

buried, for example, landslides, liquefaction, settling, or break of a geologic fault, problems that are addressed with the previously mentioned studies.

### Soft Soils

As mentioned before, the weight of the pipeline and its contents is less than that of the soil removed to place it in. This nulls the settling problem characteristic of soft soils, therefore the presence of weak soils is more a construction than a design problem, particularly in relation to the movement of construction equipment and the project's personnel.

### Erosion

There are 3 aspects to the erosion problem that are being evaluated. The first one is the potential of erosion that could undermine the pipeline at river crossings. The preliminary design of Vía Verde provides that the pipeline will pass under the bed of all the rivers and major ravines of the route, for which reason it is understood that the erosion of the channel and riverbed that could occur in those bodies of water will not have an impact on it. These sections of the project will be constructed using the HDD technique in which the drilling begins at a safe distance from the channel and runs under the riverbed at an adequate depth, which is determined through a subsoil exploration program with geotechnical drilling, an activity that is being currently undertaken.

The second aspect is the potential of erosion by the action of the waves in the stretch that runs near the Atlantic Ocean coastline. This is the stretch between El Cocal and the Bayamón River in Toa Baja. Soon will commence a photogrammetry evaluation that will evaluate the stability of these stretches of coastline during the past 70 to 80 years in terms of erosion and sedimentation, and it will serve as the basis to determine the need to implement protection measures against erosion caused by ocean waves. It bears mentioning that these stretches are generally the same in which the presence of liquefiable soils was identified, and that to minimize the potential of liquefaction and costal erosion, the pipeline will be installed by HDD at depths of 50 feet or more, which will protect the pipeline from the action of the waves. For this reason, Vía Verde will not affect the dunes or the coastline, therefore, during the construction and operation phases there will be no impact in the Levittown Coast stretch.

Finally, and certainly the AEE's greatest concern, is the potential of erosion in soils exposed by stormwater runoffs during the project's construction phase and subsequently in the long term. This will be addressed through the incorporation of strict short and long-term control measures in the design and the specifications for the project's construction, and a meticulous inspection of the functioning of these during and after the construction.

## 6.6 Impacts on Agriculture

In Peñuelas there will be a small impact on the Peñuelas, Guayanilla and Yauco Agricultural Reserve. This Reserve has a total area of 2,019,917 square meters and the temporary impact area will be 18,636 square meters, which equals 0.9% of the total Reserve area. In addition, once the project is completed in that area, agricultural activities will be able to continue in the same. The farmer will be indemnified by the AEE for the temporary damages. In addition, there is a farm where improved pasture is cultivated, the same is owned by Lucas Pérez Valdivieso and is divided in two parcels: 387-000-002-44 and 363-056-212-02.

Fifteen farms were identified in Adjuntas in which coffee is mostly cultivated and other crops such as citrus. The information of those farms is included below:

Cadaster Number	Titleholder	Crops
291-000-001-039	Charles H. Morgan	Not in use
291-000-001-038	Jose E. Carrillo Norat	Not in use
290-000-005-048	Unknown	Coffee
267-000-006-27	Jorge Ballester	Coffee
267-000-006-035	Sucn. Ramon Gonzalez Sotomayor	Coffee (the cultivated area is not affected)
267-000-006-59	Francisco López Atienza	Coffee
267-000-006-56	Unknown	Coffee
267-000-006-27	Unknown	Coffee
267-000-006-35	Unknown	Coffee
267-000-006-56	Unknown	Coffee (The cultivated area is not affected)
266-050-147-02	Unknown	Coffee
266-000-005-71	Unknown	Coffee
266-000-005-16	Unknown	Coffee
266-000-005-17	Unknown	Coffee
240-000-009-39	Luis Juan Ramos Santiago (Hacienda Central Pellejas)	Improved pastures

Ten farms were identified in the Municipality of Utuado in which coffee is mostly cultivated and other crops such as citrus. The information on these farms is included below:

Cadaster Number	Titleholder	Crops
214-000-004-14	Luis Juan Ramos Santiago (Hacienda Central Pellejas)	Improved pastures
214-000-009-34	Sucn. Juan Avila Rivera	Plantains
214-000-009-15	Juan Reyes Rivera	Coffee
214-000-009-25	Unknown	Plantains and coffee
214-000-009-16	Sucn. Juan Avila Rivera	Coffee
214-000-009-01	Unknown	Citrus, coffee and plantains
214-000-003-70	Sucn. Juan Avila Rivera	Citrus, coffee and plantains
214-000-003-48	Juan C. Cortes Lugo	Plantains
214-000-003-51	Juan C. Cortes Lugo	Plantains
214-000-003-23	Unknown	Plantains

Among the farms in Utuado, inside Hacienda Central Pellejas, there is a parcel with the FWS designation as a perpetual conservation easement and with approved permits for agro-touristic developments.

In the north of the island the farms identified belong to the Lands Authority (AT). These farms are identified in the following table:

Farm	Town	Use
Las Mercedes	Arecibo	Pastures for cutting
San Francisco	Arecibo	Pastures for cutting, milk cattle, government, natural reserve
Santa Bárbara	Arecibo	Pastures for cutting
Monte Grande	Arecibo	Pastures for cutting, autodrome, milk cattle, improved pastures
Tiburones Liza	Arecibo	Natural reserve, pastures for cutting
Garrochales	Arecibo	Landfill, pastures, natural reserve
Mendoza	Barceloneta	Sludge injection, pastures for cutting
Higuerito	Barceloneta	Pastures for cutting, cattle ranching, sludge injection
La Luisa	Manatí	Hay pastures, milk cattle
Sucn Vázquez Escobar	Vega Baja and Manatí	Pineapple farms

Carmen	Vega Alta	Transmission towers, forests
La Julia	Dorado	Agro-touristic park
Constancia	Toa Baja	Lawn planting, ornamental plants

Part of these farms are used for agriculture. Mostly they are planted with pasture for cutting and animal feed. The farms are also leased for activities such as: installation of transmission towers, autodrome, sludge injection and cattle ranching.

No pineapple groves were observed in the area of Barceloneta. These crops were found between miles 61.4 and 63.4, between the Municipalities of Manatí and Vega Baja. The same will be impacted with the 100-foot construction right-of-way. There will be coordination to construct in a season in which the impact is minimized. In case the impact is unavoidable, the AEE will indemnify farmers for their losses.

The Toa Valley in Toa Baja is catalogued as specially protected rustic soils with conservation of resources. Via Verde is compatible with this category because it will only present a temporary impact and after the construction the indicated uses can continue in effect.

The potential impacts on agricultural lands will include: Loss of crops, interference with agricultural drainage, loss of topsoil, soil compaction and impact to irrigation systems. Most of the impacts will be temporary, others will be permanent. The AEE will acquire a 150-foot wide right-of-way. Once construction ends, the lands can be used for planting again. The planting of trees whose roots could interfere with the pipeline will not be permitted.

The AEE will consult with the AT to determine the crops planting and harvesting seasons and establish the date when there would be less impact on agriculture. According to data from the AT, most of the crops are pastures and they are planted and harvested year-round. In all lands in active cultivation, the farmer affected will be indemnified for his damages. The AEE will pay for the damages caused by crop losses. The owner will be explained of the procedure he must follow to file his claim. Once the project's construction is completed, the farmers will be able to use the operations right-of-way to continue their crops, as long as they are short-rooted, such as vegetables, legumes and grasses.

As a measure to minimize the impact to sections of agricultural lands, the surface portion of the soil, or topsoil (the first 12 inches in depth) from the rest of the soil, and it will be stored to reuse it during the restoration stage. While this soil is stored, for a period no longer than a week under normal conditions, it will be covered with tarpaulin or natural covers to protect its quality and composition. Erosion control measures will also be implemented to avoid loss of nutrients in the soil and the surface terrain will be

decompacted to facilitate planting and water absorption. (See Section 6.4.2). Before starting the works in agricultural fields, the AEE will consult with the Department of Agriculture to obtain their recommendations with respect to the additional mitigation measures that should be implemented in each type of activity.

Control measures to protect alluvial aquifers that will be discussed in Sections 6.4 and 6.5 will be implemented. In addition there will be coordination with expert personnel from the Federal Department of Agriculture to obtain their recommendations for the protection of these aquifers.

The AEE will coordinate with the owners or lessees of the agricultural lands so they will identify the location of the irrigation systems, if any, and to provide copies of the available drawings, if available. In addition, there will be coordination with the owners of farms dedicated to agribusiness, to know the details of the cattle's movement patterns. Temporary bridges will be created over the trenches to permit the passage of animals, if the owner so requires. Otherwise, the work area will be cordoned off to prevent access to it by the animals. The owners or lessees will be notified, and coordination will be had with them to provide entry to the farm for the construction works.

Regarding the cumulative impact on agriculture, many of the agricultural areas have been impacted by earth movement activities for many years. The movement of earth can accelerate the erosion of the soil and the loss of topsoil and nutrients. This can result in low production and the excessive use of fertilizers to compensate for the lost resources. Notwithstanding, the impact of Via Verde, although unavoidable in these areas, is temporary. The quality of the topsoil should not be affected because it will be relocated from where it was removed, after being protected while the construction is carried out, so Via Verde will not contribute significantly as regards cumulative impact.

### **6.7 Impacts on Superficial Bodies of Water**

The possible impacts on bodies of water are: sedimentation, pollution due to spills, increase in turbidity, mortality of species, reduction of dissolved oxygen. Control measures to minimize these impacts that will be identified later will be implemented. In the event of a break in the pipeline in which the gas has to cross through a body of water before escaping to the atmosphere, the amount of gas that will dissolve in the water will be minute because the solubility of methane in water is 0.0022%. However, if the body of water is in movement, the gas will go quickly into the atmosphere due to the aeration process.

Two-hundred four (204) bodies of water through which the project will cross have been identified. This includes rivers, ravines, canals and a wetland. Some of these bodies of water will be crossed by open trench. When crossing by open trench, the trench is excavated while the body of water continues to flow through the 'dam and pump' method. This is the quickest method to cross small bodies of water.

Higher-volume bodies of water, such as rivers, will be crossed with the horizontal direct drilling method (HDD). HDD is considered a 'dry' crossing method because it does not interfere with the flow of water. This information is presented in the following table:

### Bodies of Water and Type of Crossing

T1-Horizontal Direct Drilling T2-Flume pipe, Dam and Pump T3- Open Trench

ID	Body of Water	Type of Crossing	Town
ID	Cuerpo de Agua	Tipo de cruce	Pueblo
C1	Canal	T1	Peñuelas
C2	Canal	T1	Peñuelas
C4	Canal	T3	Peñuelas
C5	Río Tallaboa	T1	Peñuelas
C6	Quebrada sin nombre	T3	Peñuelas
C7	Quebrada sin nombre	T3	Peñuelas
C8	Quebrada sin nombre	T3	Peñuelas
C9	Quebrada sin nombre	T3	Peñuelas
C10	Quebrada sin nombre	T3	Peñuelas
C11	Quebrada sin nombre	T3	Peñuelas
C12	Quebrada sin nombre	T3	Adjuntas
C13	Quebrada sin nombre	T3	Adjuntas
C14	Quebrada sin nombre	T3	Adjuntas
C15	Quebrada sin nombre	T3	Adjuntas
C16	Quebrada sin nombre	T3	Adjuntas
C17	Quebrada sin nombre	T3	Adjuntas
C18	Quebrada sin nombre	T3	Adjuntas
C19	Quebrada sin nombre	T3	Adjuntas
C20	Río Pellejas	T2	Utuaado
C21	Quebrada sin nombre	T3	Utuaado
C22	Quebrada sin nombre	T3	Utuaado
C23	Quebrada Arenas	T3	Utuaado
C24	Quebrada Arenas	T3	Utuaado
C25	Quebrada Arenas	T3	Utuaado
C26	Río Grande de Arecibo	T1	Utuaado
C27	Quebrada sin nombre	T3	Utuaado
C28	Quebrada sin nombre	T3	Utuaado
C29	Quebrada sin nombre	T3	Utuaado
C30	Quebrada sin nombre	T3	Utuaado
C31	Río Grande de Arecibo	T1	Utuaado
C32	Quebrada sin nombre	T3	Utuaado
C33	Quebrada sin nombre	T3	Utuaado
C34	Río Grande de Arecibo	T1	Utuaado
C35	Quebrada Jobos	T3	Utuaado
C38	Quebrada sin nombre	T3	Arecibo
C39	Río Tanama	T1	Arecibo

C40	Ditch	T3	Arecibo
C41	Canal Perdomo	T3	Arecibo
C42	Ditch	T3	Arecibo
C43	Rio Grande de Arecibo	T1	Arecibo
C44	Ditch	T3	Arecibo
C45	Ditch	T3	Arecibo
C46	Ditch	T3	Arecibo
C47	Ditch	T3	Arecibo
C48	Ditch	T3	Arecibo
C49	Ditch	T3	Arecibo
C50	Ditch	T3	Arecibo
C51	Ditch	T3	Arecibo
C52	Ditch	T3	Arecibo
C53	Ditch	T3	Arecibo
C54	Ditch	T3	Arecibo
C55	Ditch	T3	Barceloneta
C56	Ditch	T3	Barceloneta
C57	Ditch	T3	Barceloneta
C58	Ditch	T3	Barceloneta
C59	Ditch	T3	Barceloneta
C60	Ditch	T3	Barceloneta
C61	Ditch	T3	Barceloneta
C62	Ditch	T3	Barceloneta
C63	Ditch	T3	Barceloneta
C64	Ditch	T3	Barceloneta
C65	Ditch	T3	Barceloneta
C66	Rio Grande de Manati	T1	Manati
C67	Creek	T3	Manati
C68	Creek	T3	Manati
C69	Caño de los Nachos	T3	Manati
C70	Ditch	T3	Manati
C71	Ditch	T3	Manati
C72	Rio Grande de Manati	T1	Manati
C73	Rio Grande de Manati	T1	Manati
C74	Rio Indio	T1	Vega Baja
C75	Rio Indio	T1	Vega Baja
C76	Rio Indio	T1	Vega Baja
C78	Quebrada sin nombre	T3	Vega Baja
C80	Rio Cibuco	T2	Vega Alta
C81	Quebrada sin nombre	T3	Vega Alta
C82	Ditch	T3	Dorado
C83	Rio de la Plata	T1	Toa Baja
C84	Ditch	T3	Toa Baja
C85	Ditch	T3	Toa Baja
C86	Ditch	T3	Toa Baja
C87	Ditch	T3	Toa Baja
C88	Ditch	T3	Dorado
C89	Rio Cocal	T3	Dorado

C90	Rio Cocal	T1	Toa Baja
C91	Quebrada sin nombre	T3	Toa Baja
C95	Rio Hondo / Rio Bayamón	T1	Cataño
C97	Ditch	T3	Toa Baja
C98	Quebrada Diego	T3	Bayamón
C99	Quebrada Las Lajas	T3	Guaynabo
C100	Quebrada Santa Catalina	T3	Guaynabo
W1	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W2	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W3	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W4	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W5	Canal,Mangle	No impacto	Peñuelas
W8	Canal	T3	Peñuelas
W9	Canal	T3	Peñuelas
W10	Palustrine-Man Altered,Herbaceous	Humedal	Peñuelas
W11	Canals	T2	Utado
W17	Palustrine-Herbaceous	Wetland	Arecibo
W19	Palustrine- man altered herbaceous	Wetland	Arecibo
W20	Canal	T3	Arecibo
W21	Palustrine, man altered herbaceous	Wetland	Arecibo
W22	Palustrine, man altered herbaceous	Wetland	Arecibo
W24	Palustrine- man altered herbaceous	Wetland	Arecibo
W25	Canals	Wetland	Arecibo
W26	Palustrine- man altered herbaceous	Wetland	Arecibo
W27	Canals	Wetland	Arecibo
W28	Canals	T3	Arecibo
W29	Canals	Wetland	Arecibo
W30	Palustrine herbaceous	Wetland	Arecibo
W32	Palustrine herbaceous	Wetland	Arecibo
W33	Palustrine herbaceous	Wetland	Arecibo
W34	Palustrine, man altered herbaceous	Wetland	Arecibo
W35	Palustrine- man altered herbaceous	Wetland	Arecibo
W36	Canals	Wetland	Arecibo
W37	Palustrine-man altered herbaceous	Wetland	Arecibo
W38	Palustrine-man altered herbaceous	Wetland	Arecibo
W39	Palustrine herbaceous	Wetland	Arecibo
W40	Palustrine herbaceous	Wetland	Arecibo
W41	Palustrine herbaceous	Wetland	Arecibo
W42	Palustrine herbaceous	Wetland	Arecibo
W43	Palustrine herbaceous	Wetland	Arecibo
W44	Palustrine-man altered	Wetland	Arecibo



	herbaceous		
W45	Palustrine-man altered herbaceous	Wetland	Arecibo
W46	Palustrine-man altered herbaceous	Wetland	Arecibo
W47	Palustrine-man altered herbaceous	Wetland	Arecibo
W48	Palustrine-man altered herbaceous	Wetland	Arecibo
W49	Palustrine herbaceous	Wetland	Arecibo
W50	Palustrine herbaceous	Wetland	Arecibo
W51	Palustrine herbaceous	Wetland	Arecibo
W52	Palustrine herbaceous	Wetland	Barceloneta
W53	Palustrine herbaceous	Wetland	Barceloneta
W54	Palustrine herbaceous	Wetland	Barceloneta
W55	Palustrine-man altered herbaceous	Wetland	Barceloneta
W56	Palustrine herbaceous	Wetland	Barceloneta
W57	Palustrine herbaceous	Wetland	Barceloneta
W58	Palustrine herbaceous	Wetland	Barceloneta
W59	Canals	T3	Barceloneta
W60	Palustrine herbaceous	Wetland	Manati
W61	Palustrine, man altered herbaceous	Wetland	Manati
W62	Palustrine herbaceous	Wetland	Manati
W64	Palustrine-herbaceous	Wetland	Manati
W65	Palustrine, man altered herbaceous	Wetland	Manati
W66	Palustrine-man altered herbaceous	Wetland	Manati
W67	Palustrine-man altered herbaceous	Wetland	Manati
W68	Canals	Type 3	Manati
W69	Palustrine, man altered herbaceous	Wetland	Manati
W70	Palustrine-man altered herbaceous	Wetland	Manati
W71	Palustrine-man altered herbaceous	Wetland	Manati
W72	Palustrine herbaceous	Wetland	Manati
W74	Palustrine herbaceous	Wetland	Manati
W76	Palustrine herbaceous	Wetland	Manati
W77	Palustrine-man altered herbaceous	Wetland	Manati
W78	Canal	T2	Vega Baja
W79	Canal	T2	Vega Baja
W80	Canal	T2	Vega Baja
W81	Canal	Wetland	Vega Baja
W82	Palustrine-herbaceous	Wetland	Vega Baja
W83	Palustrine-herbaceous	Wetland	Vega Baja
W84	Canal	T2	Vega Alta
W85	Palustrine-herbaceous	Wetland	Vega Baja

W86	Canal	T2	Vega Alta
W87	Palustrine herbaceous	Wetland	Vega Alta
W88	Palustrine herbaceous	Wetland	Vega Alta
W89	Palustrine-man altered herbaceous	Wetland	Vega Alta
W90	Palustrine-man altered herbaceous	Wetland	Vega Alta
W91	Palustrine herbaceous	Wetland	Vega Alta
W92	Palustrine-man altered herbaceous	Wetland	Dorado
W93	Palustrine-man altered herbaceous	Wetland	Dorado
W94	Palustrine-man altered herbaceous	Wetland	Dorado
W95	Palustrine-man altered herbaceous	Wetland	Dorado
W96	Canal	T3	Toa Baja
W97	Palustrine-man altered herbaceous	Wetland	Toa Baja
W98	Palustrine-man altered herbaceous	Wetland	Toa Baja
W99	Palustrine-man altered herbaceous	Wetland	Toa Baja
W100	Palustrine-man altered herbaceous	Wetland	Toa Baja
W101	Canal	Wetland	Dorado
W103	Estuarine Forested	T1	Toa Baja
W105	Palustrine herbaceous	Wetland	Toa Baja
W112	Canal	Wetland	Toa Baja
W113	Palustrine herbaceous	Wetland	Toa Baja
W116	Palustrine herbaceous	Wetland	Toa Baja
W117	Palustrine herbaceous	Wetland	Cataño
W118	Palustrine herbaceous	Wetland	Bayamón/Cataño
W119	Palustrine herbaceous	Wetland	Bayamón
W120	Palustrine herbaceous	Wetland	Guaynabo
W121	Canal	T3	Guaynabo
W122	Canal	Wetland	Guaynabo
W123	Palustrine herbaceous	Wetland	Guaynabo
W124	Estuarine forested	Wetland	Guaynabo
W125	Estuarine forested	Wetland	Guaynabo
W126	Estuarine forested	Wetland	Guaynabo
W127	Estuarine forested	Wetland	Guaynabo
W128	Canal	Wetland	Guaynabo
W129	Estuarine forested	Wetland	Guaynabo
W130	Palustrine herbaceous	Wetland	Guaynabo
W131	Palustrine herbaceous	Wetland	Guaynabo
W132	Palustrine herbaceous	Wetland	Guaynabo
W133	Palustrine herbaceous	Wetland	Guaynabo
W134	Canal	No impact	Guaynabo
W135	Canal	No impact	Guaynabo
W137	Canal	No impact	Guaynabo

Throughout almost its entire course of 92 miles, the pipeline will be installed at least 3 feet under the terrestrial surface and at least 6 feet under the river beds and ravines. No permanent effect on the bodies of water is anticipated. However, a temporary effect during the construction process in the crossing of river ravines is anticipated, which will be appropriately controlled.

Two types of crossings are anticipated: open trench and Horizontal Direct Drilling (HDD). The first type, open trench, will be used in the stormwater runoff courses and the ravines; and the second will be used to cross the rivers.

In regard to the open trenches, the excavation through water beds entails impact, particularly by the suspension of solids and by disturbances in the materials of the bed. For the crossing work, the watercourse will be diverted to a temporary course that allows the excavation of the water bed and carry out the installation. Once the installation is complete, the water bed will be stabilized with materials compatible with the original bed. Then the water will be redirected in its natural course, and the site of the temporary course will be restored to its original form. The mitigation of the impacts will be carried out through erosion and sedimentation control measures. CES plans will be designed in harmony with the Stormwater Pollution Prevention Plans (SWPPP) required by the Environmental Protection Agency (EPA).

As to the HDD, the rivers will not suffer any impact on their river beds, because this technology permits making a "dry crossing" by passing well below the river bed. The drilling equipment will drill the ground below the river bed and install the pipeline without affecting the river bed. The incorporation of the 24-inch pipeline in the areas classified as aquifers may be done in two ways: first, that the pipeline is installed over the water table, and second, that the pipeline is installed below the aquifer's water table. A third way in which it could be done is when the pipeline is partially submerged in the water table as a result of the fluctuations in the aquifer's level due to the variation in the annual rainfall cycle.

When it is installed over the water table, the pipeline will not cause any alteration in the aquifer's recharge. Aquifer recharge areas begin on the flanks of the central mountain range, upstream of the aquifers *per se*. However, in those cases where the aquifer also recharges on site, there will be an insignificant effect on the direct recharge which will correspond to the diameter and length of the pipeline, since the water that has to infiltrate to the subsoil at the site of the trench will be delayed in its course because it will have to flow around the pipeline.

In those places where the pipeline must be installed below the water table, the impact will also be negligible due to the extremely low migration velocities that are normal in aquifers. However, for a more detailed evaluation it is necessary to determine the direction of the flow lines and the thickness of the aquifer. In case the flow lines are parallel or they have a minimal deviation angle with respect to the axis of the pipeline, the impact of the pipeline on the movement of subterranean water will be negligible (the

one that corresponds to the area of the 24-inch diameter pipeline, that is 3.14 square feet).

In case the flow lines are perpendicular to the axis of the pipeline or they have an incidence angle of more than 45 degrees, the flow lines will encounter an obstruction in their course and the aquifer's transmissibility will be diminished. Nevertheless, this reduction in transmissibility will be imperceptible, again due to the extremely low migration velocities. However, in those areas that during the design phase are identified as compromised to a reduction of transmissibility, transmissibility compensation measures will be employed, as for example, the installation of pockets of granular material (river sand) as backfill of the trenches in short and localized stretches sufficient to compensate the transmissibility.

Additionally, the determination of the aquifer's thickness is important, especially when the flow lines are perpendicular to the axis of the pipeline. If the thickness of the saturated aquifer is only a few feet, the impact of the two-foot diameter pipeline will be significant in terms of flow per unit of area. In this case, the compensation of transmissibility will be essential. For these reasons, in those aquifers whose thickness is of a few feet, the preferred measure will be avoiding the same. However, if it were unavoidable, studies will be made to determine the aquifer's transmissibility and the form of compensation of transmissibility will be designed with the results of said studies.

The pipeline that is installed below the water table will stand in the course of the flow of subterranean waters. However, since the velocity of the water is close to zero, the impact will be imperceptible. The hydrology of the wetland will not be affected in practice. However, in the particular case in which the pipeline runs perpendicular to the flow of subterranean water and that the wetland's aquifer is thin, structures will be installed that compensate the reduction of transmissibility, or the installation of the pipeline will run deeper. The compensation structures, when necessary, will consist of high-transmissibility granular material installed around the pipeline in localized areas. The granular material will be covered with a synthetic filter fabric.

#### **6.7.1. Crossing by open trench**

The crossings that will be made by open trench are crossings of small, perennial and intermittent ravines, ditches and drainage and irrigation canals. Some of these bodies of water are dry or of a minimal flow.

The impacts in open trench include an increase in turbidity, sedimentation downstream of the crossing, reduction of dissolved oxygen, mortality of aquatic fauna and flora. In addition to this, there could be impact to the water quality caused by leaks of oil and other fluids in the machinery.

The impact will be mitigated by reducing the time of construction. In the United States, the Federal Energy Regulatory Agency requires that crossings of bodies of water less

than 10 feet wide are crossed in 24 hours or less and bodies of water from 10 to 100 feet wide in 48 hours. These are the standards that will apply to this project.

No vehicles leaking oil or other liquids that could pollute the waters will be allowed. If the vehicle develops leaks during the work, spill kits will be used to collect any leakage and the vehicle will be removed from the site.

### **6.7.2. Horizontal direct drilling (HDD)**

A successful crossing with this method avoids impacts on the bodies of water because it does not interfere with the flow, the water quality or with the aquatic fauna and flora. The AEE is experienced in the use of this technique in projects like underground electric lines and the submarine cable of Isleta Marina.

During the drilling, a mixture of bentonite and water is used to lubricate the drill, maintain perforation and remove residues from the drill. Bentonite is the commercial name of non-toxic clays formed from volcanic ash. The United States is the world's leading producer of Bentonite. The best quality bentonite is found in Ft. Benton, Wyoming. It is acquired commercially in 50 - 100 pound bags, similar to cement. To prepare it, the bentonite is mixed with water (Eg: 50 lbs. For each 300 gallons of water, maintain a pH of 8-9) to form a slurry that acts as a cooling fluid for the drill and the probe, and as a lubricant for the drill head. The mixture is prepared in a tank and then transferred to a mud pit at the entrance and exit of the drill. Other mud pits will be needed to store the mud and to dry the used mud for later reuse. These mud pits will be covered with impermeable liners. In addition, hay bales and a silt fence will be installed around them.

Bentonite does not require special storage procedures. It can be stored in open air covered with plastic tarpaulin, or in a covered building to protect it from the rain.

The principal impact of the drilling procedure could be the inadvertent release of bentonite. Bentonite could escape through unidentified fractures in the material underlying the river bed, in the area of the mud pits, or along the course of the perforation due to unfavorable ground conditions. The HDD crossings could fail for various reasons, including the inability to close the pilot hole, inability to maintain a stable open hole or inability to pull the pipeline through the perforation. To avoid these faults, an adequate design will be developed, specific to the area, the correct equipment and specialized personnel to operate it will be used. If any of the parts of the drilling has problems and it cannot be finished, the design engineers will study the geotechnical data to identify the cause. If necessary, other geotechnical studies will be made, or the location of the crossing will be changed.

Although bentonite is composed of naturally-occurring, non-toxic materials, its deposit in bodies of water affect the turbidity, diminishes the quantity of dissolved oxygen and affects the respiration of aquatic organisms. A bentonite escape is usually detected

when there is a loss of circulation of drilling liquid, a loss of pressure and/or bentonite is detected on the surface of the body of water. One of the functions of bentonite is to seal the perforation to maintain the downhole pressure. If there is an escape there is a change of pressure and a reduction in the amount of bentonite recirculated. A bentonite escape does not require the evacuation of nearby residences. The remaining bentonite after the drilling is done is left to dry in the mud pits and later will be disposed of in accordance with the applicable regulations.

During the drilling, a dye will be added (uranine), that will help detect any escapes to the surface. If an escape is detected, the fluid's pump will be turned off, which will immediately stop the flow of bentonite. An inspector will be assigned, whose function will be to observe the body of water during the drilling. This inspector will keep in contact with the team in charge of the drilling and will instruct them to stop the process if bentonite is observed (mixed with uranine) on the surface. In addition, he will document all his observations from the beginning of the drilling to the end. Drilling could last 2-3 days, but it all depends on the depth, the distance to the other shore and the design in general. Each crossing by HDD is designed individually, based on geotechnical studies of the site. The team of workers in charge of the HDD crossings are specialists in this type of crossing. This is the only work they will perform for the project.

We enclose the Material Safety Data Sheet (MSDS) for Bentonite. It indicates that bentonite is an irritant to the eyes and the respiratory tract if inhaled (dust). It can also irritate the skin. In case of contact with the eyes, the eyes must be irrigated with water for 15 minutes. In contact with the skin, it must be washed off with soap and water. In case of inhalation, the person must be removed outdoors (in case of exposure to bentonite in an enclosed area).

In addition, we enclose the MSDS for uranine. Like uranine in its solid (powder) form it causes irritation to the eyes and if inhaled. According to the MSDS, the chemicals contained in uranine are not listed in the TSCA lists, Significant New Rule, Chemical Test Rules, Health and Safety Reporting List, CERCLA Hazardous Substances, SARA Section 302, Extremely Hazardous Substances. Uranine does not contain air pollutants, it does not affect the ozone layer. Neither does it contain pollutants listed as water pollutants.

Also enclosed is a Responses to Bentonite Escapes Plan where the HDD process and the control measures to be implemented in case of an escape are described in more detail.

Even though they are technically viable, HDD crossings can fail for various reasons, including inability to complete the pilot hole, inability to maintain a stable open hole, or inability to pull the pipeline through the perforation.

To prevent the technique from failing, geotechnical studies will be conducted and

construction plans specific to the site will be developed during the crossing's design stage.

The principal impact that could occur is the inadvertent release of bentonite. Bentonite could escape through unidentified fractures in the material underlying the river bed, in the area of the mud pits, or along the course of the perforation due to unfavorable ground conditions. Although bentonite is composed of naturally-occurring non-toxic materials, its deposit in bodies of water affects the turbidity, diminishes the quantity of dissolved oxygen and affects the respiration of aquatic organisms.

Another impact associated to the HDD is the size of the construction area. In normal construction, this right-of-way will be 100 feet. For the HDD a construction area of 100-300 feet on both sides of the body of water will be used.

Erosion and sedimentation control measures will be implemented in the construction area during the crossing, in order to minimize the sedimentation of the body of water during rain events.

To minimize the impact in case of bentonite escapes, a dye will be added to the bentonite, because small escapes are difficult to detect due to the water turbidity and to bentonite's specific gravity. If an escape is detected, the fluid pump will be turned off, which will immediately stop the flow of bentonite and the pertinent Agencies will be notified. An inspector will be assigned to corroborate compliance.

Vehicles with leaks of oil or other liquids that could pollute the waters will not be permitted. If the vehicle develops leaks during the works, a spill kit will be used to pick up any leakage and the vehicle will be removed from the site.

Once the crossing is finished, all the soil that was removed in the right-of-way will be reused to restore the same. If necessary, additional backfill will be used.

### **6.8 Impacts to Subterranean Waters and Aquifers**

Thirty-one (31) aquifers were identified in an area of within 400 meters from the project along the course of the alignment.

Trenches 4-6 feet deep will be excavated for the project and this does not represent an impact to resources of subterranean waters or aquifers. The gas pipelines can pollute subterranean waters if the natural gas used during the operation of the project contains pollutants that condense (natural gas liquids) and there is a break in the inferior part of the pipeline through which they can escape. In addition, there can be pollution where there are compressor stations to propel the gas. It is important to mention that the gas to be used in Via Verde will not have the kind of pollutant that condenses (by specification), nor will it have compressor stations.

Escapes of natural gas rise to the atmosphere because it is lighter than air. In case of an escape in the pipeline, the effects will be visible in the vegetation of the right-of-way, because it will wither and dry.

Although it is considered that the possibility of pollution of subterranean waters is remote, spills of oil and fuel that are not addressed quickly could pollute the waters. To prevent that possibility, a Spills Control Plan will be implemented. The project's Environmental Coordinator will be in charge of compliance with the parameters established in the Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operation Centers and the factors specific to each one of them will be discussed. Each Operations Center will have a copy of the Plan. The Environmental Coordinator will offer informative talks at each Center. During construction, the resident engineer will be responsible for ensuring the implementation of the control measures, in coordination with the Environmental Coordinator.

### **6.9 Impacts on Flood-prone Zones**

The possibility of impact on the flood levels by some actions emerging from the installation of the pipeline is anticipated, but at the same time structural measures destined to mitigate this possible impact are established so that the flood levels are not increased by the pipeline construction actions.

The project opens the possibility that surplus of the excavation to install the 24-inch diameter pipeline will be deposited temporarily in zones regulated as flood-prone. In relation to this, Regulation No. 13 of Flood-prone Zones of the Puerto Rico Planning Board has specific requirements for each Zone.

Zone A is an area that has not been studied. FEMA does not have a detailed study and the maps do not have base flood levels. The flood levels in this area should not be increased; unless there is a Hydrologic and Hydraulic (H/H) study that justifies the landfill action. Zone AE is an area that has a detailed study. There are two sub-zones in this Zone: the floodplain and the floodway. In the floodplain, which is the area outside the floodway, landfill can be deposited without the need of an H/H study. However, landfill in the floodway is not permitted; unless an H/H study demonstrates that the flood levels are not increased by the landfill action. Zone VE is similar to Zone AE. The difference is that in this zone the floods originate from cyclonic waves. Depositing landfill in the floodplain of this zone is permitted, not so in the floodway; unless there is an H/H study that demonstrates that the land fill action does not produce an increase of flood levels. Zone X is a zone with a 0.2% probability of occurrence (500 year rainfall), there is no restriction on the deposit of landfill. Following from the above is that in the floodplain of Zones AE and VE and in Zone X landfill can be deposited without an Hydrologic and Hydraulic study. But it is not permitted to deposit landfill in the floodways of Zones AE and VE unless an H/H study demonstrates that the flood



levels will not be increased.

The construction of the pipeline through flood-prone zones will only have the possibility of temporary impacts. The surplus materials from the excavation can have temporary effects on the flood levels if they are deposited in the floodway. This situation would have to be accidental in character, of a fortuitous flood event, which would not permit the removal of said surplus materials before its occurrence. Even despite this possibility, the temporary effects will be minimal because the volume of surplus material will be only that corresponding to the material not yet transported to its place of final disposal during the work day. Permanent effects in the flood levels are not foreseen because all the surplus from the excavation will be transported to deposit sites outside the floodway.

The surplus material from the excavation will be deposited along the installation of the pipeline in the floodplains of Zone AE, Zone VE and Zone X. The material will be dispersed within the pipeline's right-of-way. The surplus of the excavation in the floodway of Zones AE and VE, in general, will be transported and deposited in authorized places outside the floodway.

#### **6.10 Impacts on the Infrastructure**

The infrastructure services for the Municipalities through which the pipeline crosses will not be affected or significantly compromised by the project. Nonetheless, regarding other underground infrastructure in the project area, there will be compliance with Regulation 7245 of the Public Service Commission, Regulation for the Creation and Operation of the Excavations and Demolitions Coordination Center, before commencing the construction of the project. Through the coordination required to be made with the owners of other infrastructures in this Regulation, plans will be developed to avoid damage to said infrastructures and plans will be agreed in response to any emergency that could arise in case of unexpected damage to the same. Each owner of infrastructures in the area of the project will have an Inspector present at the moment of the excavation, as required in the Regulation.

##### **6.10.1. Impact on AAA Infrastructure**

The project will cross through several aqueduct lines and several sewer systems. (See Section 3.8.1.) Before carrying out the excavations in the vicinity of those underground aqueduct and sewer systems mentioned below, the constructors of Via Verde will coordinate said excavations with the owners of these underground structures, through the Public Service Commission or the new Permit Management Office, as applicable. In case of finding unidentified infrastructure, the construction will be detained until the owner of such infrastructure has been identified or a permit to proceed is obtained from the Public Service Commission.

##### **6.10.1.1. Water Consumption**

The consumption of water during the construction is estimated at 10,344,000 gallons. This consumption will be during or due to: the hydrostatic testing of the pipeline, drinking water supply for consumption by the employees, sprinkling the project's area to prevent the emission of fugitive dust and for sanitary use by the employees.

To verify the pipeline's integrity prior to its operation, it is required to conduct hydrostatic tests. This is done to ensure that the system is capable to withstand the operating pressure for which it was designed.

This test entails the greatest water consumption of the whole project. The contractor will conduct the test by stretches to reduce the amount of water needed. The decision of the length of the stretches is made by the contractor, based on his professional experience and in the topography of the route. To the effect of calculating the water consumption, a stretch length of 12 miles will be used. The total consumption will be 5,700,000 gallons. The water will be transferred from stretch to stretch until it arrives at the San Juan Thermoelectric Power Plant, where it will be discharged in the NPDES 001 discharge.

This test entails the greatest consumption of water of the whole project. The contractor will decide how to carry out the test, according to the water supply. The pipeline can be tested all at once or divided in sections. It is estimated that 7 million gallons of water will be needed to perform the test in a single day (8 hours).

The following alternatives to obtain the necessary supply were considered:

- The alternative of obtaining the water from the rivers adjacent to the project was evaluated, but it was discarded to avoid impacts on the water quality and to the fauna and flora.
- The construction of wells for this event was evaluated, but it was discarded because it represented an inefficient use of the resource.
- Because the AAA's drinking water system will be used for other phases of the project, its use was discarded so as to not overload it.
- The use of existing wells for which the AEE has a use franchise was evaluated. There is a system of wells under franchise RO-13-08-01-FI-70311. Said franchise permits a total extraction of 5.122 MGD. The decision was for this option to eliminate the impact on the public distribution system and the bodies of water.
- After this test is concluded, the water will be discharged in the NPDES 001 discharge of the San Juan Thermoelectric Power Plant. The Power Plant's NPDES discharge permit has a Certificate of Water Quality from the Environmental Quality Board. It is important to mention that the water for the

test is clean water extracted from wells. There will be coordination with the Federal Environmental Protection Agency (EPA) to obtain a temporary discharge permit. There will be compliance with all the sampling and analysis conditions established by the EPA.

During construction, it is necessary to provide drinking water to the worker brigades of the different phases of the project. It is estimated that the maximum water consumption will be 1,200 gallons daily. The project's duration is estimated at 9 months and work will proceed 7 days a week. The drinking water consumption will be approximately 324,000 gallons.

No water from the AAA will be used for this purpose. Bottled water will be provided which will be purchased from local providers. The contractor will identify the local suppliers and arrangements will be made prior to the commencement of construction that will allow them to absorb the increased demand. The temporary increase in demand will have a positive impact on local business. The project's operation does not require the use of drinking water.

Water will be used to sprinkle the project's construction areas and minimize the emissions of fugitive dust to the atmosphere. Tanker trucks with a capacity of 2,000 gallons, equipped for this purpose, will be used to sprinkle. A maximum daily consumption of 16,000 gallons is estimated for this area. This means a maximum 4,320,000 gallons during the whole project.

A local supplier will be contracted to sprinkle the soil. He will be responsible for providing the truck and the water.

#### 6.10.1.2. Wells

One hundred fifty-six (156) wells were identified within a radius of 460 meters from the alignment proposed for the project. Only six of these are within the project's operation right-of-way. (See Section 3.5.9.)

Water Wells				
ID	Well's Name	Municipality	Ward	Distance/ meters
018	Valdivieso #01	Peñuelas	Talaboa Poniente	10
019	USGS	Peñuelas	Talaboa Poniente	10
020	Valdivieso #02	Peñuelas	Talaboa Poniente	8
087	Concora Factor	Arecibo	Factor	15
131	Maguayo #02	Dorado	Higuillar	10

132	Maguayo #03	Dorado	Maguayo	10
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Of these wells, those identified as 018, 020, 087, 131, and 132 are drinking water wells; well 019 is for sampling.

The following measures will be taken to avoid or minimize impacts on the station and the wells:

- They will be identified in the project's final drawings for the knowledge of the construction personnel.
- If the wells are encountered during the clearing of the right-of-way, their location will be marked to avoid impacting them.
- There will be coordination with the owners of these wells to interrupt their operation and protect them during construction.
- Any break that could occur due to the construction will be repaired.

## 6.11 Impacts on Transportation and Traffic

### 6.11.1. Maritime transportation

The pipeline segments that will form the project and their components will be purchased out of Puerto Rico, because their manufacture is specialized. The machinery required for the project's construction process is also specialized and specifically designed for the activities of excavation, laying of the pipeline and drilling, among others. Barges will be used for the maritime transport of the materials and machinery to the Port of the Americas in Ponce and the San Juan port zone. The materials received will be carried by land transportation to the operation centers in Ponce and Toa Baja where the same will be stored. The following measures will be taken to minimize the impact the receipt, debarkation, dispatch and transportation of the machinery, pipe segments and other equipment to the operation centers could have:

- There will be compliance with all the requirements established by the different receipt ports, the Ports Authority and Federal Customs prior to the receipt of the shipment.
- The contractor will develop a logistics plan for the proposed activity, which will be presented to the pertinent authorities for comments and endorsement. The plan will include the following aspects: details of the shipping port, maritime travel itinerary, number of barges, frequency of trips, inventory of equipment, classified and identified containers, time for unloading the equipment, identification of areas for the temporary storage

in the port, maximum allowable residence time for materials in the port, travel itinerary and mobilization of materials out of the port, among others. Among the benefits derived from implementing the plan are:

- Expediting the inventory inspection and review process by the Ports Authority and Federal Customs.
- Avoid penalties for delays or residence time of the barge in the port.
- Avoid delays in the port's activities
- More efficient and speedy movement of equipment.

#### **6.11.2. Ground transportation and traffic**

The Via Verde project comprises a length of 92 miles, approximately. The roadways will be used as access to transport personnel, equipment, vehicles (light and heavy) and materials to the different areas of the project. The main highways will be: PR-337, PR-127, PR-2, PR-385, PR-132, PR-520, PR-391, PR-123, PR-10, PR-143, PR-521, PR-524, PR-111, PR-621, PR-22, PR-681, PR-684, PR-616, PR-149, PR-672, PR-137, PR-155, PR-674, PR-160, PR-676, PR-690, PR-694, PR-693, PR-165, PR-5 and PR-28. Most of these highways are catalogued as having several lanes in both directions, wide and passable.

During the construction stage there will be an increase in light and heavy traffic, especially in areas near the operation centers. This increase may cause traffic congestion and inconveniences to the population.

Small and local roads will be crossed with the open trench method and this will cause short periods of traffic delays.

The following measures will be taken to minimize the project's impact on the integrity of the public roads and on the interruption or increase in traffic:

- A Traffic Management Plan will be prepared and submitted to the Highways and Transportation Authority for their approval. The most important elements of this Plan are: Identifying traffic flow patterns, identifying alternate routes and emergency accesses, traffic control at intersections, pedestrian control, accesses for impaired persons, coordination with law and order agencies to implement the Plan. All the traffic control signs and signals will be in compliance with the requirements of applicable regulations.

Different traffic control methods are presented in Addendum 6.1, Typical MOT Diagrams.

- Unpaved roads will be crossed with the open trench method. This method

will require the temporary closure of traffic and detours will be established. This will be coordinated with the ACT and the local police and it will be referred to in the Traffic Management Plan. The contractor will be in charge of establishing measures such as the installation of warning signs to ensure safety and minimize the obstruction of traffic. If necessary, steel plates will be used to cover the trenches if the crossing works take more than a day.

### **6.12 Impacts on Archaeological Sites and Cultural and Historic Places**

Part of the information below was obtained from the ArcGIS 9 ArcMap 9.2 (ArcView Geographical Information System) software programs, with the Planning Board's database for the years 2004 to 2009. In addition, the AEE contracted Environmental and Educational Consultants (in Spanish Asesores Ambientales y Educativos (AAE)) to conduct the project's environmental studies, who in turn contracted archaeologists Marisol Rodríguez Miranda and Carlos Ayes Suárez to carry out the Phase 1A study. Said study identified the known archaeological resources and established the base to discover additional resources in the area of the project. A copy of Phase 1A Study is in Appendix 5. According to the results of the Phase 1A Study, Phase 1B studies will be conducted where necessary. After evaluating the results of the Phase 1B study, the areas where Phase II and Phase III studies will be conducted will be identified. An inventory of properties with architectural value will be made and a Structures Protection Plan will be prepared, if necessary. In case an archaeologically sensitive area is found, that had not previously been identified at the moment of movement earth, the recommendations of the archaeologist that will be contracted to those ends will be followed.

As a result of the surface survey, three rock shelters with petroglyphs were found located in the impact zone of the proposed project. The presence of possible agricultural terraces associated with pre-Columbian cultures was also detected.

In addition, the remains of two railroad bridges and two haciendas were found. Archaeologist María López Cruz prepared the evaluation sheets for these remains. To facilitate the evaluation to be made of these data by the Institute of Puerto Rican Culture (ICP), the official sheets of said Agency were used. They correspond to the Cambalache Bridge, Hacienda Teresa, Hacienda Las Lisas in Arecibo and remains associated to Hacienda Plazuela in Barceloneta.

Isolated finds of colonial material were detected all along the alignment in the North area from Cambalache Sugar Cane Mill to the Plantaje Shrine. These finds constitute an indicator of areas with greater possibilities of finding activity related to the agricultural history of the whole north zone. It is possible that these materials are associated to the habitation areas created due to the activities of the haciendas and to the subsequent population movements they generate.

The most important finds in the area to be occupied by the alignment right-of-way are indicated next: Tallaboa Site, for which a Phase IB study is recommended; Puentes, for which protection is recommended through the placement of cement and orange mesh barriers; Hacienda La Teresa, for which a Phase IB study is recommended; Hacienda Las Lisas, for which a Phase IB study is recommended; Paso del Indio, which although widely studied, there are no studies of the area where the pipeline will be located, for which reason a Phase IB study is recommended; Dorado 15, which has not been delimited, for which a Phase II is recommended; Hacienda La Candelaria, for which there is a recommendation to enter into a mitigation process that includes architectonic documentation and archaeological excavation; Warehouse 5, for which the liberation of the area is recommended, because the same has been widely studied, and to enter into a mitigation process for the site.

In case resources are impacted and the route cannot be changed, the Authority will carry out Phase III studies. In addition, it will file the request for services and file a project before the Historic Buildings Heritage Program for its evaluation and recommendations. Visits to sensitive areas will be coordinated, as required by the agency to conduct their own evaluation. In addition, a protocol will be developed to protect resources of this kind that lie near the construction of the project.

### 6.13 Noise Impacts

The location, magnitude and frequency of the environmental noise can vary considerably over the course of the day. The basic units used by the JCA to measure acceptable noise levels are the decibels dB(A). The acceptable noise limit is different for daytime and nighttime hours. The JCA's Noise Pollution Control Regulation establishes the maximum permissible levels for the different receptor zones in the day and at night. In addition, it establishes the maximum permissible for motor vehicles measured at a distance of 50 feet, stationary or in motion. This information is shown in the following tables:

#### Noise Emission Levels in dB(A)

Noise level exceeded by 10% of the measurement period (L10)

Fuente Emisora	Zonas Receptoras							
	Zona I (Res)		Zona II (Com)		Zona III (Indus.)		Zona IV (Tranq.)	
	Diurno	Nocturno	Diurno	Nocturno	Diurno	Nocturno	Diurno	Nocturno
Zona I (Res)	60	50	65	55	70	60	50	45
Zona II (Com)	65	50	70	60	75	65	50	45
Zona III (Indus.)	65	50	70	65	75	75	50	45

**Maximum permissible levels for motor vehicles in public roads measured at a distance of 50 feet**

Tipo de Vehículo	35 MIH o Menos	Sobre 35 M/H	Estacionado (Motor Encendido)
Vehículos de Motor de 10,000 lbs. o más (peso bruto)	86 db (A)	90 db (A)	88 db (A)
Motocicletas (cualesquiera)	80 db (A)	84 db (A)	88 db (A)
Otros (cualesquiera otro o combinación)	76 db (A)	80 db (A)	88 db (A)

The magnitude of a noise impact depends, generally, of the type of construction activity, the noise levels generated by the equipment and machinery, the duration of each phase of construction, and the distance between the noise source and the receptor. Vía Verde is a lineal project and the construction will move day to day. This means that the noise will not be concentrated in one specific area.

The noise levels for the heavy machinery to be used in the construction are itemized in the following table:

Equipo	Nivel de Ruido (dbA) a 50 pies
Bulldozer	85
Backhoe para excavar	80
Backhoe para rellenar	85
Sideboom	85
Niveladores	85
Camión	88
Wheel ditcher	80

The noise levels of the machinery to be used for the construction are comparable to those established by the Regulation. In the majority of cases the equipments will be operated in isolated areas outside the 50 feet of impact to the receptor. Although the Regulation establishes an exception for the prohibition of the sound emission limits during the installation of essential public services, the following measures will be taken to minimize the effects of noise on populated areas:

- The construction works will be circumscribed to the day schedule established by the Regulation.
- No vehicles or machinery without noise control equipment or with



defective equipment will be allowed.

- Inasmuch as possible, the newest equipment to be found will be used. Although there is a factory-established noise limit for construction equipment, older equipments emit more noise due to wear and tear. The friction between the parts increases the noise level.
- The machinery will be turned off when not in use.
- The construction of this project will be divided in four segments and the accesses to each work area will be located in a manner that they are not within 50 feet of residences or quiet zones.

#### **6.14 Impacts caused by Spills**

The possibility of spills always exists when working with chemical products, and equipment and machinery that use oils or other fluids to operate adequately. The key is prevention through an information program to employees and an aggressive maintenance program of the equipment used.

Generally, spills occur by human error. Among the principal causes are poor handling of the products, lack of maintenance of the equipments, and lack of adequate knowledge about the functioning and operation of the machinery.

The spills in this project, if they occur, will not be of a significant magnitude, since in the majority of cases small amounts of the products will be used (paints, oils, epoxy, etc.). The following equipments and materials are possible sources of spills: heavy machinery, light vehicles, emergency electricity generators, paints, coatings and clays (bentonite). Spills of these products or of the liquids in the equipment can impact water quality and the soil.

The following measures will be implemented to avoid spills or minimize the impact of the same, if they occur:

- The contractor's Environmental Coordinator will prepare a Spills Control Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operation Centers will be discussed, together with the factors specific to each one. Each Operation Center will have a copy of the Plan. A section on the handling of chemical products will be included.
- Prior to the commencement of the project, the Coordinator will meet with the employees (including subcontractors) to discuss the handling of oils and chemicals, and the situations that could cause spills and how to avoid

or minimize the impact of the same. In addition, they will be told how to respond to a spill and who to inform, according to their place of work. The resident engineer in the different operation centers will be responsible for ensuring the implementation of the control measures, in coordination with the Environmental Coordinator.

- The oils and other chemical products needed for the project, which are purchased by the principal contractor, will be stored in the designated warehouse area of the operation centers. Small containers will be stored in metal shelves, bentonite will be stored on wood pallets. Other products in 20 to 55 gallon containers will be stored on wood pallets.
- We will make sure that the assigned employees know the correct functioning and operation of the machinery.

#### **6.14.1. Spills on the Soil**

- The contractor's Environmental Coordinator will prepare a Spills Control Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operations Centers and the factors specific to each one will be discussed. Each Operation Center will have a copy of the Plan. A section on handling chemical products will be included.
- All the project's vehicles will have a Spill Kit.
- Small spills of oil or other liquids will be cleaned with absorbent material and the contaminated soil will be removed.
- The soil will be placed in containers and identified appropriately. Full RCRA tests will be conducted before disposal in an authorized site.
- No vehicles with leaks will be permitted in the work area, nor will it be permitted to store chemical products out of the operation centers.

#### **6.14.2 Spills in Water**

- The contractor's Environmental Coordinator will prepare a Spill Control Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operations Centers and the factors specific to each one will be discussed. Each Operations Center will have a copy of the Plan. A section on handling chemical products will

be included.

- A Plan on spills specific to the HDD process using bentonite will be prepared. (See Addendum 6.2, Spill Prevention and Contingency Plan for Drilling Mud Use).
- Oil leaks in water, if they occur, will come from the use of heavy machinery in crossings by open trench through ravines or wetlands. These will be cleaned with absorbent pads and the waste will be collected in containers for disposal.
- No vehicles with fuel or lubricant leaks will be permitted in the work area.

In case of a spill, the Environmental Coordinator will prepare a report that includes the following information:

- Physical and mailing address.
- The installation's telephone numbers.
- Day and time the spill occurred.
- Type of material spilled.
- Estimated amount of spilled material.
- Source of the spill.
- Description of the affected site.
- Cause of the spill.
- Damages caused by the spill.
- Actions taken to mitigate the effects of the spill.
- Indicate whether it was necessary to evacuate personnel or residents.
- Name of persons and/or organizations notified of the spill.

The Coordinator will have the emergency telephone numbers of the concerned agencies and will be responsible for communicating the incident to such agencies. In addition, he will attend to the inspections of these agencies and will see to it that the additional measures recommended by such agencies are implemented.

### **6.15 Impacts Caused by Hazardous and Non-hazardous Solid Wastes**

During the construction works, **non-hazardous** solid wastes, common to this type of project will be generated. These consist mostly of debris of wood, sand, rock, paper, soil, plastic, asphalt, metal, cement and vegetable cover.

The total wastes estimated for this project is greater than 100 cubic yards weekly, approximately. The contractor will pick up and transport these wastes to a nearby landfill approved by the JCA. In addition, there will be waste generated by portable toilets, paints, used oil, etc.

The impact of these wastes will be concentrated mostly in the landfills because there will be an increase in the amount of wastes they will receive during the construction of the project. This impact will be minimized by reusing part of the soil to backfill the trenches and restore the right-of-way and recycling all recyclable material, such as used oil.

Poor handling of hazardous or non-hazardous wastes can contribute to water and soil pollution.

The following measures will be taken to minimize the impacts from waste generation:

#### **6.15.1. Non-hazardous solid wastes**

- The material removed during the right-of-way clearing and leveling phase, such as **leftover** soil, rocks and debris, will be placed in hauling trucks and disposed of in places that require fill and are authorized to receive it or in an approved landfill. The trucks will use covers to minimize the emission of fugitive dust.
- The vegetable cover removed during the right-of-way clearing and leveling phase, will be mechanically shredded and reused as wood chips for the control of erosion in slopes, as allowed by Law 70 of September 18, 1992, Puerto Rico Solid Waste Reduction and Recycling Act, as amended and Regulation No. 6825, better known as the Recycling Regulation. The shredding will be carried out with a Morbark top grinder near the site where it is generated, where the resulting material will also be used.
- The material removed during the excavation of the trenches will be stored to be reused during the restoration stage. This includes subsoil and topsoil. It will be stored within the construction right-of-way and all the erosion and sedimentation measures discussed in this Document and those included in the CES Plan to be presented together with the application for the General Consolidated Permit will be taken.
- The erosion and sedimentation control measures discussed in this document and those which are included in the CES Plan that will be filed together with the application for the General Consolidated Permit will be implemented in the soil storage areas.
- The reuse of the soil to backfill the trenches and restore the rights-of-way reduces the project's impact on landfills and fill soil quarries and it maintains the integrity of the soil characteristics in the area.
- In case any surplus soil is left over, the same will be donated to a landfill site or authorized sanitary landfill.
- Wastes generated by the employees will be collected in plastic bags and placed

in containers to be later disposed of in approved landfills.

- A company will be contracted to provide portable toilet services. The same will be responsible for the transportation and disposal of the wastes. In addition it will be responsible for addressing any kind of spill of this kind of waste.

#### **6.15.2. Hazardous Wastes**

- The only hazardous chemical products to be used during the construction will be epoxy-based products, oils and lubricants. Inasmuch as possible, this type of waste will be minimized. Used oils and lubricants will be recycled and the epoxy-based products will be used to the maximum and any surplus will be stored for future use.
- Handling of chemical products such as epoxy, paints and other materials will be delegated on experienced personnel. This type of waste will be separated from the other construction wastes.
- Chemical product wastes will be disposed of in conformity with the contents of the Material Safety Data Sheet (MSDS) and applicable regulations. The project's Environmental Coordinator will carry out all the hazardous or toxic waste disposal activities.
- Prior to the disposal of solid wastes presumed to be hazardous but not yet identified, the residues will be analyzed (full RCRA) to identify whether they are hazardous or toxic.

#### **6.15.3. Used waters**

The generation of used waters will originate, for the most part, from the hydrostatic tests to verify the pipeline's integrity. In addition, there will be a fraction of sanitary residues generated by the employees.

Although the hydrostatic test water is clean water, an adequate place is required for its disposal. It is estimated that 10 million gallons of water will be needed for the test. Poor management of that amount of water and uncontrolled disposal techniques could result in soil erosion.

Poor handling and disposal of sanitary wastes could impact water quality and pollute the soil.

The following measures will be implemented to minimize the impact of used waters:

##### **6.15.3.1. Hydrostatic tests**

After the test is performed, the water will be discharged in discharge point NPDES 001 of the San Juan Thermoelectric Power Plant. There will be coordination with the Federal Environmental Protection Agency (EPA) to obtain the temporary discharge permit. All the sampling and analysis conditions established by the EPA will be complied with.

#### **6.15.3.2. Sanitary residues**

Portable toilets will be provided for use by personnel hired during the construction. In this way the inadequate disposal of biological pollutants in the areas near the project will be avoided. The contractor that provides the portable toilets will be responsible for the disposal of the wastes and for providing maintenance of such toilets at least once weekly, in accordance with the applicable regulations of the Department of Labor and Human Resources. In addition, he will be responsible for addressing any spill of this waste. This will be done in coordination with the project's Environmental Coordinator.

#### **6.16. Socioeconomic Impacts**

The socioeconomic aspect of the Municipalities where the project will be constructed will be impacted temporarily. The impact is positive for the economy, because the local labor force and the services of local businesses will be used.

In addition, there will be temporary impacts that will cause inconveniences to the citizens. Those impacts are discussed next.

##### **6.16.1. Economy**

The project represents a temporary benefit to the local economy. Among the benefits directly related to the project are: increase in taxes paid to the Municipalities due to the construction, increase in employment opportunities and an increase in sales, among others. This increase in local sales will be beneficial to the municipalities because they will receive the recently established tax on purchases.

Puerto Rico has hotels and hostels that will house workers coming from the United States who will be staying for nine months. Together with the inns, the restaurants, gas stations, fast food businesses and convenience stores will benefit from the daily consumption by these and the local workers.

During the construction stage, between 1,000 and 1,200 direct temporary jobs will be created, approximately. Hiring local workers will have a temporary positive impact on the municipal economy. In addition, there will be contracting of local businesses and industries, such as: hauling trucks, sprinkling trucks, heavy equipment, leased cars, trailers, portable toilets, purchases of lumber, gravel and bottled water, among others. In addition, it is estimated that the project will generate some 4,000 to 4,500 indirect jobs.

### **6.16.2. Community**

In Chapter 7, Socioeconomic Study, it was determined that the project's construction will not have a disproportionate environmental impact on any group.

The increase in traffic, noise and fugitive dust are factors that will impact the communities adjacent to the construction. There will also be an impact to other residents who use the public roads and to visitors, but to a lesser degree. It is important to underscore that, by the nature of the project, the impact is short-lived. The project's construction is not stationary. The same will move from one place to another in lineal form, day to day. Residents adjacent to the construction will be notified in advance of the dates construction will be carried out in their area.

The impacts caused by an increase in traffic, fugitive dust and noise cannot be avoided, but the following measures will be implemented to minimize them: free access to communities and residences will be ensured; the work area will be delimited; specialized work areas, such as the operations centers, will be located outside of the quiet zones. In addition, there will be compliance with the measures indicated in sections 6.4.1, 6.11.2 and 6.13 (Fugitive dust, Traffic and Transportation, and Noise, respectively).

The AEE will implement a public information program to educate the community. It will begin prior to the construction and will continue during the same. This will include the use of radio and the local and regional newspapers to disseminate information.

### **6.16.3. Impacts to public services and facilities**

The construction of Via Verde will cause temporary and minor impacts on the public services of police, firefighters and medical services. This impact will not be significant because, prior to the construction works, there will be coordination with the corresponding Agencies to ensure effective response in case of an emergency.

There will be coordination with state and municipal police to maintain order and control traffic in some areas. Their services will not be necessary in agricultural or barren areas, which represent the majority of the land that will be used.

The Health Centers of each municipality will be identified to transport to them any employee that could suffer an accident. The companies that will be evaluated for the construction of the project must have an impeccable safety record and no major accidents are expected. The existing system has adequate capacity to address any minor accident.

There will be coordination with emergency management agencies, such as the Fire Department, to handle emergencies.

#### **6.16.4. Land Acquisition**

One of the most important impacts will be the acquisition of land to establish the project's right-of-way. Although there are no federal or state regulations that establish a clearance distance with respect to buildings, the AEE will establish a 150-foot right-of-way along the length of the alignment for conservation and maintenance purposes. This right-of-way will be known as the maintenance right-of-way and it may be increased or reduced in those areas where there are space limitations or particular situations. It was calculated that within this maintenance right-of-way there were approximately 102 structures or residences.

The AEE will acquire the land by expropriation in the operation right-of-way and, if necessary, will extend the acquisition of land within all the maintenance right-of-way. The latter will be in the minority of cases. In public interest projects, the AEE is empowered by law to expropriate the land needed for a right-of-way. No more land than necessary will be expropriated. The AEE will appraise the properties and the owners will be compensated (fair market value) for the assessed value.

The project's construction will not alter the general use of the land. However, there will be specific limitations in the operation right-of-way. In agricultural areas, the owner will be able to use the area of the operation right-of-way for light agriculture, planting lawn or any other activity that does not interfere with the operation of the pipeline. The construction of buildings or structures and planting of trees or vegetation with deep roots will not be permitted.

#### **6.17 Impacts on flora and fauna**

The construction of the Project will necessitate clearing some 100-foot wide sections in forest areas. The greater impact will be during the construction process. In the operational phase there will be no impact in most of the areas, because there is no noise, no impermeabilization of the soil and no discharges of substances such as oil and fuel. At the end of construction, a 50-foot wide operation right-of-way will be maintained. This means that after construction, vegetation will be permitted to exist adjacent to the 50-foot wide operation right-of-way. To reduce the edge effect, the mitigation plan will contemplate the restoration of the remaining 50 feet that were cleared for the construction phase with the species that were present in that section of the forest before the construction and which exist in the contiguous forest.

The indirect impacts on the habitats are mostly related to the clearance of the existing vegetation during the construction. When deforestation occurs an edge effect is created and invading species can colonize the deforested area. Among these there are exotic and native species. These species can eliminate native species by depredation, genetic modification and transmission of diseases. To minimize this impact, part of the right-of-way will be reforested, except for the part corresponding to the 50-foot wide



operation right-of-way, which will remain free of deep-rooted vegetation.

This 50-foot wide strip will be restored naturally with herbaceous and arbustive vegetation between the two forest sub-units. Although this does not comply with the environmental requirements and conditions of all the species that could be affected, because it is not possible to reforest using trees, a natural strip is provided that serves as a connection to several species. On the forest margins or edges, the trees that will be planted as part of the mitigation plan will be the same native species with broad crowns that are found in that type of habitat. This will create a bridge between both sub-units and will provide a connection to those species that inhabit the highest forest stratum.

Vía Verde will require patrolling the 50-foot operation right-of-way, for that reason the AEE proposes that every six months a biologist patrols the right-of-way in forest areas of ecological value that are prone to the edge effect. This biologist will identify the invading species or the conditions affecting those areas and will propose control methods. In addition, these areas could serve as study platforms for universities. In this way the proliferation of undesired species will be controlled and the impact caused by the edge effect and the fragmentation in these areas will be minimized. The loss of habitat will be compensated through a mitigation plan that considers the characteristics and processes intrinsic to the habitat affected by the Project.

By mitigating compensating for the lost habitat area, the AEE proposes to mitigate in areas contiguous to the affected area, whenever possible. In this manner the proportion of perimeter to area of such zone can be maintained stable.

Recognized among the habitats that will be affected are the loss of habitat of the Guabairo (*Caprimulgus noctitherus*), Vahl's boxwood (*Buxus Vahlia*) and of other species. To determine the presence of the habitat of the listed species, studies specific to these species and their habitat were conducted. These studies will be complemented with additional field studies, as was coordinated with the FWS. In addition, the Project contemplates the preparation of a mitigation plan designed to compensate for the loss of habitat of the listed species found (if any) during said study.

As part of the work plan agreed with the FWS, a study will be made to determine the presence of the Coquí Llanero (*Eleutherodactylus juanariveroi*) in the Project's route, near the area of Punta Salinas in Toa Baja. This will provide important information to avoid its impact in case the presence of this species is determined in the area of the Project.

The fauna and flora study conducted for the Project produced a broad inventory of the species present along its route. The results found, with regards to the species observed allow us to specify the type of natural community, what type of habitat and the general conditions existing in the sampling site. The results also included data on the tree cover by type of forest, which allows us to establish an estimate of the maturity of

the forested areas sampled. In addition, the dominant species were included, of flora as well as of fauna, by area sampled. Data such as the abundance or density index of species were not part of the study's design.

With regard to errors in common and scientific names, we must indicate that we used recent published scientific references. Common names vary from region to region and even from town to town.

Other species that could be impacted are bats. There are 13 species of bats in Puerto Rico, divided into 5 families. Of these only 12 have been observed in bat roosts in the municipalities crossed by the Project's route. Although 12 species are found in the municipalities, only four species of bat could be affected by the construction of the project. These species are: *Artibeus jamaicensis* (Common Fruit Bat), *Erophylla sezekorni* (Buffy Flower Bat), *Monophyllus redmani* (Leach's Single Leaf Bat, Puerto Rican Long-tongued Bat) of the Phyllostomidae family and *Eptesicus fuscus* (Big Brown Bat) of the Vespertilionidae family. These four species use the Vega State Forest in the Municipalities of Vega Alta and Vega Baja to roost. In addition, the Common Fruit Bat can be found in Matos cave located on PR-10, in Utuado. These species that could be affected by the project nest in caves, whether warm or cold. Since the project does not contemplate the installation of pipeline in cave areas, these species are at lower risk of losing their roosting areas. The mitigation and compensation plan for the impacts caused by the Project will include the necessary measures for the protection of these species, considering the vegetation that produces fruits for frugivorous species. This plan will be developed in coordination with the DRNA.

The Project does not impact the habitat of the White-crowned Pigeon (*Columba leucocephala*) in the Municipality of Toa Baja, since no type of forest, mogotes or mangroves will be impacted in this municipality. Areas in other municipalities that could be habitat for this species will be impacted. However, such species was not seen during the field studies.

Regarding the impact on trees, an inventory will be conducted in compliance with the Planting, Pruning and Forestation Regulation (Regulation #25) of the Planning Board (JP) and the Department of Natural and Environmental Resources (DRNA), which includes the corresponding mitigation. In the study, 31 species of critical flora were identified, as designated by the DRNA (see Chapter 3). The mitigation and compensation plan for the impacts caused by the Project will include the necessary measures for the protection of these species.

The biological diversity along the project route is documented in the flora and fauna study conducted for it. Biodiversity could be affected more by indirect impacts than by the direct impact. The instantaneous (direct) effect of the Project's construction phase is the removal of species from the space they occupy at present. However, individuals of the same species remain in the adjacent, not-cleared areas. There could be indirect impacts on biodiversity by the secondary effects of fragmentation in the short and

middle terms. That is why it is important to establish the mitigation and management measures (like the previously mentioned ones) to avoid or reduce the edge effect that could promote the colonization of undesired species that have an effect on the native biodiversity.

#### **6.17.1. Protected, threatened or endangered species**

According to the consultation with the United States Fish and Wildlife Service (USF&WS), the Project could affect adequate habitat for the species listed in Section 3.2.2.15. During the field work for this study, none of the species was detected, with the exception of the guabairo. The methodology used, which consisted of walks through stretches of different longitudes and the transects to determine the occurrence of species, the forests' basal areas and the tree density by hectare, did not detect the presence of these species listed at the federal level.

The project's alignment crosses through different areas with characteristics and elements similar to the environments where these species inhabit, according to the life zone in which they are. With regard to plants, although the same were not detected, if any of those existed in the project's alignment its impact could be avoided as describe below for plants designated as critical at the state level.

With regard to the Puerto Rican Sharp-shinned Hawk (*Accipiter striatus venator*), the Guaraguaito (*Buteo platypterus brunnesens*), the Puerto Rican Parrot (*Amazona vittata*) and the Guabairo (*Caprimulgus noctitherus*), construction impacts to areas similar to their respective habitats will be avoided, especially during their mating and nesting seasons.

It bears mentioning that the species listed for PR-10 and the Río Abajo area of the Subtropical Wet Forest should not be impacted, because the Project's alignment in that zone crosses through the right-of-way of highway PR-10.

The guabairo will be protected with the implementation of a protocol for its protection and conservation during the construction phase. Also, the impact on the guabairo will be minimized by constructing the project outside of this species' nesting season. On the other hand, the guabairo has limited distribution. Nevertheless, recent studies of this species (Vilella, 2009) have demonstrated that it has a broader distribution than previously reported. That is why the protection of adjacent areas, or areas near where the guabairo exists, constitutes one of the most important measures to increase its distribution and population.

Although the only endangered species (federal designation) found in the study area was the guabairo, several species designated as critical at the state level were found. These are listed in Section 3.2.2.14.

The species of flora designated as critical can be identified with some conspicuous method (printed ribbon marker or "DO NOT CUT" flagging tape) and thus avoid

impacting them. If there is a possibility of impacting these individuals, the same will be transplanted to an adequate place, by personnel qualified for that practice. These species are designated as critical for different reasons: for folkloric importance or for being indicator species of habitats of greater importance.

The species of flora in the wetlands of the north are mostly herbaceous. Cobana Negra (*Sthalia monosperma*) is sometimes found associated with mangroves. The mangroves in the project's alignment are present in the areas of Cucharillas (Guaynabo/Cataño), Río Cocal (Toa Baja/Dorado) and in Peñuelas. However, it wasn't found there. Although this species could be in herbaceous areas adjacent to mangroves, these areas will not be impacted due to the construction method the project will use in these areas.

The white or siliceous sands through which the Project's alignment will cross are already impacted. These were found in the area of Arecibo, west of the sanitary landfill. These areas have been used for the extraction of this material, for cattle grazing and for yard maintenance in some residences. The presence of *Chamaecrista glandulosa* was not detected, although the area was walked through more than once.

With regard to the fauna species, the guabairo (*Caprimulgus noctiterus*) is designated as endangered, and the Puerto Rican Boa (*Epicrates inornatus*) and the White-cheeked Pintail (*Anas bahamensis*), as vulnerable. The white-cheeked pintail was seen flying over the project's alignment in Peñuelas. These prefer lagoons or ponds, which are not under the impact footprint of the Project.

The Puerto Rican boa will be protected by the implementation of a protocol for its protection and conservation during the construction phase. In the case of the Puerto Rican boa, its distribution is very broad and it includes most of the island.

All permanent loss of habitat of the guabairo will be mitigated in a 10:1 ratio, in coordination with the Department of Natural Resources and United States Fish & Wildlife Service. The mitigation will be made in accordance with a plan to those effects that will have the approval of both agencies before its implementation.

### **Cumulative Impact on the Habitat of the Guabairo**

According to NOAA's Environmental Sensitivity Index Map, the guabairo is present in the mountainous zone of Peñuelas, north of PR-2. The study of flora and fauna conducted for the Vía Verde project confirmed the presence of the species in Peñuelas' Tallaboa Saliente ward. The study that was conducted for the construction of Gasoducto del Sur (Southern Gas Pipeline), confirmed the presence in the Encarnación ward. There is also presence of the guabairo in the mountainous area of Ponce, in the Canas ward, which borders Peñuelas' Encarnación ward. In Peñuelas, the guabairo's habitat was impacted in the past by the construction of an industrial landfill, the clearing of part of the construction right-of-way of Gasoducto del Sur and the clearing of areas

for the construction of houses and businesses. In addition, it is under pressure from future developments.

In Ponce the habitat was impacted in the past by the construction of PR-2, the Ponce Correctional Center (Las Cucharas), and the clearing of the right-of-way for the construction of Gasoducto del Sur. In addition, it is also under pressure from future developments. There are two future housing developments, one of them with construction permit from the Municipality of Ponce. In this estate the land is completely segmented by roads.

All these projects have contributed to diminish and fragment the habitat of the species. The survival of the guabairo depends on the presence of forested areas because it nests on the ground and avoids areas with no vegetation. Although according to Vilella and Zwank, 1987, the guabairo also can exist in lands that have suffered some type of impact.

Via Verde is a future project that will add on to the past, present and future impact of the species, since it will add to the fragmentation and reduction of the same caused by the mentioned projects. However, since there will be no human habitation in the area of the right-of-way, there will be some degree of natural restoration of the same that could foster the presence in its surroundings.

It is important to mention, that far as is known, only the construction of PR-2 by the Highways Authority, and the clearing of part of the right-of-way for Gasoducto del Sur by the AEE, were the only ones that considered the impact on the guabairo's habitat and prepared mitigation plans. The AC (Highways Authority) bought lands with guabairo habitat in another area of Peñuelas, and the AEE promised to transfer \$5 million dollars to the DRNA for the purchase of land with guabairo habitat. The AEE transferred \$1.5 million dollars and the DRNA is in the process of purchasing. The AEE will continue transferring funds as the DRNA supplies yearly reports with the status of the acquisition.

For the Via Verde project, the AEE will continue to contribute to the purchase of land of high value that are guabairo habitat. These lands will be transferred to the DRNA for perpetual conservation. These lands will be acquired contiguous to the existing habitat of this species, so as to mitigate the fragmentation to said habitat by maintaining the ratio of perimeter to area of the zone. The mitigation will be in situ or in contiguous areas, in a 10:1 ratio, by acquiring land in the north portion of the hills that constitute guabairo habitat.

### **6.18 Impact on Air Quality**

Air quality can be impacted by the modification of the units, whether in regard to the criteria pollutants, dangerous and others included in the Prevention of Significant Deterioration (PSD) program, the fugitive dust and the emission sources that will be

used during the construction phase.

### **6.18.1. Description of Criteria Pollutants and their Effect on Health and the Environment**

The so-called criteria pollutants are those for which limits have been established to protect human health and well-being. There are two categories of health effects as a function of exposure time to the pollutants: acute and chronic. Acute effects affect specific organs immediately, such as those related to breathing and the eyes. Chronic effects are those that will present themselves after a long exposure (years) to the pollutants. Damages to human health vary with the intensity and duration of exposure to the pollutants and with the populations' health level. Specific population groups are more sensitive to pollution than others, such as children, senior citizens and persons with cardiopulmonary and respiratory diseases.

Next, the impacts produced by each pollutant on health and the ecology are summarized:

- **Sulphur dioxide (SO<sub>2</sub>)**

Sulphur dioxide belongs to the sulphur oxides family (SO<sub>x</sub>). These are colorless gases created by burning sulphur and they tend to dissolve easily in water. The primary source of SO<sub>x</sub> is burning fossil fuels, containing sulphur in their composition.

Exposure to SO<sub>2</sub> produces acute or chronic irritation and inflammation of conjunctival and respiratory mucous membranes. SO<sub>2</sub> can be transformed into other products, such as fine sulphate (SO<sub>4</sub>) particles and sulphuric acid fog (H<sub>2</sub>SO<sub>4</sub>). It has been found that under a combination of particles and SO<sub>4</sub>, health risk tends to increase with an increase in morbidity and mortality of chronic heart and respiratory patients. In asthmatic individuals it could produce bronchial constriction.

- **Nitrogen dioxide (NO<sub>2</sub>)**

Nitrogen dioxide (NO<sub>2</sub>), together with suspended particles are responsible for the reddish-brown layer frequently seen over many urban areas. This gas belongs to the nitrogen oxides (NO<sub>x</sub>). These are a group of highly reactive gases that contain different amounts of oxygen and nitrogen, like nitric oxide (NO) and nitrogen dioxide.

Nitrogen oxides are formed when a fuel is burned at high temperatures and/or when it contains nitrogen compounds. The principal sources of NO<sub>x</sub> are motor vehicles, electric generation plants and other industrial, commercial and residential sources that burn fuel. NO<sub>x</sub> can also be formed naturally, by bacterial decomposition of organic nitrates, forest and grassland fires and, to a lesser degree in electric storms.

The progressive increase in exposure to NO<sub>2</sub> can produce olfactory perception

problems, respiratory distress, acute respiratory pain and pulmonary edema.

- **Particulate Matter (PM)**

It forms a complex mixture of solid and liquid materials suspended in the air that can vary significantly in size, shape and composition, depending fundamentally on its origin. The size of the particulate matter varies from 0.005 to 100 microns (10<sup>-6</sup>) in aerodynamic diameter, that is, from a few atoms to the thickness of a human hair.

The particles are formed by natural processes like plant pollination and forest fires and by sources like burning fossil fuels to fertilizing agricultural fields. The particles can be directly emitted from the source, as primary particles and they can form secondary particles when some atmospheric gases react, such as: nitrogen oxides, sulphur oxides, ammonia, organic compounds, etc.

Some fifteen years ago their study and environmental regulation were centered on the total suspended particles (TSP), which are smaller than 100  $\mu\text{m}$  in aerodynamic diameter. Subsequently, the attention centered on particles smaller than 10  $\mu\text{m}$ , and until a few years ago, on fine and ultra-fine particles, that is, smaller than 2.5 and 1  $\mu\text{m}$ , respectively. Thus, the so-called PM 10 can be divided, by their size, in coarse, fine and ultra-fine, with the coarse fraction comprised of particles whose aerodynamic diameter is between 2.5 and 10  $\mu\text{m}$  (PM 2.5-10); the fine fraction includes particles with an aerodynamic diameter smaller than 2.5  $\mu\text{m}$  (PM2.5), and, finally, the ultra-fine fraction includes particles smaller than 1  $\mu\text{m}$ .

The smaller the particles, they can penetrate directly inside the lungs with possible toxic effects due to their inherent physical-chemical characteristics. In several studies, conducted in the United States and Europe, it has been found that prolonged exposure to fine particles originating in combustion is an important environmental risk factor in cases of mortality from cardiopulmonary disease and lung cancer.

- **Lead (Pb)**

Lead is a metal that was frequently used to manufacture water pipes, food containers, paints and gasoline. The primary source of air pollution from lead has been the use of leaded fuels in automobiles.

Because lead is not consumed in the combustion process it is emitted as particulate matter. Lead is a toxic pollutant for humans, its difficult removal from the body makes it accumulate in several organs and it may damage the central nervous system. Acute intoxication causes symptoms such as diarrhoea, vomit, colic, convulsions and head aches. Its elimination from the body is possible with medical treatment, although the damage caused principally to the nervous system is not reversible. Children with high levels of lead in their blood exhibit disorders in their social behavior and a limited mental development with irreversible neuro-behavioral effects.

- **Ozone (O<sub>3</sub>)**

Ozone is a colorless gas compound, it has the capacity to oxidate materials. Ozone is a secondary pollutant formed through the chemical reaction of nitrogen dioxide (NO<sub>2</sub>) and volatile organic compounds (VOC) in sunlight.

Ozone can cause pulmonary inflammation, depression of the immunologic system against pulmonary infections, acute changes in the pulmonary function, structure and metabolism and systemic effects in soft organs like the liver.

### 6.18.2 Preliminary Estimate of Criteria Pollutant Emissions

The proposed action provides for the change to natural gas in the Cambalache, Palo Seco and San Juan power plants. This change represents a substantial reduction in the emissions of criteria pollutants into the air (those regulated by federal and local regulations). A **preliminary** estimate of emissions was prepared to determine the applicability of a PSD permit and Rule 201 of the Regulation for the Control of Air Pollution (RCCA) of the JCA. For this computation, the estimate of emissions resulting from burning natural gas was based on emission factors AP-42 of the EPA and operation at 100% was presumed. The mission values will be reviewed once the contracts for the design and conversion of the generating units are granted. During this process the manufacturer's emission factors will be obtained, which are more precise.

Acid and fluoride aerosol pollutants are included in these estimates. In addition, an estimate of CO<sub>2</sub>e emissions was included. The estimate of the CO<sub>2</sub>e emissions is based on the maximum emission potential for each power plant. Below are some tables that contain the preliminary applicability analysis of PSD and Rule 201.

Preliminary PSD Analysis for Palo Seco Units 3 & 4						
Fuel S, %		1.5				
Pollutants	Existing Allowable Emissions (One Unit)* (ton/yr)	Existing Allowable Emissions Units 3 & 4 (ton/yr)	Projected NG Emissions (ton/yr)**	Increment Netting (ton/yr)	PSD Significant Emission Rate (ton/yr)	PSD, Yes or No
PM	979.00	1,958.00	32	-1,925.8	25	No
PM10	118.00	236.00	129	-107.3	15	No
SO <sub>2</sub>	13,554.00	27,108.00	10	-27,097.8	40	No
H <sub>2</sub> SO <sub>4</sub>	602.80	1,205.60	16	-1,190.0	7	No
Nox	2,417.00	4,834.00	4,740	-94.3	40	No
CO	288.00	576.00	1,422	845.9	100	Yes
VOC	44.00	88.00	93	5.1	40	No
Pb	0.24	0.48	0	-0.5	0.6	No
Fluoride	2.16	4.32	-	-	3	-



\*Existing Allowable Emissions as Stated in TV Permit Application

\*\*Emissions Factors from AP-42

Preliminary PSD Analysis for San Juan Units 7, 8, 9, 10 & San Juan Combined Cycle Units 5 & 6									
Pollutants	SJ 7, 8, 9, & 10		SJCCS & 6		Total Emissions NG Conversion (ton/yr)	PSD Significant Emission Rate (ton/yr)	Existing Allowable Emissions***	Increment Netting	PSD Applicability
	Natural Gas Emission Factors* (lb/10 <sup>6</sup> scf)	Emissions NG Conversion (ton/yr)	Natural Gas Emission Factors (lb/10 <sup>6</sup> scf)	Emissions NG Conversion (ton/yr)					
PM	1.90	32.87	1.94	28.19	61.07	25	2,946.22	-2,885.15	No
PM <sub>10</sub>	7.60	131.49	6.73	97.94	229.43	15	1,430.51	-1,201.08	No
SO <sub>2</sub> **	0.60	10.38	3.47	50.45	60.84	40	7,619.76	-7,558.92	No
H <sub>2</sub> SO <sub>4</sub>	0.92	15.90	5.31	77.26	93.15	7	1,592.26	-1,499.11	No
NO <sub>x</sub>	280.00	4,844.52	326.40	4,748.62	9,593.14	40	6,739.20	2,853.94	Yes
CO	84.00	1,453.36	83.64	1,216.83	2,670.19	100	1,654.73	1,015.46	Yes
VOC	5.50	95.16	2.14	31.16	126.32	40	190.70	-64.38	No
Pb	n/a	n/a	n/a	n/a	n/a	0.6	3.54	-	-
Fluoride	No info	No info	No info	No info	No info	3	-	-	-

\*Emission Factors from AP-42

\*\*AP-42 Table 3.1-2a

\*\*\* Existing Allowable Emissions Stated in TV Permit

Preliminary PSD Analysis Cambalache 1, 2 & 3						
Pollutants	Emission Factors (lb/10 <sup>6</sup> scf)*	Emissions NG Conversion (ton/yr)	PSD Significant Emission Rate (ton/yr)	Baseline Actual Emissions (ton/yr)	Increment Netting	PSD Applicability
<b>Cambalache 1, 2 &amp; 3</b>						
PM	1.94	21.15	25	113.90	-92.76	No
PM <sub>10</sub>	6.73	73.46	15	290.45	-216.99	No
SO <sub>2</sub>	3.47	37.84	40	780.23	-742.39	No
H <sub>2</sub> SO <sub>4</sub>	5.31	57.94	7	182.24	-124.30	No
NO <sub>x</sub>	326.40	3561.47	40	120.28	3,441.18	Yes
CO	83.64	912.63	100	207.75	704.87	Yes
VOC	2.14	23.37	40	71.80	-48.43	No

<b>Pb</b>	n/a	n/a	0.6	0.12		n/a
<b>Fluoride</b>	No info	No info	3	-		No info

\*Emission Factors from AP-42

When the increments are greater than the PSD values, the proposed action could have a significant impact on air quality. These are:

<b>Pollutant</b>	<b>Rate of Emission (tpa)</b>
Carbon monoxide	100
Nitrogen oxides	40
Sulphur dioxide	40
Particulate Matter	25
Ozone	40 (of volatile organic compounds)
Lead	0.6
PM10	15

The analysis and measures needed to minimize this possible impact will be determined under the PSD regulation and the Puerto Rico Air Pollution Control Regulation, of the Environmental Quality Board (JCA). These regulations will require the significant impact analysis by mathematic modeling of atmospheric dispersion, applying the regulatory provisions for new emission sources (New Source Performance Standard), emission control measures, visibility analysis and environmental justice. The regulatory provisions determined under these regulations will become federally enforceable conditions under the Title V federal and state permit system.

The **preliminary** emission estimates indicate that there can be applicability for Rule 201 of the RCCA (Location Approval) and PSD due to the pollution emissions of NO<sub>x</sub> and CO in the San Juan and Cambalache power stations and of CO in Palo Seco power plant. The formal exercise of applicability or no applicability of this regulation will be performed once the formal permit application process begins. This will be done when the Environmental Compliance Certification is obtained (Article 4B3 of the Environmental Public Policy Act).

The required emission control measures will be implemented according to the determinations of the applicability or no applicability analysis for Rule 201 of the RCCA (Location Approval), as well as for PSD. Each power plant will be evaluated individually

to determine if control equipment is necessary and what will be the control required in accordance with the Best Available Control Technology (BACT).

- **PM<sub>10</sub> Maintenance Area in Guaynabo**

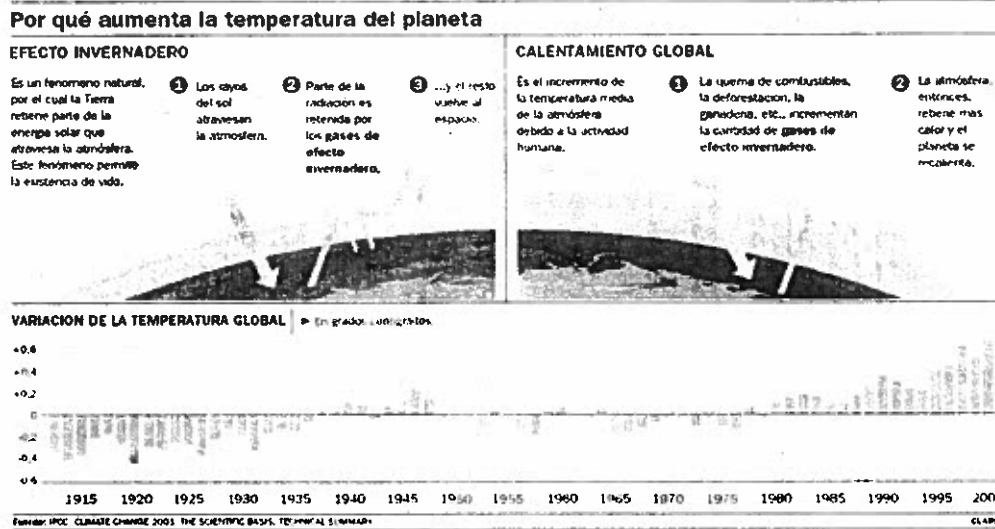
The RCCA was amended recently to re-designate the Guaynabo PM<sub>10</sub> No Achievement Area, as a Maintenance Area through a 24-Hour National Environmental Air Quality Maintenance Standard for particulate matter (PM<sub>10</sub>) for the Municipality of Guaynabo. According to the preliminary calculations, the conversion of the Palo Seco and San Juan generating units will have the effect of reducing the PM<sub>10</sub> emissions in the Guaynabo Area by about 85%. This because the almost insignificant sulphur content of natural gas, which is a precursor of the PM<sub>10</sub> pollutant.

- **Carbon dioxide**

It is important to highlight that, although the preliminary estimate indicates that Rule 201 and the PSD could apply, there is a significant reduction in the criteria pollutant emissions. In addition, Via Verde will result in a significant reduction (between 29% and 59%) in carbon dioxide (CO<sub>2</sub>) emissions.

Carbon Dioxide Equivalent (CO <sub>2</sub> e)				
Power Plant	Fuel Oil (Tons/yr)	Natural Gas (Tons/yr)	Diference (Tons/yr)	Reduction %
Palo Seco	2868,150.7	2022,146.4	846,004.3	29%
San Juan	4281,122.4	1738,194.4	2542,928.0	59%
Cambalache	1857,413.0	1303,468.8	553,944.2	30%

This gas is a product of combustion that has the capacity to retaining the heat the sun radiates on the planet. It is postulated that human activity causes an increase in the concentration of carbon dioxide in the atmosphere, which in turn results in an increase in global temperature. This phenomenon is denominated global warming. Global warming can have negative environmental impacts, such as droughts, wildfires, more intense storms, heat waves, glacier melting, considerable increase in sea levels, changes in ecosystems, coral bleaching, costal erosion and air quality deterioration, among others.



Throughout the world efforts are directed at controlling emissions of carbon dioxide. In fact several legislative projects were presented in Puerto Rico for the control of global warming, some of which are now law. However some of these laws became dead letter, due to the impossibility of enforcement.

Via Verde provides a tool to assert the legislative intent regarding Puerto Rico's contributions to the control of global warming and anticipates federal environmental laws and regulations in the process of publication, by diminishing emissions of this gas.

- **Hazardous Pollutants**

The estimate of hazardous pollutant emissions for each power plant is included in the following table: