the coming years.

This way, seminars have been included in the training plan for the years 2017 and 2018, in the schools existing in the Central and Eastern regions.

In both years, the training will be carried out in the form of seminars, where special attention will be paid to the newly graduated people incorporated to GEIPI, GEARH and INRH, so that the continuity of the works is ensured. The expenses of these activities will be borne by the INRH in terms of educational facilities, while transportation, lodging and food will be borne by each of the Enterprises and territorial Delegations participating in them.

Besides the training, as it was indicated in the ceremony for receiving the donations, GEIPI-GEARH have their corresponding research programs in tune with the strategy of the INRH, which include stepwise projects of:

- Continuity of the investigations and adjustment of the mathematical model of Cuenca Sur in the provinces of Artemisa and Mayabeque for the systematic enhancement of the groundwater water management in this basin. In order to fulfill this objective we request to maintain the exchange with the Japanese experts who have served as trainers.
- Application of the transferred technologies in the future tasks that both institutions undertake in all the Enterprises.

The financing for the continuity of work in Cuenca Sur has already been included in the proposal for the 2017 plan, currently under discussion and approval by the chairmanship, based on the request of the budget drawn up by the Grupo Empresarial de Investigaciones, Proyectos e Ingeniería of Havana and the corresponding Water Utilization Enterprises of the Artemisa and Mayabeque provinces.

Instituto Nacional de Recursos Hidráulicos

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GEIPI
GRUPO EMPRESARIAL
DE INVESTIGACIONES PROYECTOS E INGENIERIA

Calle Virtudes 680, esq. Belascoain. Centro Habana, La Habana
Tel.: (53) 78643302 / 78641964 geipi@geipi.hidro.cu

We believe that the valuable technology transferred will allow the development of studies progressively in different regions of the country, leading to better and more efficient management of aquifers facing the climate change in the world.

Eng. Bernardo Rodriguez Fernández
Director-General of GEIPI.

Given in Havana on the 12th day of the month of December 2016.

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5-2：IC/R 協議会議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of explaining and discussing the Inception Report (henceforth "IC/R").

The JICA experts (henceforth "JICA Side") explained the IC/R and held a series of discussions with the pertinent Cuban authorities (henceforth "Cuban Side") concerning the successful implementation of the Project.

As a result of the discussions, the JICA Side and the Cuban Side agreed to the matters mentioned in the attached document.

Havana, February 6, 2013

木原茂樹

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency
(JICA)

Ing. Ana Lydia Hernández G.
Directora Técnica,
Grupo Empresarial de Investigaciones,
Proyectos a Ingeniería (GEIPI)

Ing. Ibrahim Plaza Peñalver
Ingeniero Principal Hidrogeólogo,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Witnessed by

井尾祐治

Dr. Yuji Maruo
Senior Advisor,
Japan International Cooperation Agency
(JICA)

Witnessed by

Ing. Vladimir Cabranes Alpizar
Director de Relaciones Internacionales y
Colaboración
Instituto Nacional de Recursos Hidráulicos
(INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Inception Report (IC/R)

The Cuban Side basically accepted the IC/R, as presented with further clarifications.

2. Implementation Structure of the Project:

The Cuban Side explained the assignment of the counterpart (C/P) personnel for the implementation structure of the Project. The said C/P personnel assignment table (the C/P members proposed by the Cuban Side for the 4 Working Groups) is shown in Appendix 2. The JICA Side accepted, in principle, the proposed members for the 4 Working Groups.

The JICA Side explained about Joint Coordination Committee (JCC), Project Execution Committee (PEC), and both sides agreed that the first meeting of PEC would be held in March 2013, and the first meeting of JCC in July 2013.

Both Sides agreed that the involuntary omission of the Director General of GEARH as the Deputy Project Manager was duly corrected in the document R/D, specifically, in the Implementation Structure of the Project, as well as in the Cuban Side Input of the Project Design Matrix (PDM).

3. Project Design Matrix (PDM) and Plan of Operation (PO)

The JICA Side explained the new version (draft) of PDM and PO, and the reasons for the proposed modifications.

The Cuban side agreed with the changes of PDM and PO, proposed by the JICA Side, in principle. The proposed changes are scheduled to be formally approved at the first JCC.

4. Preparation of Training Program and Activity

The JICA Side mentioned that the detailed training program and activity should be prepared in collaboration with the 4 Working Groups formed according to each of the 4 Results to be pursued in the Project.

The Cuban Side agreed with the joint preparation of the training program and activity.

5. Both Sides reached agreement on the following points.

5.1 Measures to be taken by the Cuban Side

The Cuban Side shall accord privileges, exemptions and other benefits to the JICA Side in accordance with the Record of Discussion signed on September 28, 2012.

5.2 Preparation of the Offices and the Budget for Local Cost

The Havana office for the JICA experts is ready to be used, and the Cuban Side confirmed the budget for local cost. The office in Quivican would be ready in two weeks.

5.3 Test well drilling

The Cuban Side confirmed the securing of financing for the test drilling and the scheduled timing for the start of test well drilling.

- In principle, 3 (three) test wells drilling is scheduled to begin in 2014, and to be completed by March 2015.
- In the event of the start of test well drilling ahead of the planned schedule indicated above, both Sides will discuss and adjust, if possible, the assignment schedule of the Japanese expert(s) whose advice may be needed in the test drilling activity.
- Both Sides confirmed the respective commitments made in the R/D, in order to avoid repeating the same mistakes as in Camaguey (late completion of less number of test wells than the original plan).

5.4 Equipments and Materials

The JICA Side explained the specifications of equipments and materials to be acquired by the Project, and the procurement schedule.

- The said equipments and materials, except the vehicles and groundwater flow / mass transfer software (FEM), are scheduled to be procured in the 1st year.
- The Cuban Side expressed agreement with the specifications of equipments and materials to be procured by the Project.

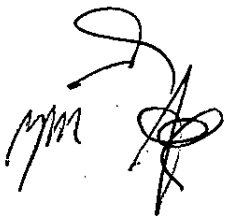
5.5 Training in Japan

The JICA Side explained that the training in Japan would be held tentatively in October 2014 (the beginning of the 3rd year) inviting 5 (five) Cuban engineers, and the detailed training

program is scheduled to be discussed considering the Results of Activities in the 1st and the 2nd years.

The Cuban Side informed that there is no obstacle to the dispatch of 5 (five) engineers for the training in Japan.

Appendix 1: List of Attendance
Appendix 2: C/P Personnel Assignment
Appendix 3: Project Design Matrix (PDM) Modification
Appendix 4: Plan of Operations (PO)
Appendix 5: Implementation Structure



Appendix 1

Attendance List

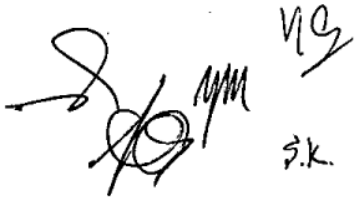
2013.2.6

Name	Institution	Position	Tel/Email
Aimeé Aguirre Hernández	INRH	Vice Presidenta	
Hildelisa Rodríguez	INRH	Especialista Colaboración	
Yaney Abreu	INRH	Especialista Colaboración	
Miriam Valdés Pérez	GEIPI	Directora General	
Ana Lidia Hernández González	GEIPI	Directora Técnica	
Fermín E. Sarduy	GEARH	Director General	
Ibrahim Plaza	GEARH	Especialista Hidrogeólogo	
Juana Dobarganes	MINCEX	Especialista de Colaboración	
Yuji Maruo	JICA	Senior Advisor	
Jun Moriguchi	JICA	Assistant Director	
Kenichiro Kawaji	JICA La Habana	Coordination Expert	
Atsushi Tsukiyama	Embajada	Secretary	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Expert, Team Leader / Groundwater Management	
Hirokatsu Utagawa	Kokusai Kogyo Co., Ltd.	Expert, Sub-leader / Water Quality	
Kiyoshi Yamada	Earth System Science Co., Ltd.	Expert, Hydrogeology 1	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Expert, Training Program / Coordinator	

Appendix 2

Cuban C/P Personnel Assignment

	Name	Institution	Position	Tel/Email
Groundwater Monitoring Group				
(1) Hydrogeology / Hydrology Sub-Group				
1	Francis F. Rguez. Rguez.	GEARH	ESPECIALISTA	
2	Ramón Yosvani Batista	GEARH	ESPECIALISTA	
3	Rafael Foeito Olivera	EIPH H GEIPI	ESPECIALISTA	
4	Ernesto Flores Valdés	EIPH H GEIPI	ESPECIALISTA	
5	Néstor Piñero Morales	EIPH H GEIPI	ESPECIALISTA	
6	Andrés Portal Casanova	EIPH H GEIPI	ESPECIALISTA	
7	Cesar Bujan Rubio	EIPH H GEIPI	ESPECIALISTA	
(2) Groundwater Observation Sub-Group				
1	Ibrahim Plaza Peñalver	GEARH	ESPECIALISTA	
2	Humberto García	GEARH	ESPECIALISTA	
3	Ernesto Morales Chirino	GEARH	ESPECIALISTA	
4	Hildelisa Jiménez Ponce de Leon	GEIPI	ESPECIALISTA	
5	Héctor Medina Alfonso	GEARH	ESPECIALISTA	
(3) GIS / DB Sub-Group				
1	Ramón Yosvani Batista	GEARH	ESPECIALISTA	
2	Celia yaima Batista	GEARH	ESPECIALISTA	
3	Humberto González	GEARH	ESPECIALISTA	
4	Ernesto Morales	GEARH	ESPECIALISTA	
5	Ernesto Flores Valdés	EIPH H GEIPI	ESPECIALISTA	
6	Pedro Luis García	EIPH H GEIPI	ESPECIALISTA	



7	Luis Ernesto Batista	EIPH H GEIPI	ESPECIALISTA	
8	Arturo Lorenzo Ferras	EIPH M GEIPI	ESPECIALISTA	
9	Orlando R Laiz Aberoff	EIPH M GEIPI	ESPECIALISTA	
Groundwater Modeling Group				
1	Dulce María Rodríguez	GEARH	ESPECIALISTA	
2	Celia Yaima Batista	GEARH	ESPECIALISTA	
3	Rafael González Abreu	GEARH	ESPECIALISTA	
4	Gabriel Alfonso	GEARH	ESPECIALISTA	
5	Alberto Cuellar Valenzuela	EIPH M GEIPI	ESPECIALISTA	
6	Lourdes Valdés González	EIPH H GEIPI	ESPECIALISTA	
7	Lemuel Ramos	CIH GEIPI	ESPECIALISTA	
8	Luis Fidel Miranda	EIPH CA GEIPI	ESPECIALISTA	
Groundwater Recharge and Seawater Intrusion Control Technology Group				
1	Arturo González Báez	GEIPI	ESPECIALISTA	
2	Fermin Sarduy Quintanilla	GEARH	ESPECIALISTA	
3	Juan Hernández Sierra	GEARH	ESPECIALISTA	
4	Humberto Garcia	GEARH	ESPECIALISTA	
5	Ernesto Morales Chirino	GEARH	ESPECIALISTA	
6	Ernesto Flores Valdés	EIPH H GEIPI	ESPECIALISTA	
7	Maricela Martínez Gracia	EIPH CMY GEIPI	ESPECIALISTA	
8	Adán Echemendia	EIPH CMY GEIPI	ESPECIALISTA	
Aquifer Management Group				
1	Ibrahim Plaza Peñalver	GEARH	ESPECIALISTA	
2	Dulce María Rodríguez	GEARH	ESPECIALISTA	
3	Fermin Sarduy Quintanilla	GEARH	ESPECIALISTA	
4	Ramón Yosvany	GEARH	ESPECIALISTA	

5	Humberto Gracia	GEARH	ESPECIALISTA	
6	Gabriel Alfonso	GEARH	ESPECIALISTA	
7	Lourdes Valdés González	EIPH H GEIPI	ESPECIALISTA	
8	Manuel Burgos	EIPH VC GEIPI	ESPECIALISTA	
9	Marta Suarez Acuña	GEARH	ESPECIALISTA	

Appendix 3 : Project Design Matrix (PDM)

Project Title: The project for Capacity Enhancement of Groundwater and Seawater Intrusion Management

Target Area: The selected areas of "Cuenca Sur" in Mayabeque and Artemisa Provinces

Duration: Four (4) years (48 months) (January 2013 – December 2016)

Target Group: GEIPI, EIPHH, GEARH, EAH-Mayabeque, EAH-Artemisa and INRH (Supervisory organization)

PDM Ver. 1.1: February , 6 in 2013

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumptions
Overall Goal The groundwater is managed in appropriate manner with the viewpoint of climate change in the selected southern coastal area of Mayabeque and Artemisa Provinces.	The hydrogeological condition, defined by the results of the Project, is sustainably maintained in the target area.	1. Monitoring data on groundwater	
Project Purpose Capacity of the institutions participating in the Project is improved in groundwater development and management including prevention of seawater intrusion in the target area.	1. The necessary personnel is allocated to the groundwater management related organizations based on the operation guidelines/manuals produced by the Project. 2. The counterpart personnel achieve the technologically satisfactory level.	1. Project Report 2. Judgment by Japanese Experts	•The Cuban government policy on groundwater development and management is maintained.
Outputs 1. The monitoring of aquifers is properly carried out in the target area. 2. The groundwater models are elaborated in the target area. 3. The various techniques are studied in terms of groundwater recharge and seawater intrusion control. 4. The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.	1. Monitoring data is accumulated regularly on GIS data base. 2. The groundwater models are calibrated once a year. 3. The Cuban side proposes more than one (1) appropriate measure for groundwater recharge and seawater intrusion control in the target area. 4. The first version of operation guidelines/manuals are prepared and distributed to the related personnel.	1. GIS data base 2. Calibration Report 3. Project Report 4. Project Report, The first version of operation guidelines/manuals.	•Those who subject to the transfer of technology do not leave their post.

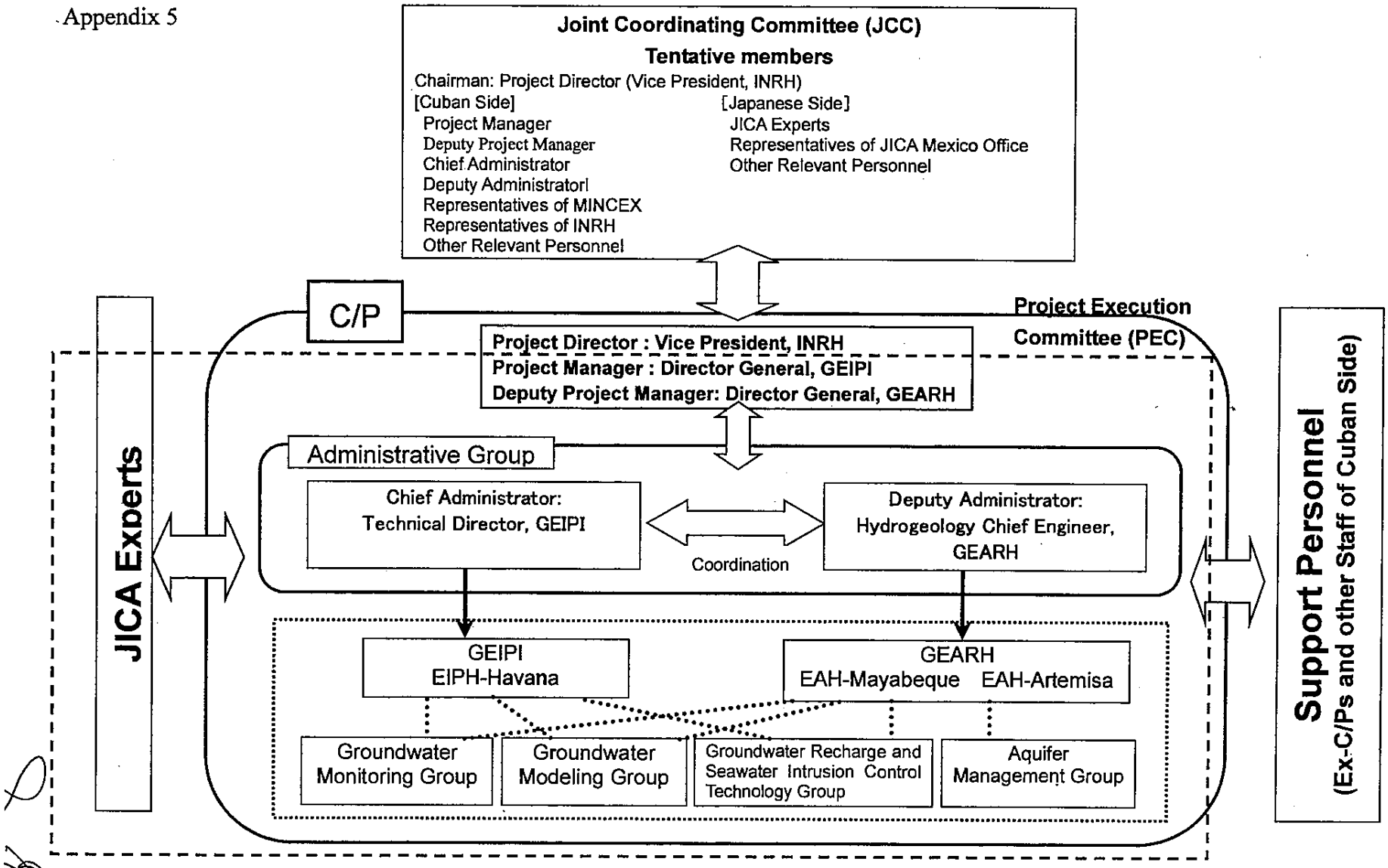
Activities	Inputs		Important Assumptions
1-1 To form the groundwater monitoring group and to evaluate its technical level. 1-2 To conduct the hydrogeological and hydrological investigation and geophysical exploration. 1-3 To install the observation equipment to the existing monitoring well. 1-4 To drill new test wells and to install the observation equipment. 1-5 To establish the observation network. 1-6 To establish GIS data base and to store the collected data. 2-1 To form the groundwater modeling group and to evaluate its technical level. 2-2 To analyze the various factors to calculate water balance and amount of groundwater recharge. 2-3 To elaborate the models for groundwater and seawater intrusion. 2-4 To calibrate the models with the newly collected data (approximately once a year). 2-5 To conduct the prediction analysis for the groundwater flow mechanism and seawater intrusion. 3-1 To form the groundwater recharge and seawater intrusion control technology group. 3-2 To study various cases in the world. 3-3 To examine the suitable methods of construction, considering the natural, social, economic and political conditions of the target area. 3-4 To make the preliminary design for the suitable method and to study its applicability. 4-1 To form the aquifer management group and evaluate their technical skill. 4-2 To verify the simulation results of models for groundwater and seawater intrusion. 4-3 To define the permissible hydrogeological conditions of the aquifer. 4-4 To prepare the annual pumping plan of each production well based on the results of analysis of groundwater model which is calibrated every year. 4-5 To prepare the groundwater management plan and its operation guidelines and manuals. 4-6 To prepare the implementation plan of works for groundwater recharge and seawater intrusion control. 4-7 To prepare a long-term groundwater management plan, taking into account the effect of climate change, groundwater recharge and seawater intrusion control works. 4-8 To hold the technical seminars on the implementation of groundwater management plan.	**[Japanese side]** 1. Experts ・ Leader / Groundwater Management ・ Groundwater model ・ Hydrogeology ・ Geophysical exploration ・ Water Quality ・ GIS/Data Base ・ Designing/Seawater intrusion ・ Coordinator/Training Program 2. Equipment ・ A set of groundwater monitoring ・ GPS ・ PC ・ Software — Software for seawater intrusion analysis — Software for groundwater model —GIS ・ Project Vehicle(s) with spare parts 3. Training in Japan 4. Technical seminars (cost for hall rental, printed materilals, meal and accommodation allowance for Cuban participants)	**[Cuban side]** 1. Human resources ・ Project Director ・ Project Manager ・ Deputy Project Manager ・ Chief Administrator ・ Deputy Administrator ・ Engineers ・ Technicians ・ Administrative staff ・ Driver(s) 2. Facilities ・ Offices for JICA experts (Habana and Quivican) ・ Storage for equipment (Havana and Quivican) 3. Activity cost ・ Test well drilling cost (materials, construction) ・ Workshops 4. Local Cost ・ Administration cost for JICA expert office (electricity and water) ・ C/P per diem including accommodation expenses	●The Cuban side actively involved in the project. ●Customs procedures and transport of equipment do not suffer significant delays. <Pre-conditions> ●Counterpart personnel are assigned appropriately in the related organizations.

Appendix 4
PO1.1 The Project for Capacity Enhancement of Groundwater and Seawater Intrusion Management

06/February/2013

Outputs	Activities	Japanese Experts							Cuban Engineers								Area	2013				2014				2015				2016				2017
		Leader/ Groundwater Management	Groundwater model	Hydrogeology	Geophysical exploration	Water Quality	GIS/ Data Base	Geography/ Seawater Intrusion	Groundwater Management	Geology	Hydrogeology	Groundwater Model	Geophysical exploration	Hydrology	GIS	Geography/ Seawater Intrusion	Cuenca Sur	1st year				2nd year				3rd year				4th year				
1. The monitoring of aquifers is properly carried out in the target area.																																	
	<Technology transfer in groundwater monitoring>																																
	1-1 (1) To form the groundwater monitoring group and to evaluate its technical level.		○		○	○	○			○	○		○	○	○		–																
	1-2 (1) To conduct the hydrogeological and hydrological investigation and geophysical exploration.		○		○	○				○	○		○	○			○																
	1-2 (2) To identify the test drilling points in the target area.	○	○		○	○				○	○		○	○			○																
	1-3 (1) To install the observation equipment to the existing monitoring wells.	○	○		○				○		○						○																
	1-4 (1) To conduct the test well drilling, well logging, pumping test and installation of equipment of the newly drilled wells.	○	○		○	○			○	○	○		○				○																
	1-5 (1) To study new monitoring points for surface water and groundwater based on the results of analysis of groundwater model and to make recommendation to the aquifer management group.	○	○	(○)	○					○	○	(○)	○	○			○																
	1-5 (2) To install monitoring wells, reflecting the proposal shown in 1-5 (1) in the monitoring network plan of GEARH.	○	○		○				○		○			○			○																
	1-6 (1) To collect and to arrange the monitoring data of groundwater and surface water.		○		○		○			○	○			○			○																
	1-6 (2) To establish GIS database and to store the collected data.	(○)	(○)	(○)	(○)		○	(○)	(○)	(○)	(○)	(○)		(○)	○	(○)	○																
	1-6 (3) To supply the monitoring data in GIS database to groundwater modeling group.						○								○		○																
2. The groundwater models are elaborated in the target area.																																	
	<Technology transfer in groundwater model>																																
	2-1 (1) To form the groundwater model group and to evaluate its technical level.	○		○							○	○		○			–																
	2-1 (2) To carry out the lecture on the preparation (development/elaboration) of groundwater model.	○		○					(○)		(○)	○		(○)			○																
	2-2 (1) To analyze the data (groundwater level, pump discharge, stream flow, meteorological data such as rainfall, temperature, evapotranspiration, etc. and water quality,) for calculation of water balance and amount of groundwater recharge.		○	○	○						○	○		○			○																
	2-3 (1) To design the models for groundwater and seawater intrusion.			○	○						(○)	○		(○)			○																
	2-3 (2) To elaborate the models for groundwater, seawater intrusion based on the calibration and verification.			○							(○)	○		(○)			○																
	2-4 (1) To calibrate the models with the newly collected data (approximately once a year).			○							(○)	○		(○)			○																
	2-5 (1) To prepare a scenario for analysis, combining different elements such as variation in the volume of recharge related to climate change, variation of the discharge volume (including the drilling of new wells), new works for the recharge and seawater intrusion.	○	○	○	○			○			○	○		○		(○)	○																
	2-5 (2) To provide to the groundwater recharge and seawater intrusion control technology group the calculation result of impact of the artificial recharge facilities and seawater intrusion control facilities based on the scenario shown 2-5 (1).			○				○				○					○																
	2-5 (3) To provide the groundwater monitoring group, (i) the projection of salinization in the future based on stage 2-5 (1) and (ii) the vulnerability information to be monitored in accordance with the results of calculations of the dynamics of groundwater.		○	○	○							○					○																
	2-5 (4) To provide the aquifer management group, (i) the state of salinization in the future based on the stage of 2-5 (1) and (ii) the results of estimation of groundwater dynamics.	○		○								○					○																
3. The various techniques are studied in terms of groundwater recharge and seawater intrusion control.																																	
	<Technology transfer in groundwater recharge and seawater intrusion control>																																
	3-1 (1) To form the groundwater recharge and seawater intrusion control technology group.				○			○		(○)	○			(○)		○	–																
	3-2 (1) To study various cases in the world.		(○)		○			○			○					○	○																
	3-3 (1) To examine the suitable methods of construction, considering the natural, social, economic and political conditions of the Cuenca Sur.		(○)	(○)	○			○		(○)	○	(○)		(○)		○	○																
	3-4 (1) To make the preliminary design for the suitable method and to study its applicability.			(○)	○			○			○	(○)				○	○																
4. The implementation of groundwater management plan is experimentally put into practice along with operation guidelines/manuals in the target area.																																	
	<Technology transfer in aquifer management>																																
	4-1 (1) To form the Cuenca Sur aquifer management group and to evaluate its technical level.	○							○								–																
	4-2 (1) To verify the simulation results of models for groundwater and seawater intrusion.	○		○					○			○					○																
	4-3 (1) To define the permissible hydrogeological conditions of the aquifer.	○	□	○					○			○			○		○																
	4-4 (1) To prepare the annual pumping plan of each production well based on the results of analysis of groundwater model which is calibrated every year.	○		○					○			○					○																
	4-5 (1) To prepare the groundwater management plan and its operation guidelines and manuals.	○	□	○	○		○	○	○		○	○		○	○	○	○																
	4-6 (1) To prepare the implementation plan of works for groundwater recharge and seawater intrusion control.	○			○			○	○		○	○				○	○																
	4-7 (1) To prepare a long-term groundwater management plan, taking into account the effect of climate change, groundwater recharge and seawater intrusion control works.	○	○	○	○		○	○	○		○	○		○	○	○	○																
	4-8 (1) To hold the technical seminar on the implementation of groundwater management plan.	○	○	○	○		○	○	○	○	○	○	○	○	○	○	–																
Activities related to all outputs																																	
	<Training in Japan>																																
	To select the participants for training in Japan.	○	○														–																
	To decide program of the training.	○	○														–																
	<Talleres en Cuba>																																
	To hold the technical seminars and workshops.	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	–																

Appendix 5



The Implementation Structure of the Project

5-3(1)：第 1 回 PEC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities during the first one and half months of the 1st Project Year according to the Plan of Operation (henceforth "PO").

The 1st Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban counterparts (C/P) and the JICA Experts (henceforth "JICA Side"), the members of PEC had a series of discussions for the successful implementation of the Project.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, March 19, 2013

SK

木原茂樹

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency
(JICA)

Ing. Miriam Valdés Pérez
Directora General,
Grupo Empresarial de Investigaciones,
Proyectos a Ingeniería (GEIPI)

Ing. Fermín Sarduy Quintanilla
Director General,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Ing. Ana Lydia Hernández G.
Directora Técnica,
Grupo Empresarial de Investigaciones,
Proyectos e Ingeniería (GEIPI)

Ing. Ibrahim Plaza Peñalver
Ingeniero Principal Hidrogeólogo,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Summary of Activities in the first one and half months of the 1st Project Year

The JICA Side reported a summary of activities in the first one and half months of the 1st project year. The Cuban Side basically accepted this explanation with further clarifications.

(1) To form the Groundwater Monitoring Group and to evaluate its technical level (Activity 1-1 on Project Design Matrix (henceforth "PDM"))

The kick-off meeting of the Hydrogeology / Hydrology Sub-Group and the Groundwater Observation Sub-Group was held on 18 February 2013. Afterwards, on 4 March 2013 was held the kick-off meeting of GIS/DB Sub-Group. The collection and the arrangement of related data are continued after the first kick-off meeting of the two Sub-Groups.

(2) To form the Groundwater Recharge and Seawater Intrusion Control Technology Group (Activity 3-1 on PDM)

The kick-off meeting of the Groundwater Recharge and Seawater Intrusion Control Technology Group was held on 5 March 2013.

(3) To study various cases in the world (Activity 3-2 on PDM)

After the kick-off meeting of the Groundwater Recharge and Seawater Intrusion Control Technology Group, the first seminar (theme: Groundwater Recharge) was held on 12 March 2013. The second seminar (theme: Seawater Intrusion Control Technology) was held on 15 March 2013. This activity will be continued in the future.

(4) To form the Aquifer Management Group and evaluate their technical skill (Activity 4-1 on PDM)

The kick-off meeting of the Aquifer Management Group was held on 12 March 2013.

(5) Basic Training of Groundwater Model

The basic training on Groundwater Model was held on 26-27 February 2013 to explain the data necessary for constructing a groundwater model. Ten engineers learned and practiced the input data requirement and handling for the groundwater model and groundwater recharge estimation method based on the Tank model.

S.K

2. Activity Plans (draft)

The JICA Side and the C/P explained the following activity plans (draft). The Cuban Side basically accepted these proposals for activity plans. Both sides will continue the corresponding discussions, and will prepare the final version by the first JCC meeting.

- Activity Plan for Groundwater Monitoring Group (draft)
- Activity Plan for Groundwater Recharge and Seawater Intrusion Control Technology Group (draft)
- Activity Plan for Aquifer Management Group (draft)

3. Equipments and Materials

The JICA Side explained the procurement schedule of the equipments and materials to be acquired by the Project. The Cuban Side promised to promptly complete all the necessary import and customs procedures for the timely reception of the equipment by the Cuban Side.

4. SIS Training

The JICA Side and GIS/DB Sub-Group requested the Cuban Side to hold the training for the operation method of GIS software (Cadcrop SIS) in June by the core engineers who participated in the Camagüey project. The Cuban Side mentioned that GEIPI will play the leading role in this matter with the due cooperation form GEARH.

5. Data

The JICA Side requested collection of the data listed below, and the Cuban Side promised to collect the necessary data.

- Meteorological data (for example, average monthly temperature since the 1950s) registered by organizations different from GEARH, such as the Meteorology Institute.
- Monthly discharge data that is compiled by Empresa de Aguas de La Habana
- Water quality data measured before the establishment of EAH-Mayabeque and EAH-Artemisa.

6. Geophysical Prospection

The JICA Side requested the participation of core engineers trained in Geophysical Prospection in the Camaguey Project. The Cuban Side basically accepted the participation of the said core engineers.

S.K

Appendix 1: List of Attendance

Appendix 2: Activity Plan (draft)

S.K

Appendix 1

List of Attendance

2013.3.19

Name	Institution	Position	Tel/Email
Fermín Sarduy Quintanilla	GEARH	Director General, GEARH	
Ana Lydia Hernández González	GEIPI	Technical Director, GEIPI	
Ibrahim Plaza Peñalver	GEARH	Specialist in Hydrogeology	
Arturo González Báez	GEIPI	Superior Specialist in Projects and Engineering	
Ernesto Flores Valdés	EIPH-La Habana	Specialist in Hydrogeology	
Pedro Luis García	EIPH-La Habana	Specialist	
Carlos Manuel Antela	EAH Artemisa	Technical Director	
Dulce M. Rodríguez Lugo	EAH Mayabeque	Technical Director	
Yosvanis Batista Cruz	EAH Granma	Specialist in Development and Management of Water Resources	
Celia Y. Garcés Batista	EAH Holguín	Specialist in Development and Management of Water Resources	
Yaney Abreu Díaz	INRH	Specialist in Cooperation	
Kenichiro Kawaji	JICA Havana	Expert in Coordination	

Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Kiyoshi Yamada	Earth System Science Co., Ltd.	Expert in Hydrogeology	
Masahiko Ikemoto	Kokusai Kogyo Co., Ltd.	Expert in GIS/DB	
Hiroshi Fujita	Kokusai Kogyo Co., Ltd.	Expert in Design / Marine Intrusion	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

Appendix 2

S.K

Plan de actividades de los Sub-Grupos del Hidrogeología / Hidrología y de Observación del Agua Subterránea (borrador)

Asunto	Plan de actividades
Objetivos de las actividades	• Se lleva a cabo adecuadamente el monitoreo de los acuíferos en el área objetivo.
Objetivo (Indicadores)	Los datos de monitoreo son archivados periódicamente en la base de datos de SIG.
Tareas necesarias antes de la planificación	1. Situación de ordenamiento de la información existente 2. Confirmación del sistema actual de monitoreo del agua subterránea 3. Nivel técnico de cada uno de los participantes
Parte Cubana / Experto de JICA	1. Parte Cubana <Sub-Grupo de Hidrogeología / Hidrología> – Ernesto Flores Valdés EIPH-Habana Líder – Rafael Feito Olivera EIPH-Habana – Néstor Piñero EIPH-Habana – Andrés Portal Casanova EIPH-Habana – Cesar Bujan Rubio EIPH-Habana – Francis F. Rguez. Rguez GEARH – Ramón Yosvani Batista EAH-Granma <Sub-Grupo de Observación del Agua Subterránea> – Ibrahim Plaza GEARH Líder – Hildelisa Jiménez Ponce GEIPI – Humberto García EAH-Mayabeque – Ernesto Morales Chirino EAH-Artemisa – Héctor Medina Alfonso EAH-Artemisa 2. Experto de JICA – Hidrogeología – Gestión de agua subterránea – Prospección geofísica
Contenido de actividades	1. Realizar estudios hidrogeológicos e hidrológicos y prospecciones geofísicas que sirvan de base para establecer una red de observación. <Estudio hidrogeológico> 1) Reordenar las propiedades hidrogeológicas del área objetivo para que sean comprensibles en forma tridimensional. – Los datos existentes aparecen resumidos en los mapas (①-1-1). – Se utiliza el mapa topográfico 1:25,000. Sistema de drenaje, ubicación de salida y entrada de karst se marca en el mapa y luego la información se guarda en formato digital (①-1-2). – Los planos geológicos e hidrogeológicos se guardan en formato digital (①-1-3). – Las secciones geológicas e hidrogeológicas son revisadas y se representan unas 10 secciones que cubren el área del proyecto con los registros de perforaciones y pozos. Las secciones se guardan en formato digital (①-1-4). – Realizar exploraciones hidrogeológicas para determinar litofacies y la ubicación de karst. (①-1-5). 2) Efectuar estudios de calidad de agua para investigar el cambio vertical de la calidad de agua en pozos existente. – La calidad del agua según profundidad será observada en los pozos de observación ubicados en la sección Norte-Sur (①-2-1). – La intrusion salina en los ríos y arroyos será indicada en los planos hidrogeológicos (①-2-2). 3) En base a dichos resultados, se prepararán los datos hidrogeológicos necesarios para establecer modelos de agua subterránea. – Forma tridimensional: (distribución geológica, isohipsas de superficies superiores e inferiores) (①-3-1). – Detalles (①-3-2). < Prospección geofísica >

S.K

	4) Preparar un plan de prospección basado en los resultados de estudios hidrogeológicos y prospecciones geofísicas existentes, y realizar estudios con énfasis en la comprensión de la distribución de karst y la de valores de resistividad en el área de intrusión salina. Respecto a la prospección y análisis de la distribución de karst, según necesidad se harán anotaciones adicionales en los textos de proyectos anteriores. – Reparar un plan de prospección (①-4-1). – Realizar estudios (①-4-2). – Adicionales en los textos (①-4-3). <Estudio hidrológico> 5) Ordenar las propiedades hidrológicas del área objetivo (precipitación, patrones de precipitación, datos meteorológicos como los de temperatura, caudal fluvial, nivel de agua fluvial, variación de las mareas, etc.), y poner estos datos a disposición del Grupo de Modelación del Agua Subterránea. – Los registros mensuales de precipitación se tabulan para cada estación de observación (1970-2013) (①-5-1). – Los registros diarios de precipitación se tabulan para cada estación de observación (1970-2013) (①-5-2). – Los datos meteorológicos mensuales (temperatura, etc.) se tabulan para cada estación de observación (1970-2013) (①-5-3). – La cantidad de bombeo de cada pozo de producción se tabula (mensualmente, por estación, anualmente) (1970-2013) (①-5-4). – Los datos hidrológicos mensuales (nivel de agua fluvial, caudal fluvial) se tabulan para cada estación de observación (1970-2013) (①-5-5). – Los registros diarios de variación de las mareas (nivel alto y bajo del agua y horarios) se tabulan para estación (1970-2013) (①-5-6). <Análisis General> 6) En base a los resultados arriba mencionados, se deducirán los sitios con deficiente información hidrogeológica y las áreas con una estructura hidrogeológica importante indicados por los resultados de la prospecciones geofísicas, y se determinarán los 3 sitios para perforaciones exploratorias, y los 7 sitios para instalar los medidores automáticos dentro del área objetivo. – En base a los resultados arriba mencionados, se deducirán los sitios con deficiente información hidrogeológica (①-6-1). – – Se determinarán los 3 sitios para perforaciones exploratorias (①-6-2). 2. Instalar los equipos de observación en los pozos existentes de monitoreo. – Instalar: Instalar medidores automáticos en 7 lugares donde sea deseable una observación contínua del nivel de agua subterránea de acuerdo a la estructura hidrogeológica determinada y los resultados del análisis de la variación del nivel de agua subterránea obtenidos en la Actividad (①-6-1) (②-1). – Recolección y ordenamiento de los datos: El Subgrupo de Observación de Agua Subterránea tendrá la responsabilidad por la recolección y ordenamiento de los datos (②-2). – Resumirán en un Manual: Se analizarán los métodos de ordenamiento de los resultados registrados automáticamente y la comprobación de su nivel de precisión, y se resumirán en un Manual (②-3). 3. Perforar nuevos pozos exploratorios, realizar registro eléctrico de pozos, prueba de bombeo e instalar medidores. – Ejecutar registros eléctricos y pruebas de bombeo en los pozos de prueba perforados por la Parte Cubana. Los resultados de la perforación y los registros eléctricos de pozos serán resumidos en una gráfica prismática de columnas al igual que en el proyecto anterio (③-1). – Efectuar el análisis de los datos de la pruebas de bombeo utilizando el texto del proyecto anterior y calcular la constante hidrogeológica (③-2). – Una vez instalados los medidores, el Subgrupo de Observación del Agua Subterránea se encargará de recolectar y ordenar los datos. (③-3). 4. Establecer la red de observación – Analizar con el Grupo de Manejo de Acuíferos las necesidades de nuevos puntos de

Plan de actividades del Sub-Grupo de SIG/BD (borrador)

Asunto	Plan de actividades
Resultado	Se lleva a cabo adecuadamente el monitoreo de los acuíferos en el área objetivo.
Tareas necesarias antes de la planificación	1. Papel de las entidades afines. 2. Miembros del grupo y su disponiblidad. 3. Nivel de conocimiento técnico de los miembros.
Objetivo (Indicadores)	Los datos de monitoreo son archivados periódicamente en la base de datos de SIG.
Miembros/ Expertos de JICA	1. Miembros 1) Pedro Luis García — EIPH-Habana — Líder 2) Ernesto Flores Valdés — EIPH-Habana 3) Orlando R Laiz Aberoff — EIPH-Habana 4) Luis Ernesto Batista — EIPH-Habana 5) Adrián Lugo — EIPH-Habana 6) Laritza Socorro — EIPH-Habana 7) Humberto García — EAH-Mayabeque 8) Ernesto Morales Chirino — EAH-Artemisa 9) Arturo Lorenzo Ferras — EIPI-Matanzas 10) Ramón Yosvani Batista — EAH-Granma 11) Celia Yaima Batista — EAH-Holguín 2. Experto de JICA 1) SIG/BD
Actividad	1. Estudiar los materiales existentes del área objetivo del proyecto 1) Obtener información hidrogeológica de EIPH-H, GEARH, EAH-Mayabeque, EAH-Artemisa y del proyecto anterior de JICA en Camagüey 2) Revisar y analizar el formato de la información existente 3) Obtener los mapas topográficos a escala 1:25,000 y las imágenes satelitales 4) Crear el formato de la base de datos del proyecto 5) Creación del sistema de intercambio de datos entre las entidades involucradas 2. Aplicación del SIG 1) Comprar el software y las PC 2) Planificación de la capacitación 3) Capacitación para operación de software 4) Creación de mapas básicos del proyecto 3. Actualizar la base de datos y el SIG 1) Recopilar los resultados de monitoreo e introducirlos a la base de datos 2) Reunión con los miembros del grupo para revisar la información obtenida
Metodología	Capacitación práctica con las PC
Cronograma	Marzo – Abril, 2013 ✓ Obtener información hidrogeológica de EIPH-H, GEARH, EAH-Mayabeque、EAH-Artemisa y del proyecto anterior de JICA ✓ Revisar y analizar el formato de la información existente ✓ Obtener los mapas topográficos a escala 1:25,000 y las imágenes satelitales ✓ Crear el formato de la base de datos del proyecto ✓ Creación del sistema de intercambio de datos entre las entidades involucradas Abril – Junio, 2013 ✓ Comprar el software y las PC ✓ Planificación de la capacitación ✓ Capacitación para operación de software ✓ Creación de mapas básicos del proyecto Después de agosto 2013, durante todo el período del proyecto ✓ Recopilar los resultados de monitoreo e introducirlos a la base de datos ✓ Reunión con los miembros del grupo para revisar la información obtenida
Lugar de la actividad	EIPH-Habana, EAH-Mayabeque, EAH-Artemisa

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	observación (agua subterránea/superficial) de acuerdo con los resultados de las simulaciones y reflejar las conclusiones en el establecimiento de la red de observación de agua subterránea de GEARH (④-1).			
Cronograma de las actividades /Experto JICA	1.	Creación del Subgrupo:	febrero, 2013	HG
	2.	①-1-1:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	3.	①-1-2:	febrero, 2013 (Cumplimiento: 27-28, febrero)	HG
	4.	①-1-3:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	5.	①-1-4:	febrero – mayo, 2013	HG
	6.	①-1-5:	marzo, 2013	HG
	7.	①-2-1:	mayo – julio, 2013	CA
	8.	①-2-2:	mayo – julio, 2013	CA
	9.	①-3-1:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	10.	①-3-2:	Julio, 2013	HG
	11.	①-4-1:	febrero – marzo, 2013 (Cumplimiento: 20, marzo)	HG
	12.	①-4-2:	junio – julio, 2013	HG
	13.	①-4-3:	julio, 2013	HG
	14.	①-5-1:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	15.	①-5-2:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	16.	①-5-3:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	17.	①-5-4:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	18.	①-5-5:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	19.	①-5-6:	febrero – marzo, 2013 (Cumplimiento: 22, marzo)	HG
	20.	①-6-1:	marzo – Julio, 2013	HG, PG, CA
	21.	①-6-2:	Julio, 2013	HG, PG, CA
	22.	②-1:	abril – julio, 2013	HG, CA
	23.	②-2:	abril – julio, 2013 (cont.)	HG, CA
	24.	②-3:	julio, 2013	HG, CA
	25.	③-1:	enero – junio, 2014	HG
	26.	③-2:	enero – junio, 2014	HG
	27.	③-3:	enero – junio, 2014	CA
	28.	④-1:	noviembre, 2013 – julio, 2014 (asesoría a GEARH continuará después del Año 3)	HG,CA, (MAS)
	HG: Hidrogeología, CA: Calidad de agua, PG: Prospección geofísica MAS: Modelo de agua subterránea			
Area de Actividad	• Area seleccionada de la Cuenca Sur en las Provincias de Mayabeque y Artemisa, así como sus alrededores			
Equipamiento requerido	• GPS			

Equipamiento necesario	PC, software de SIG
Otros materiales necesarios	● Base de datos existente (EIPH-Habana, GEARH, EAH-Mayabeque, EAH-Artemisa, proyecto anterior de JICA) ● Datos de monitoreo obtenidos durante el proyecto

Plan de Actividades del Grupo de Tecnología de la Recarga del Agua Subterránea y el Control de la Intrusión Salina (borrador)

Asunto	Plan de actividades
Resultados esperados y meta	Las diversas técnicas estudiadas en cuanto a recarga del agua subterránea y el control de la intrusión salina.
Temas a confirmar con anterioridad a la elaboración del plan de trabajo	[Recarga del Agua Subterránea] 1. Confirmar el nivel técnico de los participantes. 2. Confirmar el método actual de tecnología de recarga. [Control de la Intrusión Salina] 1. Confirmar el nivel técnico de los participantes. 2. Confirmar el nivel técnico para el diseño y la construcción estructural en Cuba. 3. Confirmar el método actual de contramedida.
Objetivos de la actividad, personas meta y expertos de JICA	1. Objetivos de la actividad Fortalecer la capacidad técnica de la recarga del agua subterránea y el control de la intrusión salina. 2. Personas meta 1) Arturo Gonzalez Baez — GEIPI — Leader 2) Rafael Feito Olivera — EIPH-Habana — Sub leader 3) Pedro Luis Garcia — EIPH-Habana 4) Amadelis Quesada — GEIPI 5) Ernesto Flores Valdes — EIPH-Habana 6) Lourdes Valdes Gonzalez — EIPH-Habana 7) Dulce Maria Rodviges — EAH-Mayabeque 8) Ibrahim Plaza Penalver — GEARH 3. Expertos de JICA 1) Experto para recarga del agua subterránea 2) Experto para control de la intrusión salina
Actividades y su contenido	[Recarga del Agua Subterránea] 1. Organizar el grupo, evaluar la actual tecnología de recarga y elaborar el plan de actividades junto a la C/P. 2. Estudiar las experiencias y ejemplos de recarga en el mundo. 3. Estudiar los métodos técnicos más adecuados teniendo en cuenta las condiciones naturales, sociales, etc. en el área objetivo. 1) Estudio preliiminar sobre las especificaciones tentativas aplicables a las actuales condiciones naturales y del uso del suelo. Materializar las especificaciones para que se evalúen en el modelo de agua subterránea (Resultado 2). 2) Revisión de las especificaciones del método de recarga a partir de los resultados de la simulación. 4. Diseño básico y estudio de factibilidad sobre las mejores técnicas aplicables. 1) Diseño básico del método de recarga en el área objetivo. 2) Revisión del diseño a partir de los resultados de la simulación, [Control de la Intrusión Salina] 1. Breve resumen del control de la intrusión salina. 1) Presentar la estructura del control de la intrusión salina (conferencia). 2) Realizar la conferencia para el flujograma de trabajo de la planificación de las contramedidas, a partir del control actual de la intrusión salina en el mundo. 2. Indagación sobre el nivel técnico con respecto al diseño y la construcción estructural. 3. Planificación del control de la intrusión salina. 3) Estudiar los métodos más adecuados de control y establecer sus especificaciones sobre la base de los resultados de la simulación (Resultado 2). 4) Revisar los métodos de control anteriores sobre la base de las actuales

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	coyunturas económicas y las tecnologías constructivas. 5) Planificar métodos factibles de control y establecer sus especificaciones. 4. Diseño básico para el control de la intrusión salina. 6) Realizar el diseño básico para el control de la intrusión salina. 7) Formular su cronograma de implementación. 5. Realizar un seminario sobre el plan de manejo del agua subterránea.
Método de las actividades	[Recarga del Agua Subterránea] 1. Impartir conferencia y capacitación. [Control de la Intrusión Salina] 1. Impartir conferencia y realizar la capacitación mediante el uso de computadoras.
Cronograma de las actividades	[Recarga del Agua Subterránea] marzo y junio-julio de 2013 ✓ Revisar las experiencias y ejemplos a nivel mundial (conferencia) noviembre a diciembre de 2013 y junio de 2014 ✓ Estudiar los métodos técnicos más adecuados teniendo en cuenta las condiciones naturales, sociales, etc. en el área objetivo. noviembre a diciembre de 2014 y junio de 2015 ✓ Estudiar los métodos técnicos más adecuados teniendo en cuenta las condiciones naturales, sociales, etc. en el área objetivo.(continuación). ✓ Realizar el diseño básico teniendo en cuenta las condiciones naturales, sociales, etc. en el área objetivo. noviembre de 2015 a enero de 2016 ✓ Estudiar los métodos técnicos más adecuados teniendo en cuenta las condiciones naturales, sociales, etc. en el área objetivo.(continuación). ✓ Realizar el diseño básico teniendo en cuenta las condiciones naturales, sociales, etc. en el área objetivo (continuación). [Control de la Intrusión Salina] marzo 2013 ✓ Presentar la estructura del control de la intrusión salina (conferencia) ✓ Realizar la conferencia para el flujograma de trabajo de la planificación de las contramedidas, a partir del control actual de la intrusión salina en el mundo ✓ Indagar sobre el nivel técnico con respecto al diseño y la construcción estructural. diciembre de 2013 ✓ Capacitación sobre contramedidas (continuación). ✓ Estudiar los métodos más adecuados de control y establecer sus especificaciones sobre la base de los resultados de la simulación (Resultado 2) junio 2014 ✓ Revisar los métodos de control anteriores sobre la base de las actuales coyunturas económicas y las tecnologías constructivas ✓ Planificar métodos factibles de control y establecer sus especificaciones noviembre 2014 ✓ Realizar el diseño básico para el control de la intrusión salina junio 2015 ✓ Realizar el diseño básico para el control de la intrusión salina ✓ Realizar seminario sobre manejo del agua subterránea (1) mayo 2016 ✓ Realizar el diseño básico para el control de la intrusión salina ✓ Formular su cronograma de implementación noviembre 2016 ✓ Realizar seminario sobre manejo del agua subterránea (2)
Sede de las actividades	EIPH-Habana
Equipamiento requerido	Computadoras
Materiales requeridos	[Recarga del Agua Subterránea]

	• Datos sobre estructura hidrogeológica (mapas geológicos, perfiles geológicos y estructura del acuífero, etc.). • Resultados de la simulación (Resultado 2). [Control de la Intrusión Salina] • Caso de estudio sobre control de la intrusión salina en el mundo. • Resultados de la simulación (Resultado 2). • Información sobre la experiencia constructiva de Cuba (experiencia de diseño y construcción de estructuras subterráneas). • Información sobre las restricciones de importación de equipos y materiales de construcción en Cuba.

Plan de actividades del Grupo de Manejo del Acuífero (borrador)

Asunto	Plan de actividades
Resultado y meta	• Se inicia la implementación experimental del plan de manejo de las aguas subterráneas de acuerdo con los lineamientos y manuales de operación en el área objetivo.
Confirmación antes de la planificación	Antes de la confección del plan, se confirmaron los siguientes aspectos con los miembros del Grupo. 1. Objetivos de la actividad del Grupo de Manejo del Acuífero. 2. El sistema regulatorio, de políticas, directrices, manuales, etc. en Cuba. 3. El "plan de manejo del agua subterranean," "el plan de utilización del agua (subterránea), etc. que se desarrollaron en Cuba. 4. Experiencia en la elaboración del "plan de manejo del agua subterranean," "el plan de utilización del agua (subterránea), etc. (entidad, miembros). – La experiencia del plan de desarrollo. – El nombre del plan y objetivo de desarrollo del plan. – El papel desempeñado por el miembro en el desarrollo del plan. 5. Evaluación de capacidades en relación con el manejo del agua subterránea (entidad, miembros). – Investigación hidrogeológica (levantamiento de campo, análisis). – Investigación hidrológica (agua superficial, meteorología) (levantamiento de campo, análisis). – Investigación sobre el agua subterránea (nivel del agua, calidad del agua) (levantamiento de campo, análisis). – Cálculo de la recarga del agua subterránea. – Cálculo de la descarga del agua subterránea. – SIG/BD. – Modelo del agua subterránea. – Estudio y/o diseño de las contramedidas para el fallo del agua subterránea (instalación, construcción). – Elaboración de las contramedidas para el fallo del agua subterránea (instalaciones, estructuras). – Sondeo socioeconómico. – Pronóstico de la demanda de agua. – Manejo de la tasa de bombeo. – Otras capacidades relacionadas con la elaboración del plan de manejo del agua subterránea. 6. Demanda sobre esta actividad.
Objetivos de la actividad / Recursos humanos de la parte cubana / Experto de JICA	1. Propósito de la actividad – Manejo del agua subterránea que integre el "balance hídrico" y el modelo tridimensional del agua subterránea. – La planificación hacia un desarrollo y manejo sostenibles del agua subterránea. 2. Parte cubana – Ibrahim Plaza GEARH Leader – Lourdes Valdés González EIPH-Habana – Fermín E. Sarduy GEARH – Dulce Mariá Rodrigez EAH-Mayabeque – Humberto García EAH-Mayabeque – Ernesto Morales Chirino EAH-Artemisa – Héctor Medina Alfonso EAH-Artemisa – Manuel Burgos EIPH-Villa Clara – Ramón Yosvani Batista EAH-Granma – Gabriel Alfonso EAH-Pinar del Río – Marta Suarez Acuña EAH-Camagüey 3. Experto de JICA – Líder/Manejo del Agua Subterránea – Hidrogeología (preparación del plan de implementación de obras para las instalaciones de recarga artificial) – Diseño/Intrusión Salina (preparación del plan de implementación de obras para el

	control de la intrusión salina)
Temas y contenido de la actividad	1. Verificar los resultados de simulación de los modelos del agua subterránea y de intrusión salina. – Modelo actual: Validación del resultado de la calibración del nivel y calidad del agua y estructura del modelo para el cálculo pronosticado (①-1). – Modelo de pronóstico: A partir del resultado del cálculo pronosticado sin nuevas contramedidas, se verifica la influencia (influencia en las instalaciones actuales y cambios en la tasa de bombeo y en la calidad del agua, etc.) en el uso actual del agua subterránea y se evalúa el efecto de las contramedidas existentes (①-2). 2. Establecer las condiciones hidrogeológicas permisibles del acuífero.. – Establecimiento de un nivel estándar de agua y de una calidad estándar de agua (calidad de agua permisible), a partir de las instalaciones existentes y el uso actual del agua (El estándar o norma en cada área se ofrece a partir del rango permisible tomando en consideración las condiciones de uso del agua subterránea en cuanto a las actividades económicas regionales, etc. Es necesario que la influencia que cada área reciba por la disminución en la entrada de agua subterránea se minimice) (②-1). 3. Preparar el plan de bombeo anual de cada pozo de explotación en base a los resultados de análisis del modelo del agua subterránea calibrado cada año. – Consideraciones sobre el plan de incremento y disminución de la tasa de bombeo en cada área mediante el uso del resultado del cálculo pronosticado del modelo de agua subterránea para lograr la "condición estándar permisible del acuífero en cada área" (③-1). – Consideraciones sobre la tasa futura de bombeo de cada pozo de producción a partir de los resultados anteriores (③-2). 4. Preparar el plan de manejo del agua subterránea, la pauta (lineamientos y manuales) de operación. – Consideraciones sobre la elaboración y contenido (borrador) del plan de manejo y guía operativa del agua subterránea (directrices y manual), etc. (④-1). – Completamiento de la elaboración y contenido (borrador) del plan de manejo y guía operativa del agua subterránea (directrices y manual), etc. (④-2). 5. Preparar el plan de implementación de obras de recarga de acuífero y control de intrusión salina. – Elaboración del plan de implementación (cronograma de construcción) de obras para la recarga del agua subterránea y el control de la intrusión salina (⑤-1). 6. Preparar el plan de manejo del agua subterránea a largo plazo, teniendo en cuenta el efecto del cambio climático, así como las obras de recarga y control de intrusión salina. – Realizar los cálculos pronosticados hasta 2100; se crea el escenario que refleje los diversos parámetros vinculados al cambio climático (⑥-1). – Se realiza el cálculo pronosticado a partir del escenario mencionado anteriormente y se proponen las contramedidas necesarias (⑥-2). – Se elabora un plan de manejo del agua subterránea a largo plazo hasta 2100 (⑥-3). 7. Organizar seminarios técnicos sobre la implementación del plan de manejo del agua subterránea. – Explicación y debate sobre la elaboración y contenido del plan de manejo y guía operativa del agua subterránea (directrices y manual), etc. (⑦-1). – Explicación y debate sobre el contenido y método operativo del plan de manejo y guía operativa del agua subterránea (directrices y manual), etc. (⑦-2). – Explicación sobre el contenido del plan de manejo del agua subterránea a largo plazo (⑦-3).
Método de la actividad	1. Trabajo cooperado 2. Capacitación: Caso de estudio en Japón y otros países
Cronograma de las actividades	1. marzo, 2013: Creación del Grupo de Manejo del Acuífero 2. noviembre, 2013: ①-1 3. noviembre – diciembre, 2013: ②-1 4. enero, 2014: ①-1, ①-2 5. enero – mayo, 2014: ②-1 6. junio, 2014: ①-1, ①-2

	7. julio – octubre, 2014:	②-1, ③-1
	8. noviembre, 2014:	①-1, ①-2
	9. noviembre – diciembre, 2014:	②-1, ③-1,③-2
	10. enero, 2015:	①-1, ①-2
	11. enero – mayo, 2015:	②-1, ③-1, ③-2, ④-1
	12. junio, 2015:	①-1, ①-2, ④-1, ⑦-1
	13. junio – octubre, 2015:	③-2, ④-2
	14. noviembre, 2015:	①-1, ①-2
	15. noviembre, 2015 - enero, 2016:	③-2, ④-2, ⑤-1, ⑥-1, ⑥-2
	16. febrero – junio, 2016:	④-2, ⑥-1, ⑥-2, ⑥-3
	17. junio, 2016:	⑦-2, ⑦-3
	18. julio, 2016 – :	Creación del sistema de implementación del plan de manejo del agua subterránea y realización de pruebas
	19. noviembre 2016:	Presentación de los resultados del proyecto
Sitio de planificación	• Área seleccionada de la Cuenca Sur de las Provincias Mayabeque y Artemisa..	
Equipamiento	• PC	
Después de la planificación	• Intercambio del plan de capacitación con las personas involucradas en el proyecto. • Confirmación de responsabilidades durante la actividad entre Japón y Cuba.	
Indicadores	• La primera versión de los lineamientos y manuales de operación está preparada y distribuida a las personas relacionadas.	

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5-3(2)：第 2 回 PEC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities during the 1st Project Year according to the Plan of Operation (henceforth "PO").

The 2nd Meeting of the Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban counterparts (C/P) and the JICA Experts (henceforth "JICA Side") according to the Progress Report 1 (P/R1), the members of PEC had a series of discussions for the successful implementation of the Project and basically accepted the P/R1.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, July 23, 2013

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency
(JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones,
Proyectos a Ingeniería (GEIPI)

Eng. Fermín Sarduy Quintanilla
Director General,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Technical Director,
Grupo Empresarial de Investigaciones,
Proyectos e Ingeniería (GEIPI)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Witnessed by

Mr. Tatsuo Suzuki
Coordination Expert in Cuba,
Japan International Cooperation Agency
(JICA)

Witnessed by

Eng. Aimeé Aguirre Hernández
Vice President,
Instituto Nacional de Recursos Hidráulicos
(INRH)

Eng. Vladimir Cabranes Alpizar
Director, International Relation &
Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos
(INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Progress Report 1 (P/R1)

The Cuban side basically accepted the P/R1 submitted by the JICA Side with further clarifications.

2. Summary of Activities in the 1st Project Year

The JICA Side and C/P summarized the activities in the 1st Project Year. The members of PEC basically accepted these explanations.

The summarized activities, as per PDM, were the following.

(1) To form the Groundwater Monitoring Group and to evaluate the technical level of the participants (Activity 1-1 on Project Design Matrix (henceforth "PDM"))

The kick-off meetings of the Hydrogeology / Hydrology Sub-Group and the Groundwater Observation Sub-Group were held on 18 February 2013. Afterwards, on 4 March 2013 was held the kick-off meeting of GIS/DB Sub-Group.

(2) To conduct the studies on hydrogeology, geophysical exploration and hydrology. (Activity 1-2 on PDM)

The Hydrogeology / Hydrology Sub-Group conducted the collection and arrangement of existing data, as well as the field reconnaissance to examine the hydrogeological structure in detail and select the test drilling points. The geophysical prospection was started from 15 July 2013.

The Groundwater Observation Sub-Group held five workshops about groundwater monitoring and water quality.

(3) To install the observation equipment in the existing monitoring wells. (Activity 1-3 on PDM)

The Hydrogeology / Hydrology Sub-Group and the Groundwater Observation Sub-Group selected 7 observation wells to install the automatic water level meter.

(4) To establish GIS data base and to store the collected data. (Activity 1-6 on PDM)

The GIS/DB Sub-Group conducted the following activities.

- Collection and arrangement of the hydrogeological data, satellite image data, etc.

- Design of GIS Data Base (Examination of format of data base)
- Training in the use of GIS software, from 15 to 23 July 2013.

(5) To form the Groundwater Modeling Group and to evaluate the technical level of the participants (Activity 2-1 on PDM)
The kick-off meeting of the Groundwater Modeling Group was held on 20 March 2013.

(6) To elaborate the models of groundwater and seawater intrusion. (Activity 2-3 on PDM)
The basic training on Groundwater Model was held on 26-27 February 2013 to explain the data necessary for constructing a groundwater model. The workshop on vertical two-dimensional model was held on 25 June 2013. The Groundwater Modeling group held meetings in several occasions to discuss the structure of the initial model.

(7) To form the Groundwater Recharge and Seawater Intrusion Control Technology Group (Activity 3-1 on PDM)
The kick-off meeting of the Groundwater Recharge and Seawater Intrusion Control Technology Group was held on 5 March 2013.

(8) To study various cases in the world (Activity 3-2 on PDM)
After the kick-off meeting of the Groundwater Recharge and Seawater Intrusion Control Technology Group, two workshops on Groundwater Recharge were held on 12 March and 17 July 2013 and two workshops on Seawater Intrusion Control Technology were held on 15 March and 1 April 2013.

(9) To form the Aquifer Management Group and evaluate the technical skill of the participants (Activity 4-1 on PDM)
The kick-off meeting of the Aquifer Management Group was held on 12 March 2013.

3. Equipments and Materials

The JICA Side explained the procurement of equipments and materials included in the Project. The Cuban Side explained the completion of import procedure and the management method of the already arrived equipment and materials.

4. Plan of Activities of the 2nd Year

The JICA Side explained the activity plan for the 2nd Year of the Project.

(1) 2nd Year Plan of Operation

The 2nd year is scheduled to begin in November 2013 and to end in July 2014.

(2) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

- The geological and hydrogeological data would be updated.
- The geophysical prospection would be continued.
- 3 (three) test wells drilling with well logging and pumping test would be conducted under the responsibility of the Cuban side.
- The plan for the network of observation wells would be prepared.
- GIS/DB would be established, and the collected data would be stored and updated.

(3) Output 2 (The groundwater models are elaborated in the target area.)

- The analysis of the various factors to calculate the water balance and amount of groundwater recharge would be continued.
- The Groundwater Model structure and parameters would be modified / adjusted based on the results of well drilling and updated hydrogeological data.
- The prediction analysis by using the Groundwater Model would be started.

(4) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

- The study of various techniques of groundwater recharge and seawater intrusion control would be continued.
- The suitable methods of construction, considering the natural, social, economic and political conditions of the target area would be examined.

(5) Output 4 (The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.)

- The simulation results of models of groundwater and seawater intrusion would be verified.
- The permissible hydrogeological conditions of the aquifer would be defined.
- The annual pumping plan of each production well based on the results of analysis of groundwater model would be prepared.

FSQ SK

(6) Training in Japan

The JICA Side explained that the training in Japan would be held tentatively in October 2014 (the beginning of the 3rd year) inviting 5 (five) Cuban engineers, and the detailed training program is scheduled to be discussed in the 2nd year.

(7) Technical Seminar

The JICA Side explained that the Technical Seminar of the 2nd Year would be held in June 2014.

5. Activities requested to the Cuban Side during August – October 2013

The JICA Side requested the Cuban Side to continue during August-October 2013 the following activities.

- Geophysical prospection according to the groundwater exploration plan.
- Collection and arrangement of monthly discharge data that is compiled by Empresa de Aguas de La Habana and pump discharge data of domestic water and irrigation water.
- Groundwater and surface water measurement (water level, water quality etc.) according to the monitoring plan.
- Training in the use of GIS software by Cuban side.

Appendix 1: List of Attendance

Appendix 1

List of Attendance

2013.7.23

Name	Institution	Position	Tel/Email
Aimeé Aguirre Hernández	INRH	Vice President	
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Miriam Valdés Pérez	GEIPI	Directora General	
Fermín Sarduy Quintanilla	GEARH	Director General, GEARH	
Ana Lydia Hernández González	GEIPI	Technical Director, GEIPI	
Ibrahim Plaza Peñalver	GEARH	Specialist in Hydrogeology	
Abel Fernández Díaz	INRH	Department of Rational Water Use	
Arturo González Báez	GEIPI	Superior Specialist in Projects and Engineering	
Ernesto Flores Valdés	EIPH-La Habana	Superior Specialist in Hydrogeology	
Rafael Feito Olivera	EIPH-La Habana	Superior Specialist in Hydrogeology	
Andrés Portal Casanova	EIPH-La Habana	Superior Specialist in Research and Projects	

Lourdes Valdés González	EIPH-La Habana	Specialist in Hydrogeology	
Pedro Luis García	EIPH-La Habana	Superior Specialist in Research and Projects	
Orlando Laiz Averhoff	EIPH-La Habana	Superior Specialist in Research	
Arturo Lorenzo Ferrás	EIPH-Colón/Matanzas	Superior Specialist	
Dulce M. Rodríguez Lugo	EAH Mayabeque	Technical Director	
Hildelisa Rodríguez Fumero	INRH	Principal Specialist in International Cooperation	
Yaney Abreu Díaz	INRH	Specialist in International Cooperation	
Atsushi Tsukiyama	Embassy of Japan	Secretary	
Tatsuo Suzuki	JICA Havana	Expert Coordinator in Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Hirokatsu Utagawa	Kokusai Kogyo Co., Ltd.	Expert, Sub-leader / Water Quality	
Lei Peifeng	Kokusai Kogyo Co., Ltd.	Expert, Groundwater Model 1	
Kiyoshi Yamada	Earth System Science Co., Ltd.	Expert in Hydrogeology	
Tsugio Ishikawa	Mitsui Mineral Development Engineering Co., Ltd.	Expert in Geophysical Exploration	
Masahiko Ikemoto	Kokusai Kogyo Co., Ltd.	Expert in GIS/DB	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

5-3(3)：第 3 回 PEC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities in the first stage of the 2nd Project Year according to the Plan of Operation (henceforth "PO").

The 3rd Meeting of the Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban counterparts (C/P) and the JICA Experts (henceforth "JICA Side") according to the Progress Report 2 (P/R2), the members of PEC had a series of discussions for the successful implementation of the Project and basically accepted the P/R2.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, January 23, 2014

S.K.

木原茂樹

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency
(JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones,
Proyectos a Ingeniería (GEIPI)

Eng. Fermín Sarduy Quintanilla
Director General,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Technical Director,
Grupo Empresarial de Investigaciones,
Proyectos e Ingeniería (GEIPI)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Witnessed by

Mr. Tatsuo Suzuki
Coordination Expert in Cuba,
Japan International Cooperation Agency
(JICA)

Witnessed by

Eng. Vladimir Cabranes Alpizar
Director, International Relation &
Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos
(INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Progress Report 2 (P/R2)

The Cuban side basically accepted the P/R2 submitted by the JICA Side with further clarifications.

2. Summary of Activities from November 2013 to Middle of January 2014

The JICA Side and C/P summarized the activities in the first stage of the 2nd Project Year. The members of PEC basically accepted these explanations.

The summarized activities, as per PDM, were the following.

(1) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

The Hydrogeology / Hydrology Sub-Group continued the collection, arrangement and analysis of existing data to examine the hydrogeological structure in detail.

The Groundwater Observation Sub-Group held six workshops about groundwater monitoring and water quality, in addition to installing the automatic water level meters in 7 existing monitoring wells.

The GIS/DB Sub-Group had the first meeting of the 2nd Project Year on 9 January 2014. The establishment of GIS/DB was continued.

(2) Output 2 (The groundwater models are elaborated in the target area.)

The first meeting of the 2nd Project Year was held on 10 January 2014. The establishment of 3D Groundwater model was continued.

(3) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

One workshop on Groundwater Recharge was held on 9 December 2013.

Three workshops on Seawater Intrusion Control Technology were held from 26 December 2013 to 10 January 2014.

(4) Output 4 (The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.)

The first meeting of the 2nd Project Year was held on 17 January 2014. In this meeting, the Aquifer Management Group discussed the basic data for the groundwater management.

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S.K.

3. Plan of Operation from End of January to March 2014

The JICA Side and C/P explained the activity plan from end of January to March 2014.

(1) Output 1 on PDM

- The geological and hydrogeological data would be updated.
- The geophysical prospection would be continued.
- The training of well logging would be conducted.
- Preparation for the drilling of 3 (three) test wells, with well logging and pumping test would be continued under the responsibility of the Cuban side.
- The monitoring work (groundwater, surface water) would be continued.
- GIS/DB would be established, and the collected data would be stored and updated.

(2) Output 2 on PDM

- The analysis of the various factors to calculate the water balance and amount of groundwater recharge would be continued.
- The Groundwater Model structure and parameters would be modified / adjusted based on the results of updated hydrogeological data.

(3) Output 3 on PDM

- The study of various techniques of groundwater recharge and seawater intrusion control would be continued.

(4) Output 4 on PDM

- The examination of basic data for the groundwater management would be continued.

(5) Training in Japan

The JICA Side explained that the training in Japan would be held tentatively in October 2014 (the beginning of the 3rd project year) inviting 5 (five) Cuban engineers, and the detailed training program is scheduled to be discussed in March 2014.

4. Equipment and Materials

The JICA Side explained the procurement of equipments and materials included in the Project. The Cuban Side explained the completion of import procedure and the management method of the already arrived equipment and materials.

V.S

S.K.

Appendix 1: List of Attendance

Appendix 2: Plan of the Test Drilling

Appendix 3: Management of equipment and materials

V.S

S.K.

Appendix 1

List of Attendance

2014.1.23

Name	Institution	Position	Tel/Email
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Miriam Valdez Pérez	GEIPI	Director General	
Ana Lydia Hernández González	GEIPI	Technical Director, GEIPI	
Ibrahim Plaza Peñalver	GEARH	Specialist in Hydrogeology	
Arturo González Báez	GEIPI	Superior Specialist in Projects and Engineering	
Hildelisa Jiménez Ponce	GEIPI	Superior Specialist	
Aimeé Aguirre Hernández	EIPH La Habana	Director General	
Ernesto Flores Valdés	EIPH-La Habana	Superior Specialist in Hydrogeology	
Rafael Feito Olivera	EIPH-La Habana	Superior Specialist in Hydrogeology	
Pedro Luis García	EIPH-La Habana	Superior Specialist in Research and Projects	
Manuel Aguiar Lamas	EAH Mayabeque	Director General	

Dulce M. Rodríguez Lugo	EAH Mayabeque	Technical Director	
Carlos Manuel Antela	EAH-Artemisa	Technical Director	
Ernesto Morales Chirino	EAH-Artemisa	Specialist – Techical Division	
Yainet Hernández	INRH	Specialist in International Relations	
Tatsuo Suzuki	JICA Havana	Expert Coordinator in Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Hirokatsu Utagawa	Kokusai Kogyo Co., Ltd.	Expert, Sub-leader / Water Quality	
Lei Peifeng	Kokusai Kogyo Co., Ltd.	Expert, Groundwater Model 1	
Masahiko Ikemoto	Kokusai Kogyo Co., Ltd.	Expert in GIS/DB	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

Appendix 2: Drilling Plan of Three Test Wells

The Drilling Plan of Three Test Wells is based on the following Agreement between the Japanese Side and the Cuban Side.

1. **Geophysical Study**

   This study will be conducted by using the specific Geophysics equipment that will be received in the coming months by the Project. The professionals of EIPH Havana will conduct the geophysical study in the second half of next March and the whole month of April, following the instructions of the JICA Expert in Geophysics, who will be in Cuba between February 19 and March 25 of the year 2014.

2. **Design of Test Wells**

   The design of test wells will take place during next March, when the JICA Experts in Geophysics and in Groundwater Management will be available to give very useful advice to Cuban professionals.

3. **Drilling of Test Wells**

   The drilling of test wells will take place starting in the second half of May, based on Geophysical Study, and in the presence of the JICA Expert in Groundwater Management.

4. **Financing**

   The Governments of the Provinces of Mayabeque and Artemisa are responsible for the financing of the drilling works of test wells, because of the new organization of the provincial governments of Mayabeque and Artemisa, which include hydraulic works in the budget of each of the provincial government, instead of assigning it to an independent institution as in other Provinces.

5. **Electric Logging and Pumping Test**

   The drilling of the test wells in the second half of May is expected to coincide with the arrival of the submersible pump and the generator, which, together with the Geophysics equipment will permit to undertake the electric logging and the pumping test of the drilled three test wells.

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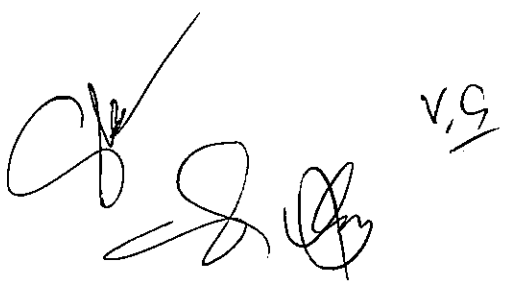
Apéndice 3: Management of equipment and materials

Item	Quantity	Organization	Responsibility
Portable water level meter	3	EIPH-La Habana	Ing. Ernesto Flores Valdés
	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
Automatic water level meter	4	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	3	EAH-Artemisa	Ing. Carlos Manuel Antela
	3	JICA Expert	Ing. Shigeki Kihara
Data transfer unit for automatic water level meter	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
Groundwater sampler with accessories	1	EIPH-La Habana	Ing. Ernesto Flores Valdés
	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
Portable water quality meter for well with accessories	1	EIPH-La Habana	Ing. Ernesto Flores Valdés
	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
Portable water quality analysis kit	1	JICA Expert	Ing. Shigeki Kihara
GIS software	1	EIPH-La Habana	Ing. Pedro Luis Garcia
	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
3D Groundwater flow analysis and Material transport software (FDM)	1	EIPH-La Habana	Ing. Ernesto Flores Valdés
	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
GPS	1	EIPH-La Habana	Ing. Ernesto Flores Valdés
	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
Desktop computers	1	EIPH-La Habana	Ing. Ernesto Flores Valdés
	1		Ing. Pedro Luis Garcia
	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
	2	JICA Expert	Ing. Shigeki Kihara
Laptop computers	1	EAH-Mayabeque	Ing. Dulce M. Rodríguez Lugo
	1	EAH-Artemisa	Ing. Carlos Manuel Antela
	1	JICA Expert	Ing. Shigeki Kihara



5-3(4)：第 4 回 PEC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

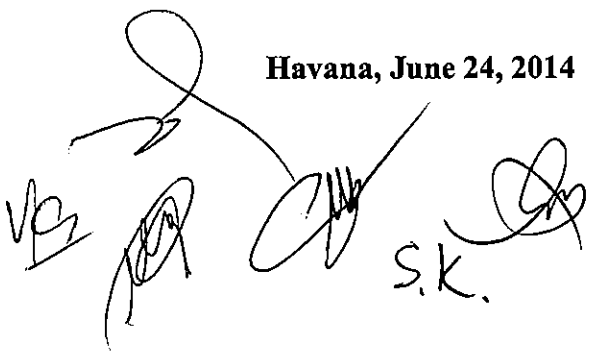
The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities in the last stage of the 2nd Project Year according to the Plan of Operation (henceforth "PO").

The 4th Meeting of the Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project, in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban counterparts (C/P) and the JICA Experts (henceforth "JICA Side") according to the Progress Report 3 (P/R3), the members of PEC had a series of discussions for the successful implementation of the Project and basically accepted the P/R3.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, June 24, 2014



Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency
(JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones,
Proyectos a Ingeniería (GEIPI)

P.O.
Eng. Fermín Sarduy Quintanilla
Director General,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Technical Director,
Grupo Empresarial de Investigaciones,
Proyectos e Ingeniería (GEIPI)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento
de los Recursos Hidráulicos (GEARH)

Witnessed by

Mr. Tatsuo Suzuki
Coordination Expert in Cuba,
Japan International Cooperation Agency
(JICA)

Witnessed by

Eng. Vladimir Cabranes Alpizar
Director, International Relation &
Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos
(INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Progress Report 3 (P/R3)

The Cuban side basically accepted the P/R3 submitted by the JICA Side, and complemented with further clarifications.

2. Summary of Activities in the 2nd Project Year

The JICA Side and C/P summarized the activities in the 2nd Project Year. The members of PEC basically accepted these explanations.

The summarized activities, as per PDM, were the following.

(1) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

The Hydrogeology / Hydrology Sub-Group continued the collection, arrangement and analysis of existing data to examine the hydrogeological structure in detail. The geophysical prospection team in EIPH-Havana continued the resistivity survey by using the existing equipment, and later in June started the resistivity survey plus the well logging as technical transfer in the use of the donated equipments. One test drilling was started on 16 June 2014.
The Groundwater Observation Sub-Group held eleven workshops about groundwater monitoring (groundwater level and water quality) in the 2nd Project Year, in addition to installing the automatic water level meters in 7 existing monitoring wells. The monitoring work of water level and quality was continued.
The GIS/DB training was held from 13 January to 27 February 2014. The establishment of GIS/DB was continued.

(2) Output 2 (The groundwater models are elaborated in the target area.)

The establishment of V2D and 3D Groundwater model was continued. The Groundwater Model training was held from 10 to 13 June 2014.

(3) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

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One workshop on Groundwater Recharge and three workshops on Seawater Intrusion Control Technology were held in the 2nd Project Year.

(4) Output 4 (The implementation of groundwater management plan is experimentally put into practice along with the operation guideline/manual in the target area.)

In the 2nd Project Year, the basic data arrangement for the groundwater management was continued. A lot of the Aquifer Management Group members participated in the activities from Output 1 to 3.

3. Plan of Activities of the 3rd Project Year

The JICA Side and C/P explained the activity plan in the 3rd Project Year.

(1) Output 1 on PDM

- The geological, hydrogeological, and water quality data would be updated.
- The geophysical prospection (resistivity survey and well logging) would be continued.
- The training of well logging would be continued.
- The training of pumping test would be continued.
- The monitoring work (groundwater, surface water) would be continued.
- The monitoring network plan would be established.
- GIS/DB would be established, and the collected data would be stored and updated.

(2) Output 2 on PDM

- The analysis of the various factors to calculate the water balance and amount of groundwater recharge would be continued.
- The Groundwater Model structure and parameters would be modified / adjusted based on the results of updated hydrogeological data.
- The real prediction analysis would be started.

(3) Output 3 on PDM

- The study of various techniques of groundwater recharge and seawater intrusion control would be continued.
- The examination of the suitable methods of construction, considering the natural, social, economic and political conditions of the Cuenca Sur Aquifer.

- The preparation of the preliminary design for the suitable method and the examination of its applicability.

(4) Output 4 on PDM

- The examination of basic data for the groundwater management would be continued.
- The verification of the simulation results of models for groundwater and seawater intrusion.
- The definition of the permissible hydrogeological conditions of the aquifer.
- The preparation of the annual pumping plan of each production well based on the results of analysis of groundwater model.
- The preparation of the groundwater management plan and its operation guidelines and manuals.

(5) Training in Japan

The JICA Side explained the training program (draft) of the training in Japan that would be held in October 2014 (the beginning of the 3rd Project Year).

4. Activities requested to the Cuban Side during July – October 2014

The JICA Side requested the Cuban Side to continue during July - October 2014 the following activities.

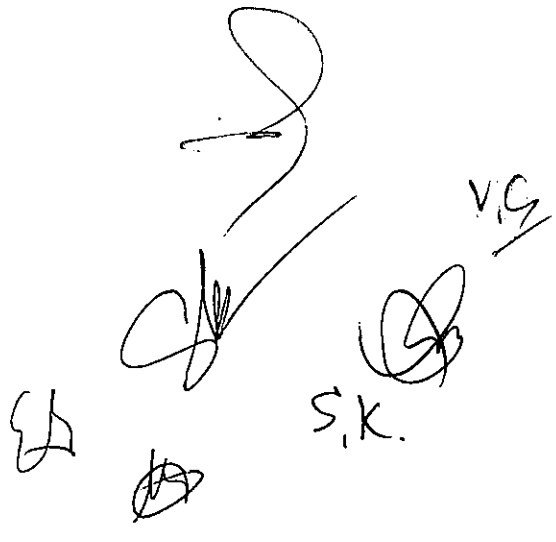
- Geophysical prospection using the donated equipments
- Test drilling work including the well logging and the pumping test
- Groundwater and surface water measurement (water level, water quality etc.) according to the monitoring plan
- Database training by Cuban Side according to the GIS/DB Sub-Group's plan
- Study at the initiative of the Cuban C/P on the data requirements of groundwater models
- Collection and arrangement of monthly discharge data of domestic water and irrigation water

5. Equipment and Materials

The Cuban Side explained that one automatic water level meter was lost because of the collapse of the wall of the well. In addition, the Cuban side explained that one portable water quality meter for well needed to be repaired by the manufacturer in Japan.

The Cuban Side presented explanations on the progress in securing the license plate of the second pick -up truck for the Project.

Appendix 1: List of Attendance



Appendix 1

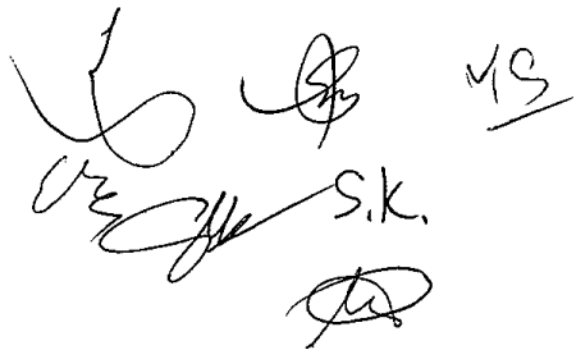
List of Attendance

2014.6.24

Name	Institution	Position	Tel/Email
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Miriam Valdez Pérez	GEIPI	Director General	
Eliy Alonso M	GEARH	Senior Specialist	
Ibrahim Plaza Peñalver	GEARH	Specialist in Hydrogeology	
Arturo González Báez	GEIPI	Superior Specialist in Projects and Engineering	
Ernesto Abreu Castillo	GEIPI	Director of the Logistics and Management Department	
Ernesto Flores Valdés	EIPH-La Habana	Superior Specialist in Hydrogeology	
Andrés Portal Casanova	EIPH-La Habana	Superior Specialist in Hydrogeology	
Yenisett Figueredo Chávez	INRH	Specialist in Cooperation Projects	
Tatsuo Suzuki	JICA Havana	Expert Coordinator in Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Lei Peifeng	Kokusai Kogyo Co., Ltd.	Expert, Groundwater Model 1	

S.K. VIC

Naoaki Shibasaki	Fukushima University	Expert, Groundwater Model 2	
Takuya Yabuta	Earth System Science Co., Ltd.	Expert, Hydrogeology	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	



5-3(5)：第 5 回 PEC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team began the field activities of the 3rd Project Year in November 2014, according to the Plan of Operation (henceforth "PO").

The 5th Meeting of the Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project, in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban Counterparts (C/P) and the JICA Experts (henceforth "JICA Side"), the members of PEC had a series of discussions in pursuance of the successful implementation of the Project.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, December 02, 2014

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency (JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones, Proyectos e Ingeniería (GEIPI)

Eng. Fermín Sarduy Quintanilla
Director General,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Technical Director,
Grupo Empresarial de Investigaciones, Proyectos e Ingeniería (GEIPI)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Witnessed by

Mr. Masami Shukunobe
Coordination Expert in Cuba,
Japan International Cooperation Agency (JICA)

Witnessed by

Eng. Vladimir Cabranes Alpizar
Director, International Relation & Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos (INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Plan of Activities of the 3rd Year

The Cuban side basically accepted the Plan of Activities of the 3rd year explained by the JICA Side with further clarifications.

(1) 3rd Year Plan of Operation

The 3rd year covers from September 2014 to July 2015.

(2) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

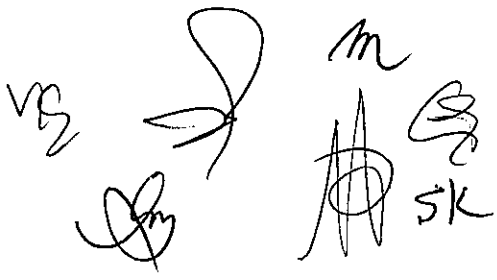
- Update of geological, hydrogeological, and water quality data
- Drilling of three (3) test wells, with well logging and pumping test, under the responsibility of the Cuban Side
- Continuation of geophysical prospection (resistivity survey and well logging)
- Continuation of training in well logging
- Continuation of training in pumping test
- Continuation of monitoring work (groundwater, surface water)
- Establishment of the Monitoring Network Plan
- Establishment of GIS/DB, and storage and update of collected data

(3) Output 2 (The groundwater models are elaborated in the target area.)

- Continuation of the analysis of the various factors to calculate the water balance and amount of groundwater recharge
- Modification/adjustment of the parameters of the Groundwater Model structure, on the basis of the results of updated hydrogeological data
- Start of the real prediction analysis

(4) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

- Continuation of the study of various techniques of groundwater recharge and seawater intrusion control
- Examination of the suitable methods of construction, considering the natural, social, economic and political conditions of the Cuenca Sur Aquifer



- Preparation of the preliminary design for the suitable method and examination of its applicability

(5) Output 4 (The implementation of Groundwater Management Plan is experimentally put into practice along with the operation guideline/manual in the target area.)

- Continuation of the examination of basic data for the Groundwater Management
- Verification of the simulation results obtained from Models of Groundwater and Seawater Intrusion
- Definition of the permissible hydrogeological conditions of the aquifer
- Preparation of the annual pumping plan of each production well based on the simulation results of Groundwater Model analysis
- Preparation of the Groundwater Management Plan and its operation guidelines and Manuals

(6) Technical Seminar

The JICA Side explained that the Technical Seminar of the 3rd Year would be held in June 2015. Emphasis will be placed, as much as possible, on Groundwater Management, because the focus of the Artemisa-Mayabeque Project is Groundwater Management.

(7) Intermediate Evaluation

The JICA Side explained that the Intermediate Evaluation of the Project would be held in January 2015 by a special JICA Mission. The evaluation will be based on the analyses of questionnaires, and a series of discussions and exchange of viewpoints with the concerned authorities in the Government of Cuba. The Cuban side accepted the schedule of the Intermediate Evaluation, to be conducted jointly with the Cuban evaluators.

During the JICA evaluation visit in January, a meeting will be scheduled, including all parties involved, in order to define the procedure to inform the monthly financial execution.

2. Training in Japan

The training in Japan was held from 6 to 17 October 2014.

Five (5) Cuban engineers, who were the Project trainees in Japan, explained the training program and the results obtained.

3. Delays in the Project Implementation

The JICA Side explained that there are some delays in the Project implementation, but efforts are being made to overcome the delays.

(1) Test well drilling

The Cuban Side explained the implementation schedule of three (3) test wells drilling with well logging, pumping test and installation of automatic water level meter.

(2) Data for groundwater model

The Cuban side explained the progress on collection and arrangement of evapotranspiration data, monthly discharge data of domestic water, irrigation water, etc.

December 10 remains as the deadline for the submittal of the well data requested.

4. Focus of the Artemisa-Mayabeque Project

The JICA Side explained that the focus of the Artemisa-Mayabeque Project is slightly different from the previous Camagüey Project, even though both are categorized as "technical cooperation" from Japan.

The focus of the Camagüey Project was "the training of fifteen (15) core Cuban engineers", who were planned to become the trainers of other Cuban engineers, so as to multiply the beneficial effects of the Project. In other words, the focus of the Camagüey Project was "training *per se*".

On the other hand, the focus of the Artemisa-Mayabeque Project is "Groundwater Management", where the training of Cuban engineers serves as a tool to achieve the ultimate goal of Groundwater Management, which will heavily depend on the simulation results of the Groundwater Models. Here lies the reason of the importance of constructing reliable Groundwater Models to serve as basis for Groundwater Management, and that explains the insistence of the JICA Side for some "necessary data" for Groundwater Models.

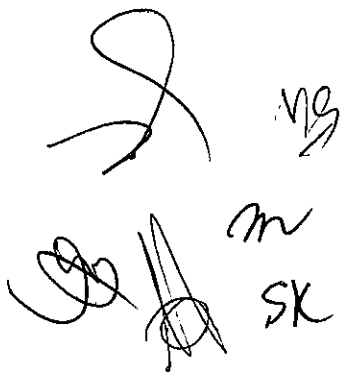
5. Equipment and Materials

The Cuban Side presented explanations on the management method of the donated equipment and materials, as well as on the progress in securing the import permission for the newly-purchased portable water quality meter sensor, which was acquired as replacement for

the same equipment, assigned to Mayabeque and taken to Japan for repair, but regrettably the manufacturer found it broken beyond repair. The JICA Side stated that the acquisition of this replacement equipment was fortunate, but it will not always be so fortunate, thereby requesting maximum care in the handling of the equipment of the Project, since a broken equipment may simply mean a loss of the equipment without the possibility of substitution.

In order to ensure the use of the vehicles (JICA-procured pick-ups) for the project-related works, the assignment of Japanese experts in Cuba will be scheduled throughout the year.

Appendix 1: List of Attendance



Appendix 1

List of Attendance

2014.12.2

Name	Institution	Position	Tel/Email
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Ana Lydia Hernández González	GEIPI	Technical Director, GEIPI	
Ibrahim Plaza Peñalver	GEARH	Senior Specialist	
Arturo González Báez	GEIPI	Senior Specialist in Projects and Engineering	
Aymée Aguirre Hernández	EIPH La Habana	Director General	
Annia Morales Hondal	EIPH La Habana	Director for Applied Research	
Ernesto Flores Valdés	EIPH-La Habana	Specialist in Hydrogeology	
Adrián Abilio Lugo Barro	EIPH-La Habana	Specialist in Topography	
Dulce M. Rodríguez Lugo	EAH Mayabeque	Technical Director	
Manuel González Rodríguez	INRH	Specialist from the International Relations Department	
Yenisett Figueredo Chávez	INRH	Specialist from the International Relations Department	

Yanisleidi Revilla CH.	INRH	Specialist from the International Relations Department	
Jun Komase	Embassy of Japan	Secretary	
Masami Shukunobe	JICA Havana	Expert Coordinator in Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Takuya Yabuta	Earth System Science Co., Ltd.	Expert, Hydrogeology	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

5-3(6)：第 6 回 PEC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities during the 3rd Project Year according to the Plan of Operation (henceforth "PO").

The 6th Meeting of the Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project, in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban Counterparts (C/P) and the JICA Experts (henceforth "JICA Side") according to the Progress Report 4 (P/R4), the members of PEC had a series of discussions for the successful implementation of the Project and basically accepted the P/R4.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, June 25, 2015

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Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency (JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones, Proyectos e Ingeniería (GEIPI)

Eng. Fermín Sarduy Quintanilla
Director General,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Technical Director,
Grupo Empresarial de Investigaciones, Proyectos e Ingeniería (GEIPI)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Witnessed by

Eng. Vladimir Cabranes Alpizar
Director, International Relation & Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos (INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Progress Report 4 (P/R4)

The Cuban side basically accepted the P/R4 submitted by the JICA Side, which complemented the contents of P/R4 with further clarifications during the PEC meeting.

2. Summary of Activities in the 3rd Project Year

The JICA Side and C/P summarized the activities in the 3rd Project Year. The members of PEC basically accepted these explanations.

(1) Output 1 in PDM

- The well logging was conducted in 3 test drilling wells in November 2014.
- The pumping test was conducted in JICA-3 test well in January 2015, and in JICA-2 test well in February 2015.
- The Hydrogeology / Hydrology Sub-Group held two workshops about pumping test analysis in Havana in June 2015.
- Hydrogeological structure analysis was continued based on the new collected data.
- The groundwater monitoring (water level) training was held in December 2014 (1 day each in Mayabeque and Artemisa) and June 2015 (1 day each in Mayabeque and Artemisa).
- The groundwater monitoring (water quality) training was held from January to March in 2015 (6 days in Havana, 3 days in Mayabeque and 2 days in Artemisa).
- The monitoring work of water level and water quality was continued, and the establishment of monitoring network was started.
- The GIS/DB training was held from January to February 2015 (5 days each in Mayabeque and Artemisa).
- The GIS/DB Sub-Group member visited EAH-Holguín and EIPH-Camagüey in February 2015, and inspected the operational environment of the existing GIS/DB system.
- GIS/DB system was established, starting the storage and update of collected data.

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(2) Output 2 in PDM

- The training sessions in Groundwater Model in Havana were held in February (3 days) and in June (2 days).
- The training sessions in Groundwater Model in Mayabeque were held from January to February (4 days) and in June (2 days).
- The training sessions in Groundwater Model in Artemisa were held from January to February (4 days) and in June (2 days).
- The calibration (modification/adjustment) continued with reference to the Groundwater Model (vertical 2 dimensional and 3 dimensional models) on the basis of the results of updated hydrogeological data.

(3) Output 3 in PDM

- The Groundwater Recharge and Seawater Intrusion Control Technology Group held four workshops in Havana in April 2015, concerning the underground dam construction technology.
- The Group members in EIPH-Havana prepared the report "Possibility to build an underground dam in La Cana basin, Las Tunas Province".

(4) Output 4 in PDM

- The workshops on Groundwater Management in Havana were held from April to May (4 days).
- The workshops on Groundwater Management in Mayabeque were held from April to May (5 days).
- The workshops on Groundwater Management in Artemisa were held from April to May (5 days).
- Study considerations proceeded on the contents of the Groundwater Management Plan (first half).

(5) Training in Japan

- The training in Japan was held from 6 to 17 October 2014 for 5 (five) Cuban participants, pursuing the following purposes.
  - Study of the latest investigation and measuring technology of the saline intrusion control

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- Inspection of the underground dam which is one of the saline water intrusion control technology and study of the management technology of related facilities
- Study of the groundwater management and monitoring methodology carried out by local authorities of Japan
- Inspection of the construction site of a diaphragm wall and study of the leading construction technology of the underground structure
- Inspection of an example of a groundwater obstacle (land subsidence)

3. Plan of Activities of the 4th Project Year

The JICA Side and C/P explained the activity plan in the 4th Project Year

(1) Output 1 of PDM

- Update of geological, hydrogeological, and water quality data
- Continuation of monitoring work (groundwater, surface water)
- Establishment of the Monitoring Network Plan
- Storage and update of collected GIS/DB data

(2) Output 2 (The Groundwater Models are elaborated for the target area.)

- Continuation of the analysis of the groundwater balance
- Calibration (modification/adjustment) of the Groundwater Model, on the basis of the results of updated hydrogeological data
- Future prediction calculations based on specified scenarios

(3) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

- Preparation of the suitable technologies related to the saline intrusion control from the long-term viewpoint

(4) Output 4 (The implementation of Groundwater Management Plan is experimentally put into practice along with the Operation Guideline/Manual in the target area.)

- Verification of the simulation results obtained from Models of Groundwater and Seawater Intrusion
- Preparation of the annual pumping plan of each production well based on the simulation results of Groundwater Model analysis

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- Preparation of the Groundwater Management Plan and its Operation Guidelines and Manuals
- Holding of the Technical Seminar on the implementation of Groundwater Management Plan (it is scheduled for June 2016)

(5) Final Technical Seminar of the Project results

The JICA Side explained that the Technical Seminar of the 4th Year would be held in November 2016 in Havana. The Cuban side accepted the schedule of the final Technical Seminar.

(6) Terminal Evaluation

The JICA Side explained that the Terminal Evaluation of the Project would be held in June 2016 by a special JICA Mission. The Cuban side accepted the schedule of the Terminal Evaluation, to be conducted jointly with the Cuban evaluators.

4. Activities Requested to the Cuban Side during July – October 2015

The JICA Side requested the Cuban Side to continue during July – October 2015 with the following activities.

- Completion of the test well drilling, with well logging and pumping test, under the responsibility of the Cuban Side
- Installation of the automatic water level meters in the test drilling wells
- Groundwater Model training by the Cuban Side
- Collection and arrangement of basic data for the Groundwater Management Plan, especially, scenario (planning for the future) creation
- Editing work of the first half of the Groundwater Management Plan

5. The Cuban Side's request for Activities in the 4th Project Year

The Cuban Side requested the JICA Side the following activities in the 4th Project Year. The JICA side accepted the Cuban side's third request and promised to continue the consideration of the above two requests.

- To consider the use of the Project vehicles at the time of the JICA side absence.
- To negotiate with JICA headquarters the additional implementation of the training in Japan.
- To prepare the action plan (schedule, person responsible, etc.).

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Appendix 1: List of Attendance

Appendix 2: Action plan

Appendix 1

List of Attendance

2015.6.25

Name	Institution	Position	Tel/Email
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Miriam Valdez Pérez	GEIPI	Director General	
Ana Lydia Hernández González	GEIPI	Technical Director	
Ibrahim Plaza Peñalver	GEARH	Senior Specialist	
Ernesto Morales Chirino	EAH Artemisa	Specialist	
Yenisett Figueredo Chávez	INRH	Specialist, International Relations	
Jun Komase	Embassy of Japan	Secretary, International Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Lei Peifeng	Kokusai Kogyo Co., Ltd.	Expert, Groundwater Model 1	
Naoaki Shibasaki	Fukushima University	Expert, Groundwater Model 2	
Takuya Yabuta	Earth System Science Co., Ltd.	Expert, Hydrogeology	
Masaru Obara	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

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Investigaciones y Proyectos
HIDRÁULICOS HABANA

Appendix 2: Action plan

July – October Activity to be executed by the Cuban side

No.	Activity Plan	Completion Date	Responsible Organization	Responsible Person	Location	Distance (km)	# Trips	Fuel Required
1	Completion of the test well drilling JICA 3		Boring Company	GEIPI Miriam	Quivicán			
	Pumping Test JICA 3		EIPHH y Perforación	GEIPI Miriam	Quivicán	70	2	
	Well Logging JICA 3		EIPHH	EIPHH. Annia	Quivicán	70	1	
	Installation of automatic water level meter JICA 3		GEARH Y EAHM	GEARH Ibrahim	Quivicán	70	1	
2	Installation of automatic water level meter JICA 1	July	GEARH Y EAHA	GEARH Ibrahim	Artemisa		1	
	Installation of automatic water level meter JICA 2	Sept	GEARH Y EAHM	GEARH Ibrahim	Batabanó	60	1	
3	Training on Mathematic Model	Sept-Oct	EIPHH	EIPHH. Annia	EAHM	50	4	
	Training on Mathematic Model	Sept-Oct	EIPHH	EIPHH. Annia	Artemisa	60	4	
4	Collection and arrangement of basic data for the Groundwater Management Plan	July	GEARH – EAHM	GEARH Ibrahim	Mayabeque	50	1	
	Collection and arrangement of basic data for the Groundwater Management Plan	Aug.	GEARH –EAHA	GEARH Ibrahim	Artemisa	60	1	
5	Editing work of the first half of the Groundwater Management Plan	Sept	GEARH – EAHM – EIPHH	GEARH Ibrahim	Mayabeque	50	1	
	Editing work of the first half of the Groundwater Management Plan	Oct.	GEARH- EAHA- EIPHH	GEARH Ibrahim	Artemisa	60	1	

Remarks: Training will take place 2 times per month in each EAH

5-3(7)：第 7 回 PEC 議事録

MINUTES OF MEETING
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THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team began the field activities of the 4th Project Year in October 2015, according to the Plan of Operation (henceforth "PO").

The 7th Meeting of the Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project, in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban Counterparts (C/P) and the JICA Experts (henceforth "JICA Side"), the members of PEC had a series of discussions in pursuance of the successful implementation of the Project.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, November 24, 2015

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency (JICA)

Eng. Miriam Valdés Pérez
Director General,
Grupo Empresarial de Investigaciones, Proyectos e Ingeniería (GEIPI)

Eng. Dixie Castillo Díaz
Director General,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Director of Science and Technology,
Instituto Nacional de Recursos Hidráulicos (INRH)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Witnessed by

Mr. Shoji Ozawa
Representative
JICA
Japan International Cooperation Agency (JICA)

Witnessed by

Eng. Vladimir Cabranes Alpizar
Director, International Relation & Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos (INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Plan of Activities of the 4th Year

The Cuban side basically accepted the Plan of Activities of the 4th year explained by the JICA Side with further clarifications.

(1) 4th Year Plan of Operation

The 4th year covers from September 2015 to February 2017 and the field activities are conducted from October 2015 to December 2016.

(2) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

- Update of geological, hydrogeological, and water quality data
- Continuation of monitoring work (groundwater, surface water)
- Establishment of the Monitoring Network Plan
- Storage and update of collected GIS/DB data

(3) Output 2 (The groundwater models are elaborated in the target area.)

- Continuation of groundwater balance analysis
- Calibration (modification/adjustment) of the Groundwater Model, on the basis of the results of updated hydrogeological data
- Future prediction calculations based on specified scenarios

(4) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

- Preparation of the suitable technologies related to the saline intrusion control from the long-term viewpoint

(5) Output 4 (The implementation of Groundwater Management Plan is experimentally put into practice along with the operation guideline/manual in the target area.)

- Verification of the simulation results obtained from Models of Groundwater and Seawater Intrusion
- Preparation of the annual pumping plan of each production well based on the simulation results of Groundwater Model analysis
- Preparation of the Groundwater Management Plan and its Operation Guidelines and Manuals

- Holding of the Technical Seminar on the implementation of Groundwater Management Plan (it is scheduled for June 2016)

(6) Groundwater Management Seminar

The JICA Side explained that the Groundwater Management Seminar would be held in June 2016. The Cuban side accepted the schedule of the Groundwater Management Seminar.

(7) Technical Seminar on Project Outputs

The JICA Side explained that the Technical Seminar of the 4th Year would be held in November 2016 in Havana. The Cuban side accepted the schedule of the final Technical Seminar.

(8) Terminal Evaluation

The JICA Side explained that the Terminal Evaluation of the Project would be held in June 2016 by a special JICA Mission. The Cuban side accepted the schedule of the Terminal Evaluation, to be conducted jointly with the Cuban evaluators.

2. Training in Japan

The JICA Side explained the training program (draft) of the training in Japan that would be held in February to March 2016 inviting 5 (five) Cuban engineers.

3. Schedule for Completion of the Groundwater Management Plan

The JICA Side and the Cuban Side agreed to the following schedule for completion of a groundwater management plan

- From the present to the end of December 2015: Completion of current condition analysis
- From January to May 2016: Completion of prediction analysis and preparation of measures for goal achievement
- June 2016: Completion of the groundwater management plan (draft)
- From July to October 2016: Trial of the groundwater management plan (draft)
- November 2016: Completion of the groundwater management plan

Appendix 1: List of Attendance

Appendix 1

List of Attendance

2015.11.24

Name	Institution	Position	Tel/Email
Vladimir Cabranes Alpizar	INRH	Director of International Relations	
Miriam Valdez Pérez	GEIPI	Director General	
Ibrahim Plaza Peñalver	GEARH	Especialista en Hidrogeología	
Hildelisa Jiménez Ponce de León	GEIPI	Senior Specialist	
Sebastián Crespo Delgado	GEIPI	System Management Director	
Aymée Aguirre Hernández	EIPH La Habana	Director General	
Annia Morales Hondal	EIPH La Habana	Director for Applied Research	
Ernesto Flores Valdés	EIPH-La Habana	Senior Specialist	
Dulce M. Rodríguez Lugo	EAH-Mayabeque	Senior Specialist	
Ernesto Morales Chirino	EAH-Artemisa	Specialist	
Jun Komase	Embassy of Japan	Chief of the Cooperation for Development Section	

Shoji Ozawa	JICA	Representative	
Masami Shukunobe	JICA Cuba	Expert Coordinator in Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Lei Peifeng	Kokusai Kogyo Co., Ltd.	Expert, Groundwater Model 1	
Takuya Yabuta	Earth System Science Co., Ltd.	Expert, Hydrogeology	

5-3(8)：第 8 回 PEC 議事録

MINUTES OF MEETING
BETWEEN
THE JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE NATIONAL INSTITUTE OF HYDRAULIC RESOURCES
OF THE REPUBLIC OF CUBA
ON
THE JAPANESE TECHNICAL COOPERATION PROJECT
"CAPACITY ENHANCEMENT OF GROUNDWATER AND
SEAWATER INTRUSION MANAGEMENT"
IN THE REPUBLIC OF CUBA

The Expert Team of the Japan International Cooperation Agency (henceforth "JICA") on the technical cooperation project for "Capacity Enhancement of Groundwater and Seawater Intrusion Management in the Republic of Cuba" (henceforth "the Project"), entrusted by JICA to conduct the Project, was sent to the Republic of Cuba with the purpose of attaining capacity development. The Expert Team carried out activities during the 4th Project Year according to the Plan of Operation (henceforth "PO").

The 8th Meeting of the Project Execution Committee (henceforth "PEC") was held to review and evaluate the progress of the Project, in the conference room of the National Institute of Hydraulic Resources (henceforth "INRH").

Based on the explanation of the activities by the Cuban Counterparts (C/P) and the JICA Experts (henceforth "JICA Side") according to the Progress Report 5 (P/R5), the members of PEC had a series of discussions for the successful implementation of the Project and basically accepted the P/R5.

As a result of the discussions, the JICA Side and the Cuban authorities (henceforth "Cuban Side") agreed to the matters mentioned in the attached document.

Havana, January 22, 2016

Mr. Shigeki Kihara
Leader of Experts/Groundwater Management,
Kokusai Kogyo Co., Ltd.
(entrusted by)
Japan International Cooperation Agency (JICA)

Eng. Miriam Valdés Pérez
Assistant to the President,
Instituto Nacional de Recursos Hidráulicos (INRH)

Eng. Rigoberto Morales Palacios
Director General,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Eng. Ana Lydia Hernández G.
Director of Science and Technology,
Instituto Nacional de Recursos Hidráulicos (INRH)

Eng. Ibrahim Plaza Peñalver
Principal Hydrogeologist,
Grupo Empresarial de Aprovechamiento de los Recursos Hidráulicos (GEARH)

Witnessed by

Mr. Masami Shukunobe
Coordination Expert in Cuba,
Japan International Cooperation Agency (JICA)

Witnessed by

Eng. Vladimir Cabranes Alpizar
Director, International Relations & Collaboration Bureau,
Instituto Nacional de Recursos Hidráulicos (INRH)

ATTACHED DOCUMENTS TO THE MINUTES OF MEETING

1. Progress Report 5 (P/R5)

The Cuban side basically accepted the P/R5 submitted by the JICA Side, which complemented the contents of P/R5 with further clarifications during the PEC meeting.

2. Summary of Activities from October 2015 to Middle of January 2016

The JICA Side and C/P summarized the activities in the first stage of the 4th Project Year. The members of PEC basically accepted these explanations.

(1) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

- The Hydrogeology / Hydrology Sub-Group continued the analysis and examination of the hydrogeological structure and pumping test in detail.
- The Groundwater Observation Sub-Group continued the monitoring work of water level and water quality and started the establishment of monitoring network.
- The GIS/DB Sub-Group continued the storage and update of collected GIS/DB data.

(2) Output 2 (The groundwater models are elaborated in the target area.)

- The training sessions in Groundwater Model in Havana were held from November to December (6 days).
- The training sessions in Groundwater Model in Mayabeque were held from November to December (4 days).
- The training sessions in Groundwater Model in Artemisa were held from November to December (4 days).
- The calibration (modification/adjustment) continued with reference to the Groundwater Model (3 dimensional models) on the basis of the results of updated hydrogeological and monitoring data.

(3) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

- The Groundwater Recharge and Seawater Intrusion Control Technology Group continued the studies of artificial recharge technology from the long-term viewpoint.

(4) Output 4 (The implementation of Groundwater Management Plan is experimentally put into practice along with the Operation Guideline/Manual in the target area.)

- The workshops on Groundwater Management in Havana were held from October to December (8 days).
- The workshops on Groundwater Management in Mayabeque were held from October to December (9 days).
- The workshops on Groundwater Management in Artemisa were held from October to December (7 days).
- The Aquifer Management Group continued the considerations of the Groundwater Management Plan (current condition analysis).

(5) Training in Japan

- The JICA Side explained the training program (draft) of the training in Japan that would be held in February to March 2016 inviting 5 (five) Cuban engineers.
- The Cuban side explained the readiness.

3. Plan of Operation from End of January to July 2016

The JICA Side and C/P explained the activity plan from end of January to July 2016.

(1) Output 1 (The monitoring of aquifers is properly carried out in the target area.)

- Update of geological, hydrogeological, and water quality data
- Continuation of monitoring work (groundwater, surface water)
- Establishment of the Monitoring Network Plan
- Storage and update of collected GIS/DB data

(2) Output 2 (The Groundwater Models are elaborated for the target area.)

- Continuation of the analysis of the groundwater balance
- Continuation of the calibration (modification/adjustment) of the Groundwater Model, on the basis of the results of updated hydrogeological and monitoring data
- Future prediction calculations based on specified scenarios

(3) Output 3 (The various techniques are studied in terms of groundwater recharge and seawater intrusion control.)

- Preparation of the suitable technologies related to the saline intrusion control from the long-term viewpoint

(4) Output 4 (The implementation of Groundwater Management Plan is experimentally put into practice along with the Operation Guideline/Manual in the target area.)

- Verification of the simulation results obtained from Models of Groundwater and Seawater Intrusion
- Preparation of the annual pumping plan of each production well based on the simulation results of Groundwater Model analysis
- Preparation of the Groundwater Management Plan and its Operation Guidelines and Manuals
- Holding of the Technical Seminar on the implementation of Groundwater Management Plan (it is scheduled for June 2016)

(5) Terminal Evaluation

The JICA Side explained that the Terminal Evaluation of the Project would be held in June 2016 by a special JICA Mission. The Cuban side accepted the schedule of the Terminal Evaluation, to be conducted jointly with the Cuban evaluators.

(6) Implementation structure

The Cuban Side explained the personal reshuffle and the implementation structure from end of January to December 2016.

Appendix 1: List of Attendance

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Appendix 1

List of Attendance

2016.01.22

Name	Institution	Position	Tel/Email
Miriam Valdez Pérez	INRH	Assistant to the President of INRH	
Lázaro González Martínez	GEARH	Technical Director	
Ana Lydia Hernández González	INRH	Director of Management, Innovation, and Technology	
Ibrahim Plaza Peñalver	GEARH	Senior Specialist in Hydrogeology	
Hildelisa Jiménez Ponce de León	GEIPI	Senior Specialist	
Sebastian Crespo Delgado	GEIPI	Technical Director	
Odet C. Herrera Betancourt	GEIPI	Specialist in Hydrogeology	
Aymée Aguirre Hernández	EIPH-La Habana	Director General	
Annia Morales Hondal	EIPH-La Habana	Director for Applied Research	
Ernesto Flores Valdés	EIPH-La Habana	Senior Specialist	
Rafael Feitó Olivera	EIPH-La Habana	Senior Specialist	

Amadelis Quesada Torres	EIPH-La Habana	Specialist	
Dulce M. Rodríguez Lugo	EAH-Mayabeque	Senior Specialist	
Humberto García Acosta	EAH-Mayabeque	Specialist	
Carlos Manuel Antela Acosta	EAH-Artemisa	Technical Director	
Ernesto Morales Chirino	EAH-Artemisa	Specialist	
Jun Komase	Embassy of Japan	Chief of the Cooperation for Development Section	
Yuichi Takemura	JICA	Official	
Masami Shukunobe	JICA Cuba	Expert Coordinator in Cooperation	
Shigeki Kihara	Kokusai Kogyo Co., Ltd.	Leader of Experts / Groundwater Management	
Takuya Yabuta	Earth System Science Co., Ltd.	Expert, Hydrogeology	
Makoto Tokuda	Kokusai Kogyo Co., Ltd.	Training Program / Coordinator	

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