Border Environmental Cooperation Commission

Air Quality Improvement in Agua Prieta, Sonora

I. General Criteria

1. Type of Project.

The project consists of reducing air contamination by suspended particles, by means of paving the most traveled streets and avenues in the city of Agua Prieta, with asphalt and hydraulic concrete, which are currently unpaved.

2. Location of the project.

The project is within the municipality of Agua Prieta in the State of Sonora. The study area only includes the city of Agua Prieta, municipal capital, located 380 km to the northeast of the city of Hermosillo, State Capital, within the 100 km border zone, bordering with the city of Douglas, Arizona. According to official census, it is estimated that the population in the city of Agua Prieta in the year 2000 was 61,944, persons. It is expected that the population will reach a little bit more than 81,000 in the year 2020.

3. Project Description and Tasks

In 2001, the City Government of Agua Prieta began the certification process with the Border Environmental Cooperation Commission, for an air quality improvement project in the area that includes the city of Agua Prieta and surrounding areas.

This project is within the frame of BECC's "Mandate Expansion" priorities in order to carry this project out, the city of Agua Prieta, project promoter, developed a great joint effort with state authorities and agencies, to execute the activities that would allow for their certification.

Objective

The objective of the project is to Improve air quality by reducing its contamination by suspended particles generated by automotive vehicles traveling through the streets of the city that have not yet been paved.

It should be clarified that even though the direct means to reduce contamination is through paving which, by its nature covers loose material and prevents particles from being suspended in air, a secondary effect that is also important is the reduction in travel time that an average vehicle currently takes in traveling within the city which, also decreases the emission time of combustion particles to the atmosphere.

In 1999, the City Government of Agua Prieta lead an important effort guided towards the important reduction of air contamination indexes in the area, for which it convened different national and international agencies and organizations to provide support in developing a project to decrease said contamination.

Thus, it obtained the support from the Arizona Department of Environmental Quality to analyze the situation in Agua Prieta with regards to contamination by suspended particles, product of automotive vehicles traveling in unpaved streets and elaborate a model to estimate the effect that paving actions would have on the reduction of said contamination.

Based on this, it requested BECC the initiation of the certification process for a project that would significantly reduce air pollution, through the paving of streets, whose coverage to date is extremely reduced.

Since this type of projects are not eligible to receive support to develop studies and projects, it looked for additional support to carry out the necessary studies to obtain the project certification and it obtained support from the University of Sonora to elaborate an Environmental Impact Study of the works, a study which is required by the Sub-secretariat of Ecology an agency of the Secretariat of Urban Infrastructure and Ecology (SIUE for its Spanish acronym) of the State Government.

It obtained the elaboration of the project to expand the Janos-Agua Prieta - Cananea highway from the Sub-secretariat of Urban Infrastructure and the Secretariat of Urban Infrastructure and Ecology, an important part of the project to Paved the City.

The North American Development Bank (NADBank), prepared a payment capability study for the city of Agua Prieta, in order to determine the magnitude of the credit resources that would be possible to apply to the project and which constitute the basis for the financial feasibility study.

The Office of Public Works of City Government in Agua Prieta, prepared the executive projects to pave the streets in the city, following the technical guidelines established by SIUE, the regulatory agency in the state.

Finally, the Promoter requested BECC for the elaboration of a certification document from data generated by each one of the previously mentioned agencies.

4. Project Components

The paving project for the city of Agua Prieta has been structured in several stages, mainly depending on the entity responsible to carry out the works. It includes the paving works in 34 stretches of streets within the city of Agua Prieta in about 34 km and will provide transit routes in the South, Southwest part of the city in order to greatly reduce air contamination in

the urban zone.

The project also includes upgrading the stretch of Federal Highway 2 Janos – Agua Prieta that intersects the city almost through the downtown area in the east-west route. This stretch includes an approximate length of 7,000 m. Currently, this stretch consists of two lanes (one going each way) and it will be expanded to six lanes (three each way).

Finally, the project is proposing the construction of 3 bridges for vehicles and a vado that will allow for the transit of vehicles from north to south, crossing the same number of arroyos in different sites in the city.

Therefore the project considers the following tasks:

A) Paving 34 km of streets (6%) of the total length of the routes in the city.

B) Expansion of the Janos – Agua Prieta – Cananea number 2 federal highway with a length of 7.0 kilometers, going from two lanes and a 7 m wide ridge to a boulevard type section with six traffic lanes, three in each direction.

C) Construction of 3 bridges for vehicles and pedestrians with a vehicle vado in equal number of intersections in the most important avenues in the city with water currents, to expedite the traveling of vehicles between the north and south areas in the city.

D) Additional works.

5. Adaptation to International Treaties and Agreements

The project will benefit health and environmental conditions on both sides of the border, being congruent with agreements signed by the United States of North America and Mexico. The construction of the proposed works will only be carried out in Mexico and will not affect the US.

6. Documents for the Project.

In order to develope the certification project, the documents listed below was consulted.

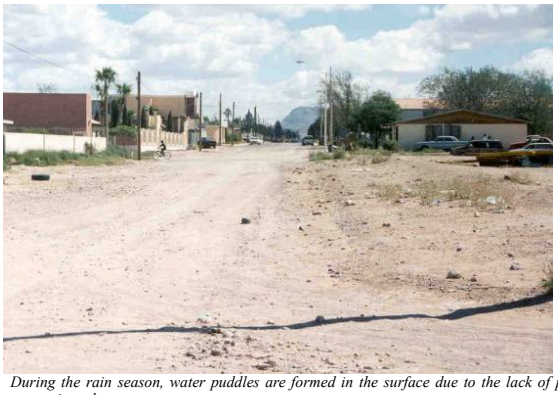
1. *PM_{10} particles emissions analysis in unpaved streets of Agua Prieta. Agua Prieta Air Quality Improvement project.*
2. *Population Growth Analysis from Agua Prieta City.*
3. *Environmental Impact Analysis, General Modality for Agua Prieta Paving Project.*
4. *Analysis of possibility of additional project debt.*
5. *Final Design of Paving from Agua Prieta..*

II. Human Health and the Environment

1. Need in the Matter of Human Health and the Environment

The purpose of the project being proposed is to improve environmental and health conditions in the community of Agua Prieta and its area of influence, which covers up to the city of Douglas, by means of paving works of 34 km of routes. The proposed works will decrease the volume of suspended particles at short term, resulting from the traveling of automotive vehicles on the soil surface, as well as from wind currents that frequently blow in this area. The previously will undoubtedly help decrease respiratory diseases and allergies, common in this region.

Currently, 83% of the streets in the city of Agua Prieta are unpaved. This situation represents a serious health problem, in view of the fact that in summer, when the soil is dry for lack of rain, the traveling of vehicles on its surface and frequent winds in this zone, cause the finest soil particles to remain suspended in the atmosphere and become a potential focus of respiratory diseases and allergies, mainly in the infant and senior citizens population. The following chart shows the situation experienced by the majority of the families in the city.



During the rain season, water puddles are formed in the surface due to the lack of paving, becoming also a focus of skin infection, mainly due to the direct contact with contaminated water.

In this season, there is a third important effect which is the dragging of soil particles by water currents that are looking for an exit and which when going towards the sewage system, fill it up with silt, reducing its capacity and causing wastewater leaks and the need to distribute additional resources for campaigns to remove silt from pipes.

The size of the suspended particles is the most important physical characteristic to determine its toxicity. Particles, which measure more than 10 micrometers, are basically retained in the upper respiratory tract. Those measuring less than 10 micrometers are predominant in the breathing fraction and penetrate the alveoli space of the lung. Particles of less than 10 micrometers have an indirect effect on the respiratory system, because they absorb microbiological agents (virus, bacteria, fungi, pollen, etc.) in their surface and transport them to the lung.

People presenting heart or lung diseases, such as asthma, chronic-obstructive lung disease, ischemic heart disease or congestive heart disease; when exposed to PM_{10} particles are at a greater risk of premature death or of having to go to the hospital or emergency room.

The following table shows the respiratory disease morbidity rate for the 1997 to 2000 period.

Respiratory disease morbidity rate

Disease	1997		1998		1999		2000	
	Rate	Total	Rate	Total	Rate	Total	Rate	Total

Acute respiratory infections	*782.1*	*4,667*	*431.4*	*2,664*	*2040.3*	*12,673*	*2317.4*	*14,355*
Pneumonias and bronchitis	*16.9*	*101*	*8.4*	*52*	*38.5*	*241*	*37.8*	*234*
Asthma	-	-	-	-	*15.3*	*96*	-	-

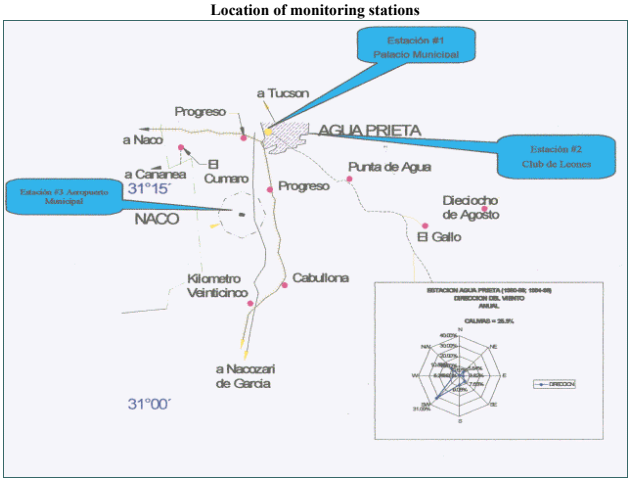
Rate by 10,000 inhabitants
Source: statistical yearbooks 1997,1998,and 2000 (INEGI)

Due to the fact that there are no air quality records in the project area, CFE (Comisión Federal de Electricidad) carried out an air quality study. The parameters taken into consideration were NO_x, SO_2 and PM_{10}, which were used as background concentration in the air quality impact assessment by the project operation. During the 9 day monitoring 2 campaigns were carried out, the first from August 4th to the 12th and the second from September 3rd to the 11th, 1999; periods in which there were three stations for continuous and simultaneous measurement of each one of the contaminants. During these campaigns meteorological parameters were determined such as: wind speed and direction, atmospheric temperature and pressure.

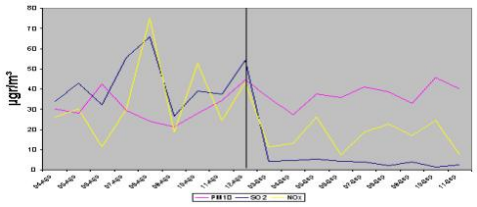
The following criteria were taken into consideration to position the contaminant measuring stations: wind rose in the zone, safety, access availability and electric energy and permits to install the stations, the prior with the purpose of insuring that the measurement results were representative of the project's zone of influence. The final monitoring results are the following: maximum concentrations measured during the first monitoring period were 125,76 µg/m³, 75,2 µg/m³ and 66.0 µg/m³ for SO_2, NO_x, and PM_{10} respectively for monitoring stations 2, 1 and 1; while the maximum concentrations for the second period were 10,48 µg/m³, 26,3 µg/m³ and 75.1 µg/m³ for SO_2, NO_x, and PM_{10} respectively, determined for monitoring stations 3, 1 and 2. These values are below the corresponding maximum permissible limits established in the Mexican norms for air quality.

The following tables and charts show the results of the study.

Location of monitoring stations



Average concentrations of SO_2, PM_{10} and maximums for NO_x



Air quality study results in the project's area of influence

Date	Measured Concentrations (µg/m³)											
	SO_2				NO_x				PM_{10}			
	1	2	3	Avg	1	2	3	Max	1	2	3	Avg
4-Aug	*69,65*	*31,44*	*1,31*	**34,13**	*24,4*	*26,32*	*1,88*	**26,3**	*36,7*	*34,2*	*19,8*	**30,24**
5-Aug	*79,26*	*45,85*	*3,93*	**43,01**	*30,1*	*5,64*	*1,88*	**30,1**	*35,2*	*nf*	*20,9*	**28,07**
6-Aug	*40,61*	*56,33*	*0,00*	**32,31**	*11,3*	*5,64*	*0,00*	**11,3**	*60,2*	*40,0*	*27,0*	**42,40**
7-Aug	*78,93*	*86,46*	*1,31*	**55,57**	*30,1*	*3,76*	*1,88*	**30,1**	*25,5*	*42,9*	*19,7*	**29,37**
8-Aug	*71,18*	*125,76*	*1,31*	**66,08**	*75,2*	*5,64*	*1,88*	**75,2**	*37,4*	*22,0*	*13,4*	**24,25**
9-Aug	*79,04*	*1,31*	*0,00*	**26,78**	*18,8*	*1,88*	*3,76*	**18,8**	*23,5*	*20,9*	*19,4*	**21,24**
10-Aug	*79,58*	*32,75*	*5,24*	**39,19**	*52,6*	*1,88*	*16,92*	**52,6**	*34,1*	*33,4*	*16,4*	**27,98**
11-Aug	*81,22*	*30,13*	*1,31*	**37,55**	*24,4*	*3,76*	*13,16*	**24,4**	*52,5*	*29,5*	*21,5*	**34,54**
12-Aug	*82,42*	*65,50*	*14,41*	**54,11**	*43,2*	*5,64*	*13,16*	**43,2**	*66.0*	*59,5*	*8,6*	**44,73**
1st Camp,	**73,54**	**52,84**	**3,20**	**43,19**	**75,20**	**26,32**	**16,92**	**75,20**	**41,24**	**35,30**	**18,54**	**31,43**
	Averages				**Maximums**				**Averages**			
3-Sept	*5,13*	*1,31*	*6,55*	**4,33**	*9,4*	*11,28*	*5,64*	**11,3**	*40,3*	*58,6*	*8,4*	**35,77**
4-Sept	*5,13*	*1,31*	*7,86*	**4,77**	*7,5*	*13,16*	*5,64*	**13,2**	*29,1*	*46,7*	*6,2*	**27,33**
5-Sept	*5,24*	*0,00*	*10,48*	**5,24**	*26,3*	*9,40*	*1,88*	**26,3**	*44,5*	*58,0*	*10,7*	**37,76**
6-Sept	*2,40*	*1,31*	*9,17*	**4,29**	*5,6*	*7,52*	*1,88*	**7,5**	*44,8*	*43,9*	*18,4*	**35,68**
7-Sept	*7,53*	*1,31*	*2,62*	**3,82**	*18,8*	*5,64*	*1,88*	**18,8**	*44,0*	*75,1*	*4,2*	**41,12**
8-Sept	*2,62*	*2,62*	*1,31*	**2,18**	*9,4*	*22,56*	*3,76*	**22,6**	*54,7*	*42,2*	*19,7*	**38,84**
9-Sept	*2,62*	*1,31*	*7,86*	**3,93**	*16,9*	*5,64*	*5,64*	**16,9**	*45,1*	*44,3*	*9,8*	**33,08**
10-Sept	*2,62*	*1,31*	*0,00*	**1,31**	*24,4*	*1,88*	*1,88*	**24,4**	*55,4*	*63,8*	*17,6*	**45,58**
11-Sept	*5,02*	*1,31*	*1,31*	**2,55**	*7,5*	*1,88*	*1,88*	*7,5*	*45,3*	*53,6*	*21,9*	**40,23**
2nd Camp	**4,26**	**1,31**	**5,24**	**3.60**	**26,32**	**22,56**	**5,64**	**26,32**	**44,80**	**54,01**	**12,98**	**37,26**
	Averages				**Maximums**				**Averages**			

Both	**38,90**	**27,07**	**4,22**	**23,40**	**75,2**	**26,3**	**16,9**	**75,2**	**43,02**	**44,66**	**15,76**	**34,35**

Note: The NO_x concentrations were measured as NO_2.

Due to the transboundary impact of PM_{10} emissions that potentially affect the neighboring city of Douglas, Arizona, the Arizona Department of Environmental Quality (ADEQ), at the request of the municipal authorities of Agua Prieta, Sonora, carried out a PM_{10} emissions analysis for the streets that have been proposed for the paving project in said city. The purpose of this study was to determine the benefits related to the paving of several routes in different points in the city, expressed in terms of air emissions reduction. In addition, consideration was given to determine if there are other routes that by being paved, could represent a major benefit than that originally proposed by the municipal authorities.

The results obtained by the modeling carried out by the ADEQ show that the total PM_{10} emissions, which, currently originate in the streets proposed by the Agua Prieta municipal authorities are approximately 125 tons/year. It is estimated that by the end of the first year of having executed the project, the total PM_{10} emissions for the same streets would be reduced 54% to 68 tons/year. At the end of the second year of the project, it is estimated that the PM_{10} particles will add up to a total of 29 tons/year; and it is estimated that at the end of the project when the 34 kilometers of proposed streets have been paved, the total PM_{10} emissions will be 0.08 tons/year.

2. Environmental Assessment.

The General Office of Ecology in the State, requested an Environmental Impact Study (MIA for its Spanish acronym) in its General Modality, which was developed by the University of Sonora.

The report of the Environmental Impact Study to be issued by the Office of Ecology in the State of Sonora, is in process and it is expected to be released during the month of October.

Based on the environmental impact assessment, the paving works will be a low environmental impact project. The previously stated, by virtue of the majority of adverse impacts that will be generated, according to the rating criteria used, were defined as having little or no significance.

As synthesis of the analysis and conclusions, it can be indicated that the majority of the impacts generated by the project are adverse non significant or of little significance (66.40%), the majority of them concentrated in the abiotic environment (56.52%); there is a 6.2% of medium adverse impact, also in the abiotic environment. The rest (27.40%) are beneficial.

The project presents a total of 17 impacts (10.66%) of medium significance, of which 10 are adverse and all of them present in the abiotic environment, due to the generation of particles that affect ground water recharge; the 7 beneficial affectations refer to benefits for flora and fauna, quality of life improvement, improvement of potable water and wastewater services and generation of employment.

The significant beneficial or very significant impacts are 4, and all of them correspond to beneficial impacts (first, air quality improvement, and others such as improving streets, quality of life for the population and increase in the value of land and the consequent generation of public income, via real estate taxes).

The adverse impacts are of medium significance and they are mainly in site preparation and construction stages and are susceptible to mitigation through preventive measures. They represent 4.3% of the total.

The conclusion of the environmental impact study is that the implementation of the project is compatible to the development plans and it adequately incorporates to the physical and socioeconomic scenario of the region, therefore it is an environmentally feasible project.

3. Compliance with Applicable Environmental and Cultural Resource Laws and Regulations

As was previously mentioned, the Office of Ecology in the State is reviewing the Environmental Impact Study, which is expected to comply with all the environmental requirements in Mexico. Potential impacts to archeological and cultural resources were not identified in the MIA, due to the fact that the works will be carried out in a surface previously impacted.

The report from the National Institute of Anthropology and History (INAH for its Spanish acronym) is under process, which states that there are no potential impacts to archeological, historic or cultural resources.

III. Technical Feasibility

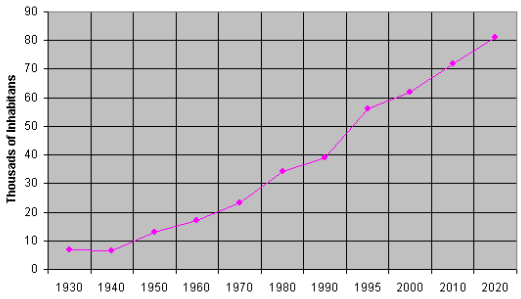
Appropriate Technology.

Background.

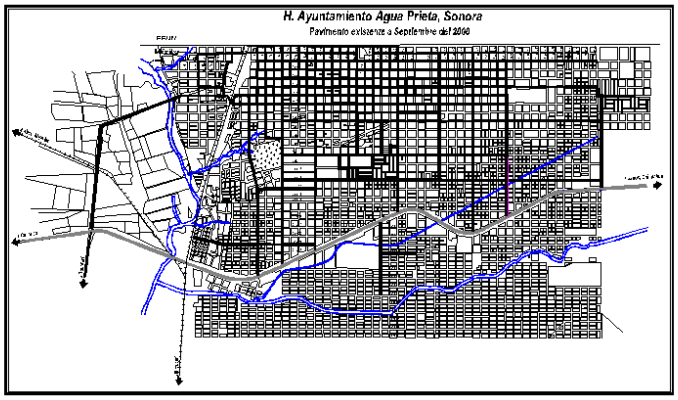
The Agua Prieta - Douglas border is considered one of the main crossing points between the states of Arizona in the United States and Sonora, Mexico. In 1999, 2,505,433 crossings of people of US nationality were registered and 3,715,351 of other nationalities, mainly Mexican. Also 2,186,310 vehicle crossings were registered during that year. This commercial traffic and the scarce paving coverage in the city, only 17%, generate high indexes of air contamination.

The streets in the city of Agua Prieta have a regular plot (North-South direction) and avenues (east-west direction), creating a regular orthogonal grid, crossed only by three obstacles: Federal Highway No. 2 Janos - Agua Prieta - Cananea that runs in a sensible direction northeast southwest, the Agua Prieta - Cananea - Nogales railroad that runs north to south on the west side of the city and the Agua Prieta river which also flows from north to south and an effluent from the river that flows east-west, sensibly parallel to highway No. 2.

In the year 2000 Agua Prieta had a population of 61,944 inhabitants, according to Official Census. According to population projections, it is expected that by the year 2020 it will increase to a little more than 81,000 people, as can be seen in the following chart:



Up until the year 2000, the city had close to 550 kilometers of streets and avenues with a total surface of 6 million square meters of which only 17%, 91 km were paved (1,044,630 square meters), of which 60% require improvement. The main paved streets are located to the north of the highway, the oldest area of town and, of course, the Janos – Agua Prieta – Cananea highway. The following chart clearly shows the situation. The dark thick lines represent paved streets up until the year 2000.



Under these circumstances, it is understandable that the strong winds that blow in the area, as well as the traffic of automotive vehicles through current routes generate a great amount of air suspended particles during the low water season in which the soil is dry and there is no cohesion between its particles to keep them in place.

During the rain season, the lack of paving causes the accumulation of water in the streets and this effect gets worse due to the lack of leveling. These puddles of water have a great noxious effect on the health of the population, because it increases the risk of contracting skin diseases, mainly in the lower extremities that are more exposed to contact with dirty water.

Compliance with Applicable Design Regulations and Standards.

In order to have more specific information regarding the scope of the problem and its possible solution, the City Government of Agua Prieta requested support from the Arizona Department of Environmental Quality (ADEQ) for an impact analysis to determine what effect the lack of paving in more than three fourths of the city would have on the health of the population.

For this purpose, DCA developed a study between 1999 and 2002 that began on the month of January 1999 and February 2000, with an intense traffic monitoring campaign (58 monitoring stations) and a tally of particles found in the environment. The result from that monitoring was that the particles found in a larger number were the PM10's, this means particles finer than 10 microns and that one of the main particle production sources is dust from unpaved streets and, also, they are the ones that are more easily suspended with the traffic of vehicles or wind currents.

The study also included measuring traffic density in the main streets of the city. The purpose is to determine the priority in which different routes in Agua Prieta should be paved, in order for the impact on the decrease of contamination to be as high as possible.

The air quality study developed by ADEQ gave as a result that the urban area of Agua Prieta generates about 1,800 tons of PM10's per year. In addition, with the 58 stations installed in the city to count traffic, the streets with the most traffic were determined and therefore, the ones that generate more solid particles. From data gathered during the study, it was concluded that the paving action reduces PM10 emissions more than 99% in that zone.

With this background, the City Government of Agua Prieta proposed a program to be developed in three years guided towards paving 34 km of the most traveled streets and avenues in the city, to decrease 6% of the remnants that the city has in this area.

The executive project to pave the city of Agua Prieta was developed by the municipal Department of Public Works with consulting from the State Sub-secretariat of Urban Development which is the regulatory agency at state level.

In addition, the Sub-secretariat of Urban Development, reliant on the Secretariat of Urban Development and Ecology for the State of Sonora, developed the executive project for the works to expand and improve the Janos – Agua Prieta – Cananea highway.

In both cases SIUE is the regulatory agency in this type of projects at state level and works in close coordination with the Federal Secretariat of Communication and Transportation, which guarantees compliance with the corresponding Design regulations and standards.

Paving project.

The paving project that is being proposed for certification for the city of Agua Prieta, includes paving works in 34 stretches of routes within the city of Agua Prieta in around 34 km and will provide primary street routes in the South, Southeast and Southwest of the city in order to greatly reduce air contamination in the urban zone.

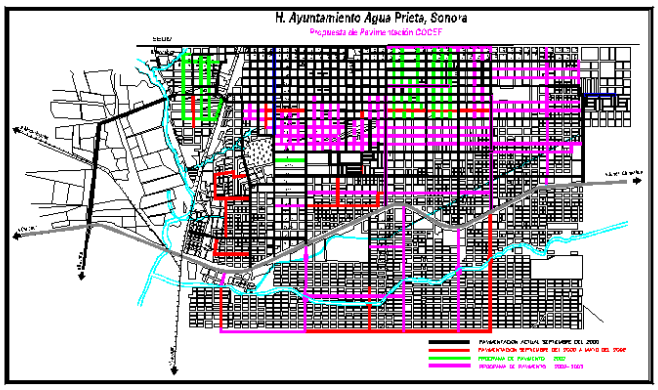
The paving works will be carried out with asphalt material in the body of each street and street intersections will be paved with hydraulic concrete, since water runoffs concentrate there during the rain seasons, providing a greater expectation in the project's life cycle.

A very important part of the proposed project is constituted by the modernization of Federal Highway No. 2 Janos – Agua Prieta – Cananea, which crosses the city in an east-west direction almost through the downtown area. This stretch includes an approximate length of 7,000 m, from km 155+500 to the junction with the Nacozari highway. Currently, this stretch consists of two lanes (one going in each direction). The extent of the existing right of way, causes a very intense vehicle flow, constituting one of the larger dust contamination focal points in the city.

The executive project for the expansion is considering a boulevard type transversal section with a separation strip and two avenues with three lanes in each direction, with returns and junctions in routes defined as "principal" by the Agua Prieta Urban Development Program. The project includes the forestation of the zone, lighting and placement of streetlights in important intersections. It will also include the construction of bridges for pedestrians and the corresponding horizontal and vertical signs. The Secretariat of Communications and Transportation, as regulatory agency, will be in charge of defining the definite transversal section of the asphalt layer for this stretch.

Finally, the project is considering the construction of three bridges for vehicles and a vado, which will ease traffic from one side to the other of several arroyos that cross the city at different sites and which will greatly decrease the current time traveled which is currently used to go around those arroyos.

As was already mentioned, the development of the Paving Program is scheduled for 3 years of construction. During the first and second years, the project is focused on paving of streets in the city, activity that will significantly decrease air pollution. City Government carried out the paving activities for the first year of the program, with its own resources for the year 2001. The activities for the second year of the project corresponding to street paving, will be carried out once the proposed project has been certified. The following figure graphically shows the paving program, indicating the streets to be paved during the three years of its development.



Consideration has been given to start expansion works in the federal highway to eight lanes during the second year, as well as the construction of the bridges for vehicles. Finally, it is considered that during the third year, the expansion of the highway and the project in general will be concluded.

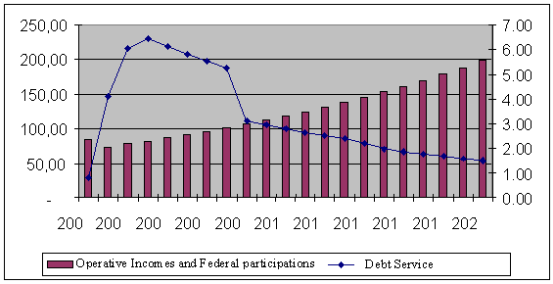
IV. Financial Feasibility and Project Management

1. Financial Feasibility

The Agua Prieta Air Quality Improvement Project objective is within the framework of the so called Mandate Expansion and is therefore it currently eligible to receiving support only from the North American Development Bank through loan resources.

For this reason, the complete analysis was centered on the determination of debt capacity of the Agua Prieta City Government.

The analysis of debt capability is based on projections of cash flow of the municipality, which shows that total debt service, included the proposal new loan, does not exceed 7 per cent of income, and this percentage goes down significantly over time.



According to the analysis developed by the NADBank, the City Government of Agua Prieta has a current public debt of 12.25 million pesos of which 10 million pesos are owed to BITAL at a 7-year amortization term. The remaining 2.25 million pesos have an amortization term that is due in the years 2015 and 2016. Considering the current public debt, Agua Prieta has an Additional Sustainable Debt of 30 million pesos under credit conditions established by the NADBank.

However, the City Government proposes to pay off the BITAL debt early, which it would permit, the increase of an additional sustainable debt in 25 million pesos.

Project financing.

The paving project includes 3 phases: the first phase includes paving works only and it was already constructed; the second phase considers the continuation of paving works until 34 km of routes have been completed; the third phase includes the improvement of the Agua Prieta – Janos highway intersection and the construction of three bridges for vehicles and a vado over several water currents at different sites in the city.

INVESTMENTS NECESSARY FOR THE PROJECT

Concept	Investment (millions of pesos)	%	Situation
Paving Phase I	*26.24*	*15.4*	*Project under construction. 100% financing*
Paving Phase II	*71.31*	*35*	*6.0 million pesos in bidding. Remainder in management.*
Modernization of Federal Highway and 2 bridges	*56.29*	*33.1*	*In preliminary project stage. Funding in management*
Supervision	*0.70*	*0.4*	
IVA	*15.41*	*9.1*	
TOTAL	*170.0*	*100*	

Resource Management

The municipality of Agua Prieta is in the process of managing resources for the phase II paving components, street intersection and the 4 bridges for vehicles. In a preliminary manner, the municipal authorities have identified a total of 111.0 million pesos in the form of state, federal and municipal participations, as well as private contributions for the construction of these components.

The following table shows the financing Plan for the project submitted by the Municipality of Agua Prieta. It is important to mention that the investment program greatly depends on budget availability from federal and state benefits.

Source		Type		US$ Mill	MX$ Mill	%
Phase I Municipal Paving Program						
Agua Prieta City		*Capital*		*$0.97*	*$9.67*	*5.69%*
BITAL Bank		*Loan*		*$1.00*	*$10.00*	*5.88%*
State Participation		*Grants*		*$0.93*	*$9.33*	*5.49%*
		Total		**$2.90**	**$29.00**	**17.06%**
Phase II Municipal Paving Program						
Agua Prieta		*Capital*		*$2.56*	*$25.60*	*15.06%*
State Participation -SIUE[1]		*Grants*		*$2.32*	*$23.20*	*13.65%*
NADB/COFIDAN		*Loan*		*$3.00*	*$30.00*	*17.65%*
		Total		**$7.88**	**$78.80**	**46.35%**
Modernization and Expansion of the Federal Highway						
Federal Participation - SCT -SIUE		*Grants*		*$3.11*	*$31.10*	*18.29%*
Federal Participation - SCT		*Grants*		*$3.11*	*$31.10*	*18.29%*
		Total		**$6.22**	**$62.20**	**36.59%**
Project Total Cost *				**$17.00**	**$170.00**	**100.00%**
Total Capital				*$3.53*	*$35.27*	*20.75%*
Total Grants				*$9.47*	*$94.73*	*55.73%*
Total Loans				*$4.00*	*$40.00*	*23.53%*

SIUE Secretariat of Urban Infrastructure and Environment
SCT Secretariat of Transport and Communications
** Includes Tax and construction supervision cost*

2. Contributions from the Community

A quota was scheduled to support the project's financing, which is fixed in the so called "Contribution of Improvements for the Construction of Public Works", that will imply that each family pays around 560 pesos per linear meter in front of their houses. City Government developed a payment program in order for the citizens that will be benefited to pay their contribution on time.

3. Project Management

The Municipal Office of Public Works, having of course the support from state SIUE and SCT will head the paving works for this project. The Works at Street Intersections (Federal Highway), because it is Federal, will be constructed by SCT, federal entity accountable in this matter.

The Municipal Office of Public Works should improve and increase their specialized machinery for paving, as well as carry out budget projections necessary to successfully deal with the challenge of providing adequate and timely maintenance of paved surfaces, since it will significantly increase the city's paved surface.

The supervision of the Paving works and the construction of the vehicles bridges it will be completed by The Municipal Office of Public Works. Two percent of the total cost of the project is provided for this. The Highway Modernization component will be supervised by SIUE, of the Sonora State Government.

The project funds, includes grants and loans resources, will be expended over a 4 year construction period.

V. Public Participation

Opening of Public Process: *this public process begins on August 16, 2002, when BECC's Citizens Participation Guide is presented to Mr. Angel Gonzalez Robles, Director of Municipal Planning and Social Development for Agua Prieta, Son., as well as other reference material, as official promoter of the project to open the public process.*

Citizens Committee: *is constituted on September 6, 2002 during a meeting that took place in a Meeting Room at City County in Agua Prieta, Son., where the board of directors was elected for said Citizens Committee. The following people were elected:*

President: Dr. Ruben Vasquez Beltran.
Secretary: Eng. Marco Antonio Parra.
Technical Secretariat: Miguel Angel Gonzalez Robles.

Community Participation Comprehensive Plan: *With strengthen enthusiasm due to the previous experience of having a project certified by BECC in 1996 (Solid Waste), which is an example of success in a shared effort, the community of Agua Prieta, Son., got involved as in that previous occasion, with great cheerfulness and hope to continue on an ascending road towards improving the quality of life of its inhabitants, with the benefit of taking advantage of what was learned in the previous experience with BECC.*

The Community Participation Comprehensive Plan was received on September 9, 2002 and it was authorized by BECC on September 10 of the same year.

Public Information: *The information was distributed through approximately 4 thousand brochures and fliers. Likewise, the project was promoted through radio stations in the community. The Citizens Committee did an outstanding job in organizing information meetings with community groups, specifically Chambers, Professional Associations, Service Clubs and groups of Professors from schools in the community. The project has been available to the citizens for their consultation at the Planning and Social Development Offices at City County.*

Public Meetings:

1st Public Meeting: *this meeting was carried out on October 10, 2002, at the Magna Hall of the Technological Institute in Agua Prieta, Son., with 130 people in attendance. During this meeting the technical scope of the project, its location, the problem that it is addressing and its approximate cost was made known. The Co-Chair of BECC's Advisory Committee for Mexico, Lic. Josefina Guerrero attended the meeting who verified the quality of the meeting and suggested that at the same time the Exit Survey was taking place to identify the level of support from the community for the project being presented, to carry out a simultaneous survey for health issues; the purpose was met.*

There was active participation from those in attendance; the interest in knowing when these works would commence prevailed. In the Exit Survey, 90% of those surveyed explicitly expressed that they were in complete agreement with the project.

2nd Public Meeting: *this meeting took place on October 10, 2002. The meeting took place at the Magna Hall of the Technological Institute of Agua Prieta, Son., once again. The Citizens Committee organized a meeting with an approximate attendance of 150 persons, with representation from the most important community groups; specifically from the colonias, academia, Chambers, etc. The Mayor, Mrs. Irma Villalobos Rascon de Teran also attended. The meeting took into consideration as a central issue, the presentation of the project in its technical aspect, its cost and the rate plan that will be charged to the community. The citizens concern is the potential increase in the level of the municipal debt, issue that was clarified by the municipal authorities; giving proof that the level of the debt was very low, allowing the Municipality to agree to the North American Development Bank resources without causing an unbalance in municipal finances. On the other hand, the community took advantage of the presence of the municipal authorities to present different issues that even though they were not related to the project, gave proof of the openness of the meeting.*

An "exit survey" was made once again to see whether the presentation had been understood, detecting some other parameters of interest and mainly, to know if the community agrees to the rate established. 73 surveys were answered of which 80% of those surveyed agree to the project and are willing to pay the rate submitted.

VI. Sustainable Development

1. Definition and Principles

Sustainable development is defined as an economic and social development based on the conservation and protection of the environment and rational use of natural resources, but taking into consideration current and future needs, as well as present and future impacts from human activities; as is defined by the Border XXI environmental program developed by authorities from the United States and Mexico.

In compliance with **Principal No. 1**, *which specifies that the human beings are the central point of all concerns for sustainable development and have the right to a healthy and productive life in harmony with nature, it can be assured that paving the streets and complementary works will decrease diseases that have their origin in the generation of suspended particles caused by the traffic of vehicles and wind currents in the area, especially in unpaved streets.*

Principle No. 2 *states the right to develop in such a way that development and environmental needs of present and future generations are met, which complies with this project since it insures the rehabilitation of the physical environment for the population of Agua Prieta, initiating actions that will allow for current air quality improvement in the project's area of influence, and adequately planning the development of the city, to preserve adequate air quality for future generations.*

In considering the effect that paving will have in decreasing air contamination by reducing solid suspended particles and decreasing contamination as a result of using automobiles the least amount of time and recognizing the important reduction of travel time within the city, **Principle No. 3** *is addressed which implies environmental protection as a comprehensive part of the development process, insuring with these works a decrease in diseases, mainly from the respiratory tract.*

Principle No. 4 *establishes the interest of the parties involved in participating in any activity related to this project to Improve air quality through paving. This principle is satisfied by complying with the creation of an extensive community participation program which has given way to the involvement of different community sectors together with different related institutions for environmental, social and economic improvement of community sectors, accomplishing a balanced planning and a better recovery of resources.*

Since the works commenced in 1999, a series of meetings have taken place for said purpose, organized by city government with the participation of Department of Public Works, the Secretariat of Urban Development and Ecology, the Secretariat of Communications and Transportation, the University of Sonora, the Arizona Department of Environmental Quality, the City of Douglas, Arizona and the community in general, where different perspectives concerning the project have been received and analyzed, from the sectors involved.

In addition, on October 10 of this year, a workshop to validate the Current Conditions and Identification of Performance Indicators Report for the Air Quality problem in the City of Agua Prieta took place. Members of the citizens committee and officers from City Government participated in the workshop.

2. Strengthening Institutional and Human Capacity

The actions taken into consideration by the project will help the Agua Prieta Municipal Government to strengthen in the following areas:

- *The capacity to respond to paving works will increase.*
- *The income for the municipality will increase by incorporating income from the enforcement of the Contribution to Improvements by Municipal Public Works Law, which will increase resources to meet new financial commitments and future investment requirements.*
- *In addition, the municipality will implement parallel to this project, other programs that will help preserve or improve the quality of the environment, specifically the atmosphere in the area, such as the reforestation program in the area to be paved.*

3. Adaptation to Applicable Local/Municipal and Regional Conservation and Development Plans

In order to protect and preserve the environment in the border region between both countries, the US and Mexico signed on August 14, 1983 an "Agreement for Environmental Protection and Improvement in the Border Region between the United States and Mexico", better known as the La Paz Agreement. The purpose of the agreement is to improve and preserve environmental conditions in the border region and establish the regulatory basis and necessary measures to prevent and control contamination in the border area, by establishing formal methods for joint work and cooperation in the matter of border environment. This agreement defined the border area as the area extending 100 km to the north and south of the boundary line between both countries.

Among other additional terms of binational cooperation, this agreement includes the agreement to coordinate efforts to include air, water and soil contamination problems in the border, as well as taking several joint actions among which environmental monitoring, environmental impact evaluations and exchange of information are included as well as data related to contamination sources that can affect the other side.

National Development Plan 2001-2006

The National Development Plan 1998 - 2003 in chapter 5 with regards to economic Growth, in objective 5.7 on the efficient use of resources for growth, subparagraph 5.7.4. Infrastructure and basic products takes into consideration the following: "On the other hand, the competitiveness of national economy requires access of national producers to basic products for production such as fuels and electricity in adequate quality and price conditions".

United States - Mexico Environmental Program "Border 2012"

The project adheres to the program's objectives and goals, in which "Objective #2 Reduce Air Contamination" establishes the following goals:

- *For the year 2012 or before, reduce air-contaminating emissions to comply with air quality standards and reduce exposure to contaminants in the border region.*
- *For the year 2003, define a base for minimum emissions, air quality and alternative scenarios for emissions reduction along the border, and its impact on air quality and the population's exposure to air contaminants.*
- *For the year 2004, based on results of the previous goal, define specific strategies for emissions reduction, goals for air quality and reduction of exposure to air contaminants to be accomplished in the border region by the year 2012.*

State Development Plan 1998-2003

The State Development Plan in Chapter IV.6. Housing, Urban Development and Supply of Basic Services, on the issue of Electric Energy it states: …Promote urban development in the cities of state territory, looking to establish balances in economic opportunities and access to all services and urban equipment; promote the development of a comprehensive electrification system to improve the recovery of the state energy potential; restructure and redefine existing routes in a comprehensive manner with use of soil and urban transportation.[2]

Urban Development Plan for the Municipality of Agua Prieta 2000-2003

This plan establishes the basis for an orderly growth, as well as the use of soil for the next 20 years. The urban development plan considers reducing the remnants of public services and the planning of future infrastructure.

Within the scope of proposed projects and actions in the development plan the following are outstanding for their social importance and impact:

- *Conduct before the corresponding authorities alternatives to implement Stage 1 of the Master Plan to Improve Potable Water, Sewage and Wastewater Services in Agua Prieta.*
- *Construct new routes in the area that uses the railroad.*
- ***Paving of routes.***
- *Promote, in coordination with the corresponding authorities, the planning of urban passenger transportation routes.*
- *Improve, in coordination with the federal and state governments, the physical conditions of Federal Highway No. 2 (Agua Prieta-Cananea-Janos Highway).*
- *Install public lighting.*

4. Conservation of natural resources

The nature of the project does not directly imply the conservation of a hydraulic resource or a material recycling program. The scope of the project directly impacts the quality of life of the Agua Prieta population, potentially decreasing the incidence of respiratory diseases, as well as decreasing air contamination in surrounding areas. However, it is important to emphasize that one of the mitigation measures considered in this project is the implementation of a reforestation program in sidewalks and streets to be paved, in order to mitigate the loss of green areas, as a consequence of the city's growth, said species should be indigenous and consequently of low water use.

5. Community Development.

The project will improve urban routes, quality of life of the population and will have an increase in the value of real estate. Paving will improve access to other public services, and will potentially reduce the incidence of respiratory diseases.

6. Current Conditions Report.

A report of current conditions was prepared and was validated during a workshop in which the citizens committee and Agua Prieta City Government officials participated. Said report is attached to this document.

7. Performance Indicators.

Performance indicators identified for the scope of this project are:

- *Paving of 403,887 m^2 of streets; 34,053 lineal meters*
- *A 54% reduction of PM_{10} emissions on the first year, only generating 68 ton/year, in streets included within the scope of the project.*
- *For the second year, a generation of only 29.04 ton/year of PM_{10} emissions is expected in streets included within the scope of the project.*
- *At the conclusion of the paving of streets included in the project, a generation of only 0.08 ton/year is expected in the project area.*
- *Construction of two urban bridges to improve traffic conditions.*
- *Carry out an analysis of alternatives for paving materials, selecting the alternative whose sum of investment costs and maintenance is the most accessible for the community.*
- *Improve institutional capacity to maintain/improve-paved streets.*
- *Implement actions that improve the financial capability of city government to pay credits and retain resources for maintenance of paved streets.*
- *Implement user contributions to pay for pavement.*

Without being part of the scope of the project, City Government has promoted to observe the following indicator:

- *Improve institutional capacity to monitor and report air quality.*

The Federal Electric Company will begin operating an air quality monitoring station in downtown Agua Prieta, beginning in April of 2003. In addition, the Arizona Department of Environmental Quality has been operating three air quality monitoring stations since 1999, and it stated that it would continue operating said stations.

The Agua Prieta Municipal Urban Development Plan 2000-2003 is contemplating the following indicator:

- *Promote the integration of air quality issues in urban planning.*

The following indicators were identified in the workshop that are considered relevant and will look for their development in an immediate future, independently from the current project.

- *Improve public transportation systems.*
- *Improve the routes of the public transportation system.*
- *Promote the use of cleaner processes and fuels for brick manufacturing.*