

ECOLOGICAL BASELINE REPORT

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1 ECOLOGY

1.1 INTRODUCTION

This appendix report presents the findings, in terms of ecology and nature conservation interest of habitats and species present along the pipeline route, of a desk-top study and field surveys undertaken for the proposed SCP. Natural habitats and the species of plants and animals within them are of vital importance to the protection, maintenance and continuing functionality of the world's ecosystems. The conservation of these natural habitats and their biodiversity, not only of species but also of genes and populations, is therefore essential for long-term sustainable development.

The aims of the study and surveys were to describe the extent of the different floral and faunal assemblages found within the various habitats along the proposed SCP. Any sites or species of nature conservation importance, which may be affected by construction of the pipeline, have been identified. These findings have been used to help identify areas where further survey work is required and to develop mitigation measures to reduce the impacts of the proposed SCP development.

During the pipeline routing process emphasis was placed on avoiding designated protected areas and habitats or species sensitive to disturbance. As a consequence, the route now only crosses one area proposed for nature conservation, and the majority of land crossed is agricultural (62.2%).

1.2 METHODOLOGY

The proposed SCP follows the Western Route Export Pipeline (WREP) for the majority of its length. The literature reviews undertaken by the Institute of Botany, Institute of Zoology and Institute of Fisheries during the planning phase of the WREP were therefore re-examined and supplemented with additional information provided by local experts. Survey data obtained for the WREP also reviewed for relevance to the proposed SCP route.

A baseline field survey of the BTC pipeline/SCP route was undertaken in August-September 2000 by ERM and local experts (ERM, 2000), with a further baseline survey of reroutes undertaken in January 2001 by AETC and local experts (AETC, 2001). A river corridor survey of the main river crossings was undertaken in November 2001 by AETC (Part 5 of Baseline Reports in the Appendices). In order to improve the seasonal coverage of the surveys, experts from the Institute of Botany undertook a survey for spring flowering species in the Gobustan area during April 2002. A further survey of birds, mammals and herpetofauna along the whole route began during April 2002.

As a result of additional reroutes during the latter half of 2001 short sections of the proposed pipeline route fell outside of the area previously surveyed by ERM and AETC. Due to the late time of year it was decided that further field surveys were unsuitable and therefore baseline habitats along the rerouted sections were mapped with the aid of aerial photographs (taken in summer 2001 on behalf of BP).

It should be noted that only six broad habitat categories (desert, semi desert, agriculture, woodland and scrub, wetland and other) could be distinguished from the aerial photographs. Details of vegetation, faunal assemblages or protected species of flora or fauna could not be ascertained. For the purpose of this exercise, therefore, where rare / protected species of flora or

fauna were identified during field surveys along the initial SCP route it has been assumed that these species will also be present along any parallel rerouted section of the pipeline.

In order to verify the baseline data in this report further surveys will be undertaken within the proposed pipeline corridor prior to construction.

The information contained within these above mentioned surveys has been used to write this baseline description along with additional information provided within the EIA of the WREP (AIOC 1997), which was based on extensive literature reviews and field surveys for the whole of the WREP undertaken in August – October 1996.

The local experts who have been involved in the various aspects of ecological work during these projects are listed in Table 1-1 below.

Table 1-1 Involvement of local experts

ACTIVITY	NAME	ORGANISATION	SPECIALISATION
Literature Review for WREP 1996	Academician Gadjiyev	Institute of Botany	Flora
	Academician Musayev	Institute of Zoology	Fauna
	Professor Z M Kuliyeu	Institute of Fisheries	Freshwater fish stocks
Field survey for WREP, August - October 1996	Eldar Shukurov	Institute of Botany	Flora
	Professor Shaig Ibrahimov	Institute of Zoology	Fauna
Field survey for SCP, August - September 2000	Maya Asker Nuriyeva	Institute of Botany	Flora and habitat
	Eldar Shukurov	BP	Assistance in flora and habitat
	Ilham Khayyam Alekperov	Institute of Zoology	Fauna and protected areas
Field survey for SCP reroutes January 2001	Salim Musayev	Institute of Botany	Flora
	Nijat Hasanov	Institute of Zoology	Fauna
	Shaig Ibraghimov	AETC	Fauna
Field survey for BTC pipeline/SCP – April 2002	Rafik Melikov Tofik Guliyev Vahid Gadjiyev	Institute of Botany	Flora
	Nijat Hansanov	Azer Consulting Services	Fauna

In addition to the information already contained within the WREP EIA (AIOC, 1997), the present baseline field surveys, carried out by ERM and ATEC, were undertaken, in order to provide:

- Detailed baseline information on the vegetation types and habitats to be crossed by the proposed pipeline route

- Detailed baseline information on the faunal assemblages encountered along the route of the proposed pipeline
- Information on the presence/ potential presence of species of flora or fauna which are internationally protected or are listed in the 'Red List' of the Azerbaijan Republic (1989)
- Information on any additional specialist surveys that are required
- Verification of WREP data
- Analysis of WREP corridor condition

The standard survey corridor was 100m either side of the pipeline centreline. During the surveys, the botanists and zoologists were required to complete proforma data sheets for each different habitat encountered, for different faunal assemblages in different habitats or for any unusual or rare species.

The proforma for flora comprises the identification of the habitat including a species list and general comments on the extent and nature of the habitat such as disturbance, anthropological uses and nature conservation significance. Habitats were identified in accordance with The Vegetation Map of Azerbaijan, 1996 and species were identified using Flora Azerbaijan (1950-1961).

The presence of faunal species was recorded by direct observation or observation of footprints, food remains, faecal remains, burrows, corpses and any other field signs. Additional information was also obtained from discussions with the local population and a review of available literature. The species are listed on the proforma for fauna, along with any additional information on rarity or conservation significance.

The ERM baseline was a rapid reconnaissance survey undertaken by driving along the right of way of the WREP. GPS readings were taken and proforma data sheets for flora and fauna were completed at regular stops along the pipeline route. Additional Proformas were completed as and when points of interest were seen.

The AETC reroute survey was undertaken predominantly on foot and in more detail than the ERM survey since no baseline data existed for these new routes. Where habitat areas and faunal assemblages required description or where rare/protected species of flora and fauna were seen, a GPS reading was taken and a proforma data sheet filled in. Due to the timing of this survey in January, it was not possible to record many species of flora and fauna. The majority of annual plants were absent or just beginning to emerge making identification difficult, while some faunal species were still in hibernation or dormant, eg amphibians, reptiles, invertebrates or wintering elsewhere (ie migratory). Therefore the survey concentrated on perennial plants, mammals and birds which are either resident or wintering in the region.

The original AIOC survey and the ERM survey were both undertaken during late summer and autumn. In these circumstances many of the annual plants will also not have been recorded since they would already have died off. However, a better coverage of fauna was achieved since species had not gone into hibernation. Some birds may already have migrated away from the region, but the surveys were undertaken during the migratory season and this would have added to bird species recorded. To overcome the weakness in the original botanical surveys, supplementary surveys were carried out by the Institute of Botany on behalf of BP during May 2001 and April 2002 in the Gobustan, Kazi-Magomed and Shamkir sections of the pipeline route.

A survey of birds, mammals and herpetofauna started in April 2002 to expand the zoological dataset, particularly for those areas that have been identified as important during previous surveys. Particular emphasis will be placed on breeding birds and spur-thighed tortoises (*Testudo graeca*).

Simple methodologies will be used, to facilitate repeat surveys in other seasons and years. The dataset thus generated will form the basis for future monitoring programmes.

It is considered that the data on birds and mammals are of a good standard as regards completeness and accuracy. The data on other vertebrate groups are adequate, although more reliance has had to be placed on prediction based on known habitat requirements and distribution data. Invertebrate coverage is less extensive and it has been assumed that any rare species are likely to be associated with scarce habitats or plants and that measures to safeguard these will therefore embrace any important invertebrates.

1.2.1 Species status and occurrence

The conservation status of species has been assessed by reference to the Red Data Book for Azerbaijan (1989), information from local scientists on proposed additions to the Red Book, European Bird Populations: Estimates and Trends (Birdlife International/ European Bird Census Council, 2000) and the 2000 IUCN Red List of Threatened Species. The status categories used in tables in the following sections are described in Table 1-2. The definition or likelihood of occurrence of a species along the pipeline route is described by three different categories as outlined in Table 1-3.

Table 1-2 Threatened species status categories

STATUS CATEGORY	DESCRIPTION
Ie	Species of International Conservation Concern – endangered
Iv	Species of International Conservation Concern – vulnerable
Ilr	Species of International Conservation Concern – low risk
Ee	Bird of European Conservation Concern - endangered
Ev	Bird of European Conservation Concern - vulnerable
Er	Bird of European Conservation Concern – rare
Ed	Bird of European Conservation Concern - declining
RDB	Listed in Red Data Book of Azerbaijan Republic
PRDB	Proposed for inclusion in Red Data Book of Azerbaijan Republic

Table 1-3 Definitions of occurrence

OCCURRENCE	
Possible	Identified in literature review (AIOC, 1997), but unknown if suitable conditions exist along pipeline route or downstream of it.
Probable	Identified in literature review (AIOC, 1997) and suitable conditions are likely to be present along pipeline route according to field survey data
Confirmed	Observed (directly or indirectly) during field surveys.

1.3 OVERVIEW OF FLORA AND FAUNA IN AZERBAIJAN

The UNEP World Conservation Monitoring Centre has recently produced (2001) a Biodiversity Profile for Azerbaijan that provides information on the biodiversity resource within the country, conservation measures in place and the threats to biodiversity. The following information is taken from this report.

Azerbaijan lies at the convergence of at least three biogeographic provinces, where species typical of Europe (eg brown bear, lynx, chamois, red deer), Central Asia (eg wild goat, leopard), and Asia Minor (eg striped hyena, goitered gazelle) occur. This geographic position, combined with the country's varied climate, topography and geology, has resulted in high levels of biodiversity.

Azerbaijan is included within one of Conservation International's 25 'biodiversity hotspots'. These are biologically rich areas that are under the greatest threat of destruction and represent a variety of global ecosystems, identified on the basis of three criteria: the number of species present, the number of endemic species in an ecosystem and the degree of threat faced. Hotspot areas cover less than 2% of global terrestrial ecosystems, yet account for 44% of all vascular plant species and 38% of birds, mammals, reptiles and amphibian vertebrate groups. Azerbaijan is included within the 'Caucasus' hotspot. The area also includes Georgia, Russia (Dagestan) and Armenia and a small portion of north-east Turkey.

The key biodiversity ecosystems within Azerbaijan include marine and coastal biomes, forests (lowland and montane), subalpine and alpine meadows, dry and semi-desert areas, grassland/steppes and wetlands.

The flora of Azerbaijan comprises of approximately 4,200 identified species, more than Georgia or Armenia, divided into 125 families and 920 genera. An estimated 270 species of plants (6.4%) are endemic to Azerbaijan, but a much greater proportion (of plants and animals) is unique to the Caucasus region.

The fauna of the country is represented by 99 species of mammals, 360 species of birds, 54 species of reptiles, 11 species of amphibians, 95 species of fish and 14,000 species of insects. Azerbaijan is particularly important for some animal groups especially birds and bats. The diverse large mammal fauna includes wild goat (*Capra aegagrus*), mouflon (or urial) (*Ovis orientalis*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), and their predators, including wolf (*Canis lupus*), lynx (*Lynx lynx*) and possibly leopard (*Panthera pardus*).

In all, Azerbaijan has 77 animal species and 3 plant species that are considered threatened (IUCN, 2000). A summary of the global status of Azerbaijan's animal and plant populations is presented in Table 1-4 below.

Table 1-4 Threat status of Azerbaijan's plants and animals

	CR	EN	VU	LR/CD	LR/NT	DD	TOTAL
Flora	0	0	0	0	2	1	3
Fauna	2	7	28	3	21	16	77

Source: Hilton-Taylor, C. (Compiler). 2000, and IUCN Red List at <http://www.redlist.org>

Note: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LR/CD = Low Risk (Conservation dependent); LR/NT = Low risk (Near Threatened); DD = Data Deficient

Table 1-5 Summary of diversity and threat status of the flora and fauna of Azerbaijan

	NUMBER OF SPECIES	NUMBER OF ENDEMIC SPECIES	NUMBER OF GLOBALLY THREATENED SPECIES	NUMBER OF CRITICALLY ENDANGERED SPECIES
Mammals	99	0	11	
Birds (breeding)	360 (248)	0	8	
Reptiles	52	0		
Amphibians	8	0		
Fresh water Fish		0		
Plants	4,300	240	28	0*

Source: Hilton-Taylor 2000, WCMC 2000, Walter and Gillett 1998.

In 1977, the Government of Azerbaijan adopted a resolution to develop a Red Book of the nation's most threatened and valuable flora and fauna, which was first published in 1989. It lists 50 species of plant, 5 species of fish, 5 amphibians, 8 reptiles, 36 birds, and 14 species of mammal as threatened (no information is included on how the degree of threat is assessed). A further 16 species of plant have been proposed for inclusion by Azerbaijan botanists. Several fish species whose stocks have declined markedly in Azerbaijan's coastal waters in recent years, such as barbel (*Barbus mursa*) and Danubian bleak (*Chacalburnus chalcoides*), are under threat and have also been suggested for inclusion in an updated Azerbaijan Red Book. A second edition is now being prepared.

The main threats to Azerbaijan's biodiversity have been identified as pollution, habitat destruction, over-exploitation of wildlife populations and other threats such as war and rise in Caspian Sea level.

1.4 PROTECTED AREAS

In Azerbaijan, sites or areas that are of particular importance for nature conservation are designated as protected areas covered by the *Law on the Protection of the Nature Environment and the Utilisation of Natural Resources* (Anon, 1992). There are several different levels of protection (Table 1-6) ranging from the Nature Reserve where public access is allowed through to Hunting Areas where licenced hunting is possible through to the protection of individual trees or palaeontological sites.

Table 1-6 Significance of designated conservation sites (in descending order of conservation importance)

DESIGNATION	SIGNIFICANCE	USAGE CONSTRAINTS
Nature Reserve	National	No public entry, some scientific research.
Forbidden Area	National	Permission for restricted human activities given by State Committee on Ecology.
National Park	National	Public access.
Hunting Area	National or Local	State licensed shooting area. Habitat managed for game.
Nature Monuments	National	Individual features of landscape eg trees, caves, palaeontological sites.

In addition, several of the protected areas in Azerbaijan have also been assigned a Management Category by IUCN (1994). The full list of IUCN categories is presented in Table 1-7. Only two

categories, Category Ia and Category IV are represented in Azerbaijan, and only four of the 10 protected areas in the vicinity of the pipeline route have been assigned an IUCN category.

Table 1-7 IUCN protected area management categories

DESIGNATION	MANAGEMENT OBJECTIVE
Category Ia	Strict Nature reserve: protected area managed mainly for science
Category Ib	Wilderness Area: protected area managed mainly for wilderness protection
Category II	National Park: protected area managed mainly for ecosystem protection and recreation
Category III	Natural Monument: protected area managed mainly for conservation of specific natural features
Category IV	Habitat/ Species Management Area: protected area managed mainly for conservation through management intervention
Category V	Protected Landscape/ Seascape: protected area managed mainly for landscape/ seascape conservation and recreation
Category VI	Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

As already mentioned 10 protected areas, of which four are proposed sites, are present within 10 km of the proposed pipeline route. Whereas the WREP crossed three designated and two proposed protected areas, the proposed SCP has specifically been routed to avoid crossing protected areas where at all possible. However, it has not been possible to avoid crossing the proposed Gobustan State National Park which comprises a range of desert and semi-desert habitats and encircles Sangachal. The Barda State Forbidden Area is 6km downstream of the proposed pipeline crossing. Table 1-8 gives an indication of the location and proximity of the protected areas to the pipeline, while the Environmental Route Maps (Volume 2) show the spatial extent of the areas.

In addition, Azerbaijan is in the process of becoming a Contracting Party to the Ramsar Convention, which is aimed at protecting the wildlife and habitats of internationally important wetlands, having recently submitted their instrument of accession to UNESCO.

Lake Jandari, which straddles the border between Azerbaijan and Georgia has been included in the book of potential Ramsar sites in Azerbaijan, but it is not known when or if this site will become designated. Never the less, under the Ramsar Convention proposed sites are afforded the same level of protection as designated sites and contracting parties have an obligation to maintain/protect any wetland within their territory.

Table 1-8 Protected areas in the vicinity of the proposed pipeline

PROTECTED AREA	IUCN CATEGORY	REASON FOR DESIGNATION	APPROX. LOCATION ALONG PIPELINE (KP POINTS)	APPROX. DISTANCE FROM PIPELINE (KM)
Gobustan State National Park (proposed)	-	Nationally important desert/semi-desert with an area of 178,700 hectares (ha) located west and south west of Baku.	KP 19.5-28.5	0
Basic Steppe State Nature Reserve (proposed)	-	Grassland steppe habitat with an area of 268,000 ha. Site now very degraded and future designation is unlikely	KP 120 – 122.5	1
Shilyan State Forbidden Area (proposed)	-	Wetland area which has been drained and degraded. Future designation very unlikely	KP 146 – 147.5	1.5
Barda State Forbidden Area	IV	Rare Tugay river forest area of 7,500 ha in the Barda/Agdas Regions.	KP 200-215	6
Varvara State Hunting Area (proposed Local Site)	-	Varvara Reserve and adjacent habitat comprising an area of 5,650 ha in the Yevlakh Region	KP 232 - 237	4.5
Korchay State Forbidden Area	-	Steppe/semi-desert area of 27,050 ha in the Samukh and Goranboy Regions.	KP 285-301	3
Samukh State Hunting Area (National Site)	-	Wetland area including part of Mingechaur Reservoir comprising 40,424 ha	KP 301-319	3.5
Shamkir State Forbidden Area	IV	Rare Tugay river forest area of 10,000 ha in the Shamkir Region.	KP 332-359	5
Karayazo-Akstafa State Forbidden Area	IV	Rare Tugay river forest area of 17,873 ha in the Kazakh Region	KP 410-434	0.5
Karayazi State Nature Reserve	Ia	Rare Tugay river forest area of 4,900 ha in the Kazakh Region	KP 434-442	4
Jandari Lake (proposed Ramsar site)	-	Large wetland area known for its large numbers of wintering wildfowl	KP 437-442	3

1.5 HABITATS AND VEGETATION

The results of the vegetation survey have been mapped at 1:50,000 scale and are presented in the Environmental Route Maps (Volume 2). The vegetation along the proposed pipeline route have been categorised into six broad habitat types. These are detailed in Table 1-9, which provides an analysis of the habitats crossed by the proposed pipeline.

Table 1-9 Extent of the main habitat types crossed by the proposed SCP

HABITAT TYPE	LENGTH IN KM	% OF TOTAL LENGTH
Desert	110.15	24.9
Semi-desert	35.5	8.0
Woodland and scrub	4.3	1.0
Wetland	16.25	3.7
Agricultural	275	62.2
Other (quarries, refugee camps etc.)	0.8	0.2
Total	442	100

Where vegetation data has been collected during field surveys, community types for each broad habitat type have been identified. These are detailed in Table 1-10. Their extent is shown on the Environmental Route Maps (Volume 2) of the ESIA and their structure and species composition described below.

Table 1-10 Vegetation communities with broad habitat categories

DESERT	
D1	<i>Artemisia fragrans</i>
D2	<i>Artemisia fragrans</i> + <i>Salsola nodulosa</i>
D3	<i>Artemisia fragrans</i> + <i>Salsola dendroides</i>
D4	<i>Artemisia fragrans</i> + <i>Suaeda dendroides</i>
D5	<i>Salsola nodulosa</i>
D6	<i>Salsola dendroides</i>
D7	<i>Suaeda dendroides</i>
D8	<i>Kalidium caspicum</i>
D9	<i>Halocnemum strobilaceum</i>
D10	<i>Capparis spinosa</i>
D11	Ephemeral desert
D12	Interzone
D13	<i>Salsola nodulosa</i> + <i>Artemisia fragrans</i>
D14	<i>Salsola ericoides</i>
SEMI-DESERT	
SD1	<i>Artemisia fragrans</i>
SD2	<i>Artemisia fragrans</i> + <i>Salsola nodulosa</i>
SD3	<i>Artemisia fragrans</i> + <i>Salsola dendroides</i>
SD4	<i>Salsola dendroides</i>
SD5	Interzone
AGRICULTURAL	
A1	Fields
A2	Old Fields
WOODLAND AND SCRUB	

Table 1-10 Vegetation communities with broad habitat categories

WS1	Plantations
WS2	Scrub
WETLAND	
W1	River
W2	Lake
W3	Canals (Major)
W4	Marsh
W5	Seasonal marsh / Chal meadow
OTHER	
Individually Named	

The predominant habitat type crossed by the proposed pipeline route is agricultural (62.2% in total). As such, the majority of the land, which the proposed pipeline will cross, is of little biodiversity or nature conservation interest with respect to plant species, although it is capable of supporting several species of fauna, which are of interest. A further 0.2% of the route is taken up by other land uses such as quarries.

The remaining 37.6% of habitats along the proposed pipeline route are of greater nature conservation importance since they have a greater structural and species diversity compared to agricultural land and are more semi-natural in character, even if some of these habitats have been subject to significant disturbance.

These semi-natural habitats also provide an important wildlife resource and refuge for many animals, which would otherwise not survive within the agricultural landscape sections of the pipeline route. Linear structures, such as bands of trees and watercourses, can also act as wildlife corridors, allowing the passage of animals and plants along them and linking larger areas of wildlife habitat so as to prevent their isolation.

A description of the main habitats types and their distribution along the proposed pipeline route is provided below.

1.5.1 Desert and semi-desert

The desert and semi-desert vegetation of the region has primarily been determined by the extreme climate, with its low rainfall and high summer temperatures, which creates a pronounced seasonal rhythm of growth and seed production typical of interior continental deserts. This is tempered to some extent in the Gobustan region by the proximity of the Caspian.

The complex geology, topography and soils of Azerbaijan are also involved in the smaller scale distribution of different plant communities and therefore desert or semi-desert vegetation types. These factors range from hill areas with lower salinity soils to areas with highly saline soils to depressions and valleys with a variety of soil types.

Desert and semi-desert vegetation in this region has two main components, perennial plants and, annual or ephemeral plants. Perennial plants include bushes such as mugwort species (*Artemisia fragrans*) and several species of saltwort (*Salsola species*) which are visible all year, beginning growth in early spring with the rains, slowing in mid-summer and then growing again with the autumn rains until colder temperatures stimulate leaf fall. Other perennial species include the xerophytic desert grass: bulbous meadow-grass (*Poa bulbosa*), which uses a different life strategy to mugwort species (*Artemisia spp.*) and saltwort species

(*Salsola* spp.) It is an ephemeroid ie a long-lived perennial species, which flowers and sets seed early each spring within a 40-50 day period, then withers until the autumn rains stimulate new growth from underground root stocks. Annual or ephemeral species, such as bur-medick (*Medicago minima*), live for one year only and tend to germinate with the autumn rains, grow slowly through the winter and then quickly develop with the spring rainfall and increasing ground temperature. They flower and set seed in spring and early summer then die.

Desert and semi-desert habitats can be differentiated by the density of the ephemeral and ephemeroid plant species cover, which tends to grow as a 'mat' between the perennial bushes, and the nature of their root systems. In the desert habitat the plant cover does not generally exceed 40% - 45% and the roots of individual plants do not form an interconnecting turf. Conversely in the semi-desert the plant cover may be as high as 75% and the roots are interconnected. The same species are frequently present in both habitat types.

The amount of cover given by the 'mat' varies and can often be patchy. Various factors determine the amount of vegetative cover. The soils of areas that are heavily grazed have a higher nutrient content due to animal dung, and this encourages the growth of ephemeral and ephemeroid species. Flat plateaux or plain areas can also have a high mat cover and this is possibly due to reduced soil erosion by water. Manmade factors in the form of physical disturbance eg vehicular traffic and trampling by stock will reduce the amount of cover.

Due to the ephemeral nature of many of the herbaceous species in desert and semi-desert plant communities and the different seasonal rhythms of the different vegetation groups, it is the varying dominances of perennial bush species that are used as a basis for vegetation classification. Generally one or two species will form the basis for a vegetation type. Combinations of three or four dominant species are rare.

Four main types of desert, based on the soil type, were distinguished in the former USSR: clay, solonchak (pale salty soils), sand and stone. Changes in vegetation cover are closely associated with changes in soil type. The main soil type along the pipeline route is clayey and is most often dominated, or co-dominated by communities comprising mugwort species (*Artemisia fragrans*) and / or saltwort species (*Salsola nodulosa*). Solonchak desert occurs to a lesser extent. According to Knystautas (1987) this type of desert is associated with river terraces where salt rich water has accumulated. This habitat also occurs in the lower lying areas of the pipeline route in Gobustan and on the Shirvan Plain.

Table 1-11 provides information on the soil and salinity affinities of the main indicative desert and semi-desert plants which were observed during the field surveys.

Table 1-11 Main indicative desert and semi-desert shrubs and their soil and salinity affinities

SPECIES	SOIL AFFINITY
Mugwort sp (<i>Artemisia fragrans</i>)	low salinity, typically clay
Saltwort sp (<i>Salsola dendroides</i>)	slight salinity, clay and pale loam
Saltwort sp (<i>Salsola nodulosa</i>)	salty pale soils
<i>Capparis spinosa</i>	copper association
Saltwort (<i>Salsola ericoides</i>)	salinised clay
Saltwort (<i>Salsola crassa</i>)	salty pale soils (Solonchak)
Seablight sp (<i>Suaeda dendroides</i>)	salty pale soils (Solonchak)
<i>Halocnemum strobilaceum</i>	wet salty pale soils (Solonchak)
<i>Kalidium caspicum</i>	salty pale soils (Solonchak)

The desert and semi-desert communities in the Gobustan area represent the most ecologically important habitats, from a botanical point of view, along the proposed pipeline route. These

are the most natural and extensive habitats of the region and are of national significance due to this area being a stronghold for mugwort species (*Artemisia fragrans*) deserts. The great age of many of the desert communities and their slow growth rate further enhance their botanical significance. The importance of this habitat type is one of the reasons that the Gobustan National Park has been proposed, so that some level of protection is offered to these deserts. Desert plant communities such as these, which develop very slowly are particularly susceptible to disturbance and are easily lost, taking many years to recover.

Besides having their own intrinsic value, the many plant species within these habitats also have a human value due to their use for medicines, oils and dyes. Several are strictly protected by law, while many others are used extensively for livestock grazing, particularly in the winter when mugwort species (*Artemisia fragrans*) is palatable to animals due to low concentrations of alkaloids. In the spring and summer alkaloid concentrations are high making the plants unpalatable. Saltwort species (*Salsola nodulosa*) is a plant of very high nutritional value and provides much more energy per gram than mugwort species (*Artemisia fragrans*).

Several Azerbaijan Red Data Book species are expected to occur in the Gobustan area one of which, *Iris acutiloba*, was confirmed during the April 2002 survey at KP 28. This species has also been confirmed to the west of Gobustan at KP 50. At this location plant densities up to 6 per square metre were recorded

1.5.1.1 Desert communities

The desert plant communities identified along the pipeline corridor are shown in Table 1-10. The most widespread desert community complex comprises mugwort species (*Artemisia fragrans*) and saltwort species (*Salsola nodulosa*), either occurring as individual dominants or as co-dominants. Associated with these habitats are ephemerals and ephemeroïds such as the grass (*Eremopyrum orientale*), saltwort species (*Salsola crassa*), bulbous meadow-grass (*Poa bulbosa*), *Torularia contortuplicata*, Perfoliate pepperwort (*Lepidium perfoliatum*), bur-medick (*Medicago minima*), *Noaea mucronata*, Alisons species (*Alyssum desertorum*), chive species (*Allium rubellum*), wall barley species (*Hordeum leporinum*), rye grass species (*Lolium rigidum*) and brome species (*Zerna rubens*).

On more salinised soils saltwort (*Salsola*) communities occur and the saltwort species *Salsola dendroides*, *Salsola ericoides* and *Salsola ericoides* and sea blight species (*Suaeda dendroides*) communities are quite common. Saltwort species (*Salsola dendroides*) is a species, which can dominate an area with high ground cover during early succession and thus often occurs in concentrations along the built section of the WREP. Associated species include spring herbs such as *Torularia contortuplicata*, bulbous meadow-grass (*Poa bulbosa*) and bur-medick (*Medicago minima*); and halophytes such as saltwort species (*Salsola crassa*).

Seablight species (*Suaeda dendroides*) communities are a widespread formation, which occur in small areas. Typical associated species include bur-medick (*Medicago minima*), wall barley species (*Hordeum leporinum*), the grass (*Eremopyrum orientale*) and ephedra (*Ephedra procera*) as well as halophytes such as sea lavender species (*Limonium spicatum*) and seablight species (*Suaeda altissima*).

The *Kalidium caspicum* saline community occurs only in small areas in Gobustan. Typical species recorded growing in this species-poor habitat included the salt-tolerant species saltwort species (*Salsola crassa*) and sea blight (*Suaeda microphylla*). Typical xerophytic species are wall barley species (*Hordeum leporinum*), Thunberg's brome (*Bromus japonicus*)

and *Torularia contortuplicata*. The saline hummock formation typical of the eastern Transcaucasian and Caspian plains is less obvious and absent in some areas.

The *Halocnemum strobilaceum* wet solonchak community is seen on moister, salt rich soils such as the site of the former Lake Shilyan (now drained) (KP 145) on the Shirvan Plain. It can be hummocky and is species-poor with halophytes such as sea lavender species (*Limonium meyerii*), saltwort species (*Salsola paulsenii*), seablight species (*Suaeda confusa*) and common glasswort species (*Salicornia europaea*).

The spineless caper (*Capparis spinosa*) community is associated with copper minerals and usually has a number of indicative constant species such as bulbous meadow-grass (*Poa bulbosa*), bur-medick (*Medicago minima*), Alisons species (*Alyssum desertorum*) and wall barley species (*Hordeum leporinum*). Of these, only wall barley species (*Hordeum leporinum*) was recorded in the one area where this habitat occurred along the WREP. Dominant camel prickly (*Alhagi pseudoalhagi*) also occurred suggesting that this is a disturbed form of this habitat. Desert communities, which contain camel prickly (*Alhagi pseudoalhagi*) and weeds such as *Karthamus glaucus* and chicory (*Cichorium intybus*), being indicative of disturbance, are classified as 'desert interzone'. These interzonal communities were typically found where anthropogenic influence was great.

The Ephemeral community occurs in the early stages of succession on de-vegetated desert/semi-desert sites. This community was evident in the Gobustan and Shirvan Plain area and comprises ephemeral species such as wall barley species (*Hordeum leporinum*), grass species *Eremopyrum triticum*, plantain species (*Plantago praecox*), bur-medick (*Medicago minima*) and bulbous meadow-grass (*Poa bulbosa*).

1.5.1.2 Semi-desert communities

In addition to the amount of vegetative cover and complexities of the root system, the semi-desert plant community is distinguished from the more xerophytic desert community by the presence of temperate species such as elder (*Sambucus nigra*) and common couch (*Elymus repens*) and by steppe species such as needle grass species (*Stipa szowitsiana*).

The mugwort (*Artemisietum*) community is the most frequently occurring type of semi-desert vegetation in Azerbaijan and it was the most frequently encountered semi-desert type along the proposed SCP. It is characterised by green grass in winter, due to autumn rains. Along the proposed pipeline it also occurs occasionally in conjunction with saltwort (*Salsolietum*) semi-desert vegetation forming a co-dominant community of mugwort species (*Artemisia fragrans*) and saltwort species (*Salsola dendroides* or *Salsola nodulosa*).

There are also arable communities, which contain semi-desert elements such as camel prickly (*Alhagi pseudoalhagi*), spineless caper (*Capparis spinosa*) and mugwort species (*Artemisia fragrans*), along with weeds such as *Karthamus glaucus* and chicory (*Cichorium intybus*). These communities are indicative of disturbance. Semi-desert interzonal communities were typically found where anthropogenic influence was great and they occurred uncommonly along the proposed SCP. These disturbed inter-zonal semi-desert areas are of less botanical significance since the species present are associated with disturbance.

1.5.2 Wetlands

Numerous small-scale wetlands are recorded along the proposed pipeline route and can be split into the following four types:

- Rivers

- Irrigation canals and ditches
- Lakes and ponds
- Marsh or chal meadow

The wetlands recorded along the proposed SCP vary in their morphology, salinity, naturalness and degree of permanence throughout the year. Additionally, some reveal signs of eutrophication in algal blooms and eutrophic species assemblage. This may be due to oil pollution, sewage water and in arable areas, to fertilizers.

1.5.2.1 Rivers

The proposed SCP has 21 principal river crossings and numerous minor stream and canal crossings. Apart from the Djeyrankechmes and Pirsagat rivers all of the other main rivers form part of the River Kura catchment.

The rivers often have a turbid flow and an unstable bed which restricts vegetation to side channels or the seasonally inundated margins. Species such as common reed (*Phragmites australis*), mint species (*Mentha spp*), water cress species (*Nasturtium spp*), water-milfoil species (*Myriophyllum spp*), pondweed species (*Potamogeton spp*) and buttercup species (*Ranunculus spp*) proliferate in silty pools and seasonal meanders.

The riverside vegetation generally comprises scrub and tree species such as tamarisk species (*Tamarix ramosissima*), bramble species (*Rubus spp*), rose species (*Rosa spp*), oleaster (*Elaeagnus angustifolia*), willow species (*Salix spp*), pomengranate (*Punica granatum*) (Azerbaijan Red Data Book Species) and poplar species (*Populus spp*) as well as swamp species such as common reed (*Phragmites australis*), sea club rush (*Bolboschoenus maritimus*), water-pepper (*Polygonum hydropiper*) and galingale (*Cyperus longus*).

In the case of seasonally dry rivers, these are still able to support tamarisk species (*Tamarix ramosissima*), and common reed (*Phragmites australis*) and occasionally milk thistle (*Silybum marianum*), sun spurge species (*Euphorbia helioscopia*), salwort species (*Salsola dendroides*) and various grasses.

1.5.2.2 Canals and ditches

The irrigation channels are much disturbed by man and their flora is largely limited to a swamp-like community comprising species such as common reed (*Phragmites australis*) (very common and abundant), bulrush (*Typha latifolia*) (widespread), sea club rush (*Bolboschoenus maritimus*), galingale (*Cyperus longus*), water-pepper (*Polygonum hydropiper*) and strangewort (*Cynanchum acutum*).

The colourful purple loosestrife (*Lythrum salicaria*), which is a valuable invertebrate nectar source, is also common along the canal margins. In some instances salt-tolerant species such as common glasswort (*Salicornia europaea*) and sea lavender species (*Limonium meyerii*) occur. The banks commonly support species such as tamarisk species (*Tamarix ramosissima*), bramble species (*Rubus sanguineus*), orache species (*Atriplex tartarica*) and camel prickly (*Alhagi pseudoalhagi*).

The proposed Azerbaijan Red Data Book Species glabrous liquorice (*Glycyrrhiza glabra*) also occurs in some of the shallow ditches as, occasionally, does another Azerbaijan Red Data Book Species woodland grape (*Vitis sylvestris*) (eg KP 190).

1.5.2.3 Marsh / 'chal meadow'

The 'chal meadows' represent a species-rich, natural plant community which is of high value ecologically, provides important animal fodder, through grazing and hay making and supports useful medicinal plants.

This marsh community develops in hollows and low-lying areas and is generally slightly saline. It is usually seasonally inundated, is species-rich and is widely encountered along the pipeline route. For example, the drained Lake Shilyan (KP 145), to the west of Kurdamir, is now largely dominated by 'chal meadow'.

Typical species include glabrose liquorice (*Glycyrrhiza glabra*) (a proposed Azerbaijan Red Data Book Species), sea lavender species (*Limonium meyerii*), camel prickly (*Alhagi pseudoalhagi*), bermuda-grass (*Cynodon dactylon*), saltwort species (*Salsola dendroides*) and orache species (*Atriplex tartarica*). Scrub intrusion by tamarisk (*Tamarix spp*) was common.

1.5.2.4 Ponds and lakes

Several lakes were recorded along the proposed SCP, the most significant of which were the ox-bow lakes associated with the Kura at the eastern pipeline crossing. Vegetation was dominated by common reed (*Phragmites australis*) and tamarisk species (*Tamarix spp*).

1.5.3 Woodlands and scrub

Woodland is extremely restricted on the proposed SCP route. It is often planted and (*Rubus spp*) is often dominated by ash spp (*Fraxinus spp*), pedunculate oak (*Quercus robur*) and vardim oak (*Quercus longipes*) with much bramble (*Rubus spp*) and some common or black mulberry (*Morus nigra*) and smooth-leaved elm (*Ulmus foliacea*). The two Azerbaijan Red Data Book Species woodland grape (*Vitis sylvestris*) and pomengranate (*Punica granatum*) also occur. The artificial nature, isolation and limited size (generally < 500 m) of these plantations reduces their ecological value. However, it does provide valuable habitat for a range of fauna in an area, which has been seriously depleted of woodland habitat. Small woodland sections of approximately 150 to 600 m are crossed at KP 105.5, 106, 175, 192.5, 223, 387.5, 411.5 and 423.5.

Some small areas of scrub also occur along the proposed SCP at KP 175, 192.5 and 411.5. These are generally dominated by tamarisk species (*Tamarix ramosissima*) which may form a mosaic with other habitats such as 'chal meadow'; or include species such as bramble species (*Rubus sanguineus*) which forms dense scrub along canal and river banks. Such areas provide useful cover and food for fauna.

The floodplain in Tugay forest habitat is associated mainly with the alluvial silt floodplains of the Kura river and its existence depends on maintaining high local water table levels. It is present in the Barda State Forbidden Area and the Karayazo-Akstafa State Forbidden Area and Karayazi State Nature Reserve. These reserves are 6 km, 0.5 km and 4 km from the proposed pipeline route respectively. Tugay forest is an internationally recognised, mature forest environment that has historically been found along banks of the Kura river. Previously, the forest thrived on the flood plain of the Kura river, which used to flood its banks frequently, providing suitable conditions for the forest species. The forest habitat has been seriously degraded since the construction of the Mingachevir dam and due to deforestation, associated with the lack of energy / primary fuel in the regions. This has created an extremely fragmented habitat, with small pockets of forest isolated from each other. The ability of the forest to function as a wildlife corridor has therefore been lost.

Close to the river where groundwater is high, willow species (*Salix australis*), grey popular (*Populus canescens*) and black popular (*Populus nigra*) are found. Many of the popular species (*Populus spp*) trees are over 100 years old and heavily laden with ivy (*Hedera helix*). Where willow species (*Salix spp*) trees are cut down or other events cause disturbance, then tamarisk species (*Tamarix ramosissima*), sea buckthorn (*Hippophae rhamnoides*) and oleaster species (*Elaeagnus spp*) often grow. Other species indicative of disturbance and stoney, riparian communities often invade when these areas are used for grazing in summer, including small reed species (*Calamagrostis pseudophragmites*), common spike rush (*Eleocharis palustris*), jointed rush (*Juncus articulatus*) and fleabane spp (*Pulicaria uliginosa*). Other species observed include cocklebur species (*Xanthium spp*) and thorn-apple (*Datura stramonium*).

Further back from the river, where groundwater is deeper, oak species (*Quercus pedunculiflora*) and smooth elm (*Ulmus carpinifolia*) grow. Other species observed in the woodlands include Caucasian hornbeam (*Carpinus caucasica*), seablight species (*Suaeda australis*), hawthorn species (*Crataegus spp*), common privet (*Ligustrum vulgare*) and large quantities of the lianas *Smilax excelsa*, travellers joy/old mans beard (*Clematis vitalba*), woodland grape (*Vitis sylvestris*) and ivy (*Hedera helix*). Many streams run into the forest from the irrigation canals feeding the adjacent agricultural land. The wetter areas support common reed (*Phragmites australis*).

Characteristic mosses of these floodplain forests are *Camhypylium chrysophyllum*, *Brachyctectum mildeanum*, *Fissidens taxifolius* and *Amblystegium serpens*.

1.5.4 Protected plant species

Several species which are included in the Azerbaijan Red Data Book or which have been proposed for inclusion in the revised Azerbaijan Red Data Book have been recorded along the proposed pipeline route (Table 1-12).

Table 1-12 Azerbaijan Red data book plant species recorded along the proposed SCP

SPECIES	STATUS	OCCURRENCE
Glabrose Liquorice (<i>Glycyrrhiza glabra</i>)	pRDB	Confirmed (AIOC, 1997) (ERM, 2000), (AETC, 2001)
Iris (group) (<i>Iris acutiloba</i>)	RDB	Confirmed (AIOC, 1997)
<i>Merendera trigyna</i>	pRDB	Confirmed (AETC, 2001)
Pomengranate (<i>Punica granatum</i>)	RDB	Confirmed (AIOC, 1997)
Woodland grape (<i>Vitis sylvestris</i>)	RDB	Confirmed (AIOC, 1997)

Iris species (*Iris acutiloba*) is one of several rare species expected in the Gobustan area and was recorded during the 1996 AIOC survey. The survey had been carried out late in the season however and this may have led to the under-recording and mapping of the distribution of this species. The presence of *Iris acutiloba* was confirmed at KP 28 and 50 during a survey for this species during April 2002. *Merendera trigyna* was recorded at KP 51, to the east of Kazi-Magomed at the western extent of the Gobustan desert area during 1996, but was not found in 2002. Both of these species are bulbs and could be translocated to protect them during construction activities.

Glabrose liquorice (*Glycyrrhiza glabra*) was recorded in many of the artificial watercourses and chal meadow areas along the pipeline route. This species is a useful medicinal plant and is used in over 100 medicinal preparations, and in 22 industrial sectors (eg food and paint).

The two species woodland grape (*Vitis sylvestris*) and pomengranate (*Punica granatum*) were recorded at several locations, generally associated with canals, ditches and river banks. However, these species will not be included in the revised edition of the Azerbaijan Red Data Book since further assessment of their status found it to be unnecessary.

1.6 FAUNA

1.6.1 General

Many species of fauna are present along the proposed pipeline route and within the survey corridor, the majority of which are common and widespread. The information obtained from literature reviews and the field surveys serves to give an indication of the general faunal assemblages along the proposed pipeline which are associated with different habitat types and to highlight those species which are of national or international importance.

The fauna within the Kura plain is made up of elements of the European and Asian zoogeographical regions. However, some species, particularly reptiles, of the Asian zoogeographical group, which is at its north-western limits in Azerbaijan, are undergoing a reduction in distribution towards the south-east. This is mainly as a result of habitat loss due to agriculture.

The faunal assemblages present along the proposed pipeline route are most easily split into those found in desert and semi-desert, woodland and scrub, agricultural and wetland habitats. The following sections describe the faunal assemblages of the different taxonomic groups along the proposed pipeline and also highlights those species which are rare or protected which have been identified as being present along the proposed pipeline route.

1.6.2 Mammals

The desk study (AIOC, 1997) identified 51 mammal species which are, or were, known to occur in the central part of the Kura River Plain from Gobustan to the Georgian border. However, this desk study was largely reliant on literature sources dating from 1940 to 1980. The more recent research for which papers are available has concentrated on bats.

Extensive human modification of many habitats, hunting pressure on various game animals eg wild boar (*Sus scrofa*) and goitered gazelle (*Gazella subgutterosa*) and killing of large predators has taken place during and since many of these papers were written. This makes it likely that several of the recorded species are no longer present in the region.

There are 14 species of mammal which are rare, either on a national or international scale, which have the possibility of being present in the vicinity of the proposed SCP (Table 1-13). Five of these are already included in the Red Data Book for Azerbaijan (1989), while a further six are proposed for inclusion in the revised Azerbaijan Red Data Book and six are listed as being internationally rare by the 2000 IUCN Red List of Threatened Species.

Table 1-13 Mammals of conservation importance which may occur along the proposed SCP

SPECIES	STATUS	OCCURRENCE
Water vole (<i>Arvicola terrestris</i>)	Prdb	Confirmed (AIOC, 1997)
Barbastelle bat (<i>Barbastella barbastellus</i>)	Iv	Confirmed (AETC, 2001)

SPECIES	STATUS	OCCURRENCE
Reed cat (<i>Felis chaus</i>)	PRDB	Possible
Wild field cat (<i>Felis lybica</i>)	RDB	Confirmed (AETC, 2001)
Goitered gazelle (<i>Gazella subgutterosa</i>)	RDB	Confirmed (A. Pritchard, 1998)
Edible, fat or squirrel-tailed dormouse (<i>Glis glis</i>)	llr	Confirmed (AIOC, 1997)
Striped hyaena (<i>Hyaena hyaena</i>)	RDB, llr	Possible
Porcupine species (<i>Hystrix indica</i>)	PRDB	Confirmed (ERM, 2000)
Eurasian otter (<i>Lutra lutra</i>)	pRDB, lv	Probable
Schreiber's bat (<i>Miniopterus schreibersii</i>)	RDB	Possible
Greater horseshoe bat (<i>Rhinolophus ferrumequinum</i>)	llr	Confirmed (AETC, 2001)
Lesser horseshoe bat (<i>Rhinolophus hipposideros</i>)	pRDB, lv	Confirmed (AETC, 2001)
Pygmy white-toothed shrew / Eurasian shrew (<i>Suncus etruscus</i>)	PRDB	Possible
Marbled polecat (<i>Vormela peregusna</i>)	RDB	Probable

Wild field cat (*Felis lybica*) is generally confined to the Gobustan region and Tugay Forest but is said to be present in the region of KP 349 (just to the south of the Shamkir State Forbidden Area) from discussions with the local population (AETC, 2001). Goitered gazelle (*Gazella subgutterosa*) no longer occurs regularly outside the Shirvan reserve, to the south of the proposed SCP, although two were seen during other fieldwork in April 1998 just to the north of proposed route in the Gobustan area (A. Pritchard, *pers. com.*) and therefore do cross the region.

Porcupine species (*Hystrix indica*) is the largest of the rodents in Azerbaijan, which tends to live in holes on river banks and feeds on invertebrates. Survey information over the last 60 years suggests that it is increasing its distribution. During the ERM survey, spines of this species were recorded at KP 171.5 (bank of the Geychay river), KP 315 (near Kushkarachay river), and KP 320.5 (near Karasu river) (ERM, 2000). With respect to various references it could be expected to be present between KP 170 – 400 of proposed route.

The greater horseshoe bat (*Rhinolophus ferrumequinum*), lesser horseshoe bat (*Rhinolophus hipposideros*) and barbastelle bat (*Barbastella barbastellus*) are known to be present in the Gobustan region as a result of recent field surveys (AETC, 2000). They, along with Schreiber's bat (*Miniopterus schreibersii*) may utilise buildings or caves as roost sites and may feed in the desert areas along the proposed pipeline route.

Water vole (*Arvicola terrestris*), which is a species occurring in grasslands and edible, fat or squirrel-tailed dormouse (*Glis glis*), known from Tugay forest areas, were both recorded along the route of the WREP (AIOC, 1997).

Striped hyaena (*Hyaena hyaena*) (RDB) is reported only in the Tugay forest areas. Eurasian otter (*Lutra lutra*) is a wetland species mainly confined to rivers and major waterbodies.

Pygmy white-toothed shrew / Etruscan shrew (*Suncus etruscus*) is one of the smallest recorded mammals in Azerbaijan and although it was not recorded during any field surveys is likely to be found between KP 47 - 155, in the Kura-Araks lowland.

The population and distribution of marbled polecat (*Vormela peregusna*) has dramatically decreased due to agricultural conversion of areas of steppe and desert and the use of rodenticides making its main prey scarce. It is thought that they would be expected between KP 43 –160.

Reed cat (*Felis chaus*) is distributed along the River Kura, River Araz and their tributaries. It is possible that it may be present along the proposed pipeline route in the water and swamp habitats of the Geychay, Turianchay, Kura, Shamkir region (KP 330 - 370) and Karayazo State Nature Reserve (KP 410 - 441).

The remainder of mammals recorded during all of the field surveys are generally those, which are common and widespread throughout Azerbaijan. It should be noted that many burrowing mammals, particularly small rodents, have excavated in the backfill soil over the WREP. This is probably because it is softer and easy to dig.

Species, which have been recorded and are ubiquitous to the entire route include the brown hare (*Lepus europaeus*), the rodents: red-tail sanderling (*Meriones erythraurus*), house mouse (*Mus musculus*), common wood mouse (*Apodemus sylvaticus*), striped field mouse (*Apodemus agrarius*) and Gunther's vole (*Microtus socialis*) and the carnivores red fox (*Vulpes vulpes*), golden jackal (*Canis aureus*), wolf (*Canis lupus*) and Eurasian badger (*Meles meles*).

The rodents, small jerboa (*Allactaga elater*) and mountain Asian jerboa (*Allactaga williamsi*) were recorded in the desert regions of Gobustan and Kazi-Magomed and tend to be restricted to these areas (AETC, 2001). The insectivores long-tailed white-toothed shrew (*Crocidura guldenstaedti*) and long-eared desert hedgehog / ear shrew (*Hemiechinus auritus*) are also known to be present in the Gobustan region (AETC, 2001). Other commonly expected mammals in the desert and semi-desert include eastern European hedgehog (*Erinaceus concolor*), Kuhl's pipistrelle (*Pipistrellus kuhli*) and desert serotine bat (*Eptesicus bottae*) (ERM, 2000).

The Gobustan region in the vicinity of the pipeline route supports important habitats for mammals as well as other faunal groups due to the vegetation and variety of niches present. These are the Jeirankechmes River and the Jingirdag and Azraildag heights.

Reed thickets along canals, rivers and other wetland habitat provide suitable habitat for brown rat (*Rattus norvegicus*), wild boar (*Sus scrofa*) and coypu (*Myocastor coypus*), which is an introduced species.

The Tugay forest habitat on the floodplains of the Kura River is very rich in animals, and represents the last refuge in the area for a number of species due to loss of habitat elsewhere. This area is not crossed by the proposed pipeline route. Thirty-five mammal species are found in the area, several of which are included in the 2000 IUCN list of threatened species, including Eurasian otter (*Lutra lutra*) and striped hyaena (*Hyaena hyaena*). An isolated population of red deer (*Cervus elaphus*) is known from the Tugay forest area, which also supports three endemic species grey hamster (*Cricetulus migratorius*), Brandt's hamster (*Mesocricetus brandti*) and Shelkownikov's water shrew (*Neomys shelkownikowi*). There are also confirmed populations of wild boar (*Sus scrofa*), Libyan jird species (*Meriones libicus*)

and other small mammals (AIOC, 1997) and whiskered bat (*Myotis mystacinus*) and forest dormouse (*Dyomys nitedula*) (ERM, 2000).

Species recorded in mid-November 1996 (AIOC, 1997) included footprints of red deer (*Cervus elaphus*), red fox (*Vulpes vulpes*) and wild cat (*Felis silvestris*) and the scats of brown hare (*Lepus europaeus*) along the river banks. Golden jackel (*Canis aureus*) was seen crossing a track.

1.6.3 Birds

Bird assemblages can change dramatically throughout the year due to their high mobility and ability to migrate such that species can be summer breeders, resident, wintering or migratory. Bird assemblages also vary between different habitats.

Desert and semi-desert areas or seasonal/chal meadow and marshes, where productivity in terms of food resources is low, lead to a low density of birds of generally fewer species than can be found in more productive habitats. Such species include crested lark (*Galerida cristata*), lesser short-toed lark (*Calandrella rufescens*), northern wheatear (*Oenanthe oenanthe*), isabelline wheatear (*Oenanthe isabellina*), Finsch's wheatear (*Oenanthe finchii*) and calandra lark (*Melanocorypha calandra*).

Agricultural areas and areas which are becoming more degraded by anthropological activities, such as winter grazing on desert pasture and in Tugay forests, as well as hay mowing, lead to the bird assemblage consisting of species which are common and widespread throughout the country and which have been regularly recorded during all the field surveys. These include bee-eater (*Merops apiaster*), tree sparrow (*Passer montanus*), house sparrow (*Passer domesticus*), sand martin (*Riparia riparia*), roller (*Coracias garrulous*), magpie (*Pica pica*), starling (*Sturnus vulgaris*), rook (*Corvus frugilegus*), carrion crow (*Corvus corone*). White stork (*Ciconia ciconia*) (Ev) and heron species (*Ardea* spp.) are frequently seen feeding with cattle, which disturb the insects they feed on.

Wetland areas, such as river, canals, lakes and marsh, often support a relatively diverse mixture of waterfowl and waders, the more ubiquitous of which include heron (*Ardea* spp), egret (*Egretta* spp), coot (*Fulica atra*), mallard (*Anas platyrhynchos*) and gull (*Larus* spp).

Tugay forest areas, associated with the River Kura flood plain, which have not been degraded, are very rich habitats supporting a wide range of bird species. A desk top study (AIOC, 1997) estimated that 98 species of bird nest in the Tugay forest, twenty of which are associated with aquatic habitats, eleven are birds of prey. Nests of the following species of conservation concern have been recorded in the vicinity of the pipeline corridor: white-tailed eagle (*Haliaeetus albicilla*) (RDB, Er, Ilr), grey partridge (*Perdix perdix*) (Ev), black francolin (*Francolinus francolinus*) (RDB, Ev). Other Ciconiiformes found nesting in the floodplain forests are grey heron (*Ardea cinerea*), night heron (*Nycticorax nycticorax*) (Ed) and little bittern (*Ixobrychus minutus*) (Ev).

Surveys in October and mid-November 1996 (AIOC, 1997) recorded long-legged buzzard (*Buteo rufinus*) (Ee), black kite (*Milvus migrans*), and lesser spotted eagle (*Aquila pomarina*) over the forest. Herring gull (*Larus argentatus*), grey heron (*Ardea cinerea*), little egret (*Egretta garzetta*), and white wagtail (*Motacilla alba alba*), kingfisher (*Alcedo atthis*) and cormorant (*Phalacrocorax carbo*) associated with water. Blackbird (*Turdus merula*), jay (*Garrulus glandarius*), long-tailed tit (*Aegithalus caudatus*) and great tit (*Parus major*). Buzzard (*Buteo buteo*) was heard calling.

Table 1-14 Birds of conservation importance which may occur along the proposed SCP

SPECIES	STATUS	RESIDENCY*	OCCURRENCE
Kingfisher (<i>Alcedo atthis</i>)	Ed	R	Confirmed (AETC, 2001)
Chukar (<i>Alectoris chukar</i>)	Ev	R	Confirmed (AIOC, 1997), (AETC, 2000)
Golden eagle (<i>Aquila chrysaetos</i>)	RDB, Er	R	Confirmed (AIOC, 1997)
Tawny Eagle (<i>Aquila rapax ssp. nipalensis & orientalis</i>)	RDB, Ev	M/W	Confirmed (AIOC, 1997), (ERM, 2000)
Squacco heron (<i>Ardeola ralloides</i>)	Ev	M/W	Confirmed (AIOC, 1997)
Bittern (<i>Botaurus stellaris</i>)	Ev	M/W	Confirmed (AIOC, 1997), (AETC, 2001)
Stone curlew (<i>Burhinus oedichnemos</i>)	Ev	S	Confirmed (AIOC, 1997), (AETC, 2001)
Long-legged buzzard (<i>Buteo rufinus</i>)	pRDB, Ee	R/M	Confirmed (AIOC, 1997), (ERM, 2000), (AETC, 2001)
Nightjar (<i>Caprimulgus europaeus</i>)	Ed	S/ M	Confirmed (AIOC, 1997)
Sociable plover (<i>Chettusia gregaria</i>)	RDB	M	Confirmed (ERM, 2000)
White-tailed plover (<i>Chettusia leucura</i>)	RDB	S	Confirmed (ERM, 2000)
White stork (<i>Ciconia ciconia</i>)	Ev	S	Confirmed (AIOC, 1997)
Hen harrier (<i>Circus cyaneus</i>)	Ev	W	Confirmed (AIOC, 1997), (AETC, 2001)
Lesser Kestrel (<i>Falco naumanni</i>)	Ev, Iv	R	Probable
Eurasian kestrel (<i>Falco tinnunculus</i>)	Ed	R	Confirmed (AETC, 2001)
Back francolin (<i>Francolinus francolinus</i>)	RDB, Ev	R	Confirmed (AIOC, 1997), (AETC, 2001)
Collared pratincole (<i>Glareola pratincola</i>)	Ee	S	Probable
Black-winged pratincole (<i>Glareola nordmanni</i>)	RDB, Er	S	Confirmed (ERM, 2000)
Crane (<i>Grus grus</i>)	Ev	M	Confirmed (AIOC, 1997)
White-tailed eagle (<i>Haliaeetus albicilla</i>)	RDB, Er, Ilr	R	Confirmed (ERM, 2000), (AETC, 2001)
Blue rock thrush (<i>Monticola solitarius</i>)	Ev	S	Confirmed (AETC, 2001)
Egyptian Vulture (<i>Neophron percnopterus</i>)	Ee	R/M	Confirmed (AIOC, 1997), (AETC, 2001)
Red-crested pochard (<i>Netta rufina</i>)	Ed	M	Confirmed (AIOC, 1997)
Night heron (<i>Nycticorax nycticorax</i>)	Ed	M/W	Confirmed (AIOC, 1997)
Osprey (<i>Pandion haliaetus</i>)	RDB, Er	S	Confirmed (ERM, 2000)
Pygmy cormorant (<i>Phalacrocorax pygmeus</i>)	Ev, Ilr	M	Confirmed (AETC, 2001)

Table 1-14 Birds of conservation importance which may occur along the proposed SCP

SPECIES	STATUS	RESIDENCY*	OCCURRENCE
Glossy Ibis (<i>Plegadis falcinellus</i>)	pRDB, Ed	S	Confirmed (ERM, 2000)
Purple gallinule (<i>Porphyrio porphyrio</i>)	RDB, Er	W	Confirmed (AETC, 2001)
Ruddy Shelduck (<i>Tadorna ferruginea</i>)	Ev	S/R	Confirmed (AETC, 2001)
Little Bustard (<i>Tetrax tetrax</i>)	RDB, Ev	W	Confirmed (AETC, 2001)
Grey partridge (<i>Perdix perdix</i>)	Ev	R	Confirmed (AIOC, 1997)
Quail (<i>Coturnix coturnix</i>)	Ev	S	Confirmed (ERM, 2000)
Little bittern (<i>Ixobrychus minutus</i>)	Ev	M	Confirmed (AIOC, 1997)

* - Residency: R = resident and breeding; S = summer and breeding; W = wintering; M = passage migrant

The remainder of this section discusses those bird species which have been recorded along the proposed pipeline route and are of some nature conservation significance on a national, European or international scale.

Many species of birds of prey have been recorded, normally flying, over the proposed pipeline route. It is likely that they hunt for food in the vicinity of the proposed pipeline or pass through the area on migration. However, it is unlikely that any of them breed on the proposed pipeline route since the larger eagles and buzzards require rocky crags or large trees to nest in and the Eurasian kestrel (*Falco tinnunculus*) nests in buildings or trees.

Eurasian kestrel (*Falco tinnunculus*) was recorded regularly along the proposed pipeline route, but most frequently in the western part of the route. Long-legged buzzard (*Buteo rufinus*) has been recorded at KP 216.5, but mainly in the Shamkir region at KP 338.5 and KP 349.5. Osprey (*Pandion haliaetus*) is a fish-eater and prefers river and wetland habitats. It was recorded at KP 395 (west Kura crossing). White-tailed eagle (*Haliaeetus albicilla*) is a large eagle normally found in plains areas. During the survey this species was recorded at KP 0, KP 328, KP 402.5 and KP 414. The Egyptian vulture (*Neophron percnopterus*) has been recorded at KP 10 and KP 40 in the Gobustan area. The tawny eagle (*Aquila rapax*) (which has the subspecies *nipalensis* and *orientalis*) prefers semi-desert plain areas and was recorded twice during the 2000 survey at KP 81 and KP 98. Records from 1996 (AIOC, 1997) indicated that the golden eagle (*Aquila chrysaetos*) (RDB, Er) was observed at KP 22.

Harriers unlike other birds of prey do nest on the ground. One species of European conservation status, hen harrier (*Circus cyaneus*), has been recorded on the route at KP 386 and KP 411.5.

Lesser kestrel (*Falco naumanni*) may also occur in the area, but like the rest of the birds of prey is likely to only hunt over the proposed pipeline route.

Other birds of conservation importance are ground nesting species, which live in the plains, deserts and sometimes in the more agricultural areas. These species are of more concern with respect to pipeline construction since they could nest within the working area.

These species include stone curlew (*Burhinus oedipnemus*) (Ev) in the Gobustan region at KP 13.5. Chukar (*Alectoris chukar*) may breed in the Gobustan area, and was recorded at KP 12 as well as KP 291.5 around the Korchay River along with the other ground nesting bird, black

francolin (*Francolinus francolinus*). Both these species have also been recorded in potentially suitable nesting habitats around KP 106.5.

Many birds associated with wetlands, such as wildfowl and waders are also ground nesting and several such species of conservation importance have been recorded.

Black-winged pratincole (*Glareola nordmanni*) at KP 79. White-tailed plover (*Chettusia leucura*) prefers shallow lakes and flooded swamp habitats. It was recorded at KP 116, 315 and 411.5. Sociable plover (*Chettusia gregaria*) was confirmed at KP 140.5. Glossy Ibis (*Plegadis falcinellus*) was recorded three times during the survey: as a singleton within a group of little egret (*Egretta garzetta*) near irrigation canal (KP 145.5), a flock of more than 15 birds in wetland habitat of Gush-Garachay (KP 319) and one at KP 396.5.

Blue rock thrush (*Monticola solitarius*) was recorded at the East Kura crossing (KP 223.5).

Kingfisher (*Alcedo atthis*) was recorded at the west Kura crossing area at KP 411 and nests in holes in river banks.

White stork (*Ciconia ciconia*) was proved nesting (KP 205). Collared pratincole (*Glareola pratincola*) may be present in the area. It feeds on arable farmland and grazing land and nests on the ground in grassland, often near wetlands.

Species, which only winter in the region include little bustard (*Tetrax tetrax*) and bittern (*Botaurus stellaris*) which were recorded at KP 291.5. Bittern (*Botaurus stellaris*) has also been recorded at KP 223.5 (east Kura crossing) and KP 311. Nightjar (*Caprimulgus europaeus*) has been recorded and was probably a passage migrant. Purple gallinule (*Porphyrio porphyrio*) was recorded near the west Kura crossing at KP 408 during the January 2001 survey. Other species of concern in the European context, which were recorded at KP 311, include night heron (*Nycticorax nycticorax*), squacco heron (*Ardeola ralloides*), red-crested pochard (*Netta rufina*) and crane (*Grus grus*). The last two species were certainly passage migrants and the others may be migrants or wintering birds. The internationally rare pygmy cormorant (*Phalacrocorax pygmeus*) was also recorded at the east Kura crossing (KP 223.5) but is known only as a passage migrant in Azerbaijan.

1.6.4 Amphibians

The 1996 desk study (AIOC, 1997) noted five amphibian species, which had been recorded in the region of the proposed pipeline. These are generally found in canals, rivers, lakes and swampy areas except for European treefrog (*Hyla arborea*) (Ilr), which is found in vegetation. Table 1-15 indicates species of conservation concern, which may occur along the proposed pipeline route.

The 1996 survey regularly recorded green toad (*Bufo viridis*) and marsh frog (*Rana ridibunda*) along the WREP and spadefoot toad (*Pelobates syriacus*) in Tugay forest. Marsh frog (*Rana ridibunda*) was again recorded in abundance during the 2000 survey (ERM, 2000) and common toad (*Bufo bufo*) (RDB), the biggest of the toads in Azerbaijan was recorded near an irrigation canal at KP 140.5 and on the edge of Tugay forest in a hollow fallen tree at KP 223.5.

Table 1-15 Amphibians of conservation importance which may occur along the proposed SCP

SPECIES	STATUS	OCCURRENCE
European tree frog (<i>Hyla arborea</i>)	IIr	Possible
Common toad (<i>Bufo bufo</i>)	RDB	Confirmed (ERM, 2000)

No amphibians were recorded during the 2001 survey (AETC, 2001) since it was during January and the main hibernation period.

1.6.5 Reptiles

The 1996 (AIOC, 1997) literature review noted that 27 species had been recorded from habitats in the vicinity of the proposed pipeline. There are two main groups of reptiles; those which inhabit arid desert and semi-desert regions and those which inhabit wet lowland marsh, forest and waterbodies. Table 1-16 indicates which reptiles of conservation significance may be found along the proposed pipeline route.

Those which were commonly recorded in the desert and semi-desert areas, during the 1996 (AIOC, 1997) and 2000 (ERM, 2000) surveys include, gecko (*Gymnodactylus caspius*), the lizards: Caucasian agama (*Agama caucasica*), sand lizard (*Lacerta agilis*), Balkan green lizard (*Lacerta trilineata*) (which is rare but not Red listed) (AIOC, 1997) and rock lizard (*Lacerta saxicola*), blunt-nosed viper (*Vipera lebetina*) and spur-thighed tortoise (*Testudo graeca*) (RDB, Iv). Other species likely to be recorded include Caspian green lizard (*Lacerta strigata*), lizard species (*Lacerta raddei*), rapid fringed-toed lizard (*Eremias velox*), Schmidt's whipsnake (*Coluber schmidtii*) and Caucasian sand boa (*Eryx jaculus*).

In the wetland areas, along canals and in low terrain forest areas widespread species such as freshwater terrapin species (*Clemmys caspica*) (pRDB), European pond terrapin (*Emys orbicularis*) (pRDB), European grass snake (*Natrix natrix*) and water snake (*Natrix tessellata*) were commonly recorded. Other reptiles may also be recorded including snake-eyed lizard (*Ophiosops elegans*), and Montpellier snake (*Malpolon monspessulanus*).

No reptiles, except for spur-thighed tortoise (*Testudo graeca*) (RDB, Iv), were recorded during the 2001 survey (AETC, 2001) since it was during January and the main hibernation period.

Table 1-16 Reptiles of conservation importance which may occur along the proposed SCP

SPECIES	STATUS	OCCURRENCE
Freshwater terrapin species (<i>Clemmys caspica</i>)	PRDB	Confirmed (AIOC, 1997), (ERM, 2000)
Ladder snake spp (<i>Elaphe hohonackeri</i>)	PRDB	Confirmed (AIOC, 1997)
European pond terrapin (<i>Emys orbicularis</i>)	PRDB	Confirmed (AIOC, 1997)
Long-legged skink (<i>Eumeces schneideri</i>)	RDB	Possible
Spur-thighed tortoise (<i>Testudo graeca</i>)	RDB, Iv	Confirmed (AIOC, 1997), (ERM, 2000), (AETC, 2001)

Several species of conservation concern were recorded during the surveys and are described below. Ladder snake (*Elaphe hohonackeri*), was recorded towards the western end of the proposed pipeline route (KP 311.5) (AIOC, 1997).

Two species of terrapin, fresh water terrapin (*Clemmys caspica*) and European pond terrapin (*Emys orbicularis*) were recorded regularly in wetland areas along the proposed pipeline route during the 1996 and 2000 surveys, however it was impossible to distinguish between the two species in the field. It possible, therefore, that either of these species may be presented at the following KP points: 33, 97, 106, 114.5, 130.5, 141.5, 143, 146, 152.5, 153.5, 154, 155.5, 157, 167.5, 183.5, 189, 192, 203.5, 213, 216, 219, 220, 225, 228.5, 247, 319, 321, 362, 394, 402, 413 and 423.5.

The spur-thighed tortoise (*Testudo graeca*) (RDB, Iv) was recorded frequently in the desert, semi-desert and scrub habitats, mainly in the west of the proposed pipeline route and particularly the Shamkir region, during all three periods of survey. The population is relatively high within Azerbaijan but they are very susceptible to persecution and other anthropogenic impacts. They live in holes and usually hibernate during the winter, although they were recorded during the January 2001 AETC survey.

This herbivorous tortoise is found most frequently where soft soil hummocks form on the sides of vegetation. This habitat provides ideal places for burrowing and laying of egg clutches (three clutches per year). They are especially apparent during the first warm days of the year when they begin to pair (usually around early April).

Table 1-17 Breeding and incubation periods for spur-thighed tortoise

Common name	Event	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
Spur-thighed tortoise	Breeding												
	Incubation												

Spur-thighed tortoise has been recorded at the following KP points: 17, 146, 304, 311, 314, 349.5, 351, 359, 361.5, 363, 399, 401, 402.5, 412, 421.5, and 441.5.

A more detailed survey of the route will be undertaken during spring 2002 to determine the precise location of animals and burrows in relation to the pipeline route.

1.6.6 Fish

This section is based on the information collated for the WREP (AIOC, 1997). The proposed pipeline crosses 21 principal rivers and numerous minor watercourses, mostly in the central and western parts of the proposed route. With the exception of the Djeyrankechmes and Pirsagat, which occur in the eastern part of the proposed pipeline route and flow directly into the Caspian, all the rivers form part of the Kura catchment.

More than 50 species occur in the Kura and its tributaries, with over 20 having some commercial value. However, stocks of some species are now depleted, with the construction of the Mingechaur Reservoir being a major contributory factor.

The fish fauna can be divided into two groups. The first, which includes the Cyprinids: common crab (*Cyprinus carpio*), Caspian roach (*Rutilus rutilus caspicus*) and bream (*Abramis brama orientalis*) mainly spawn in April to June during spring floods. The second group are principally migrants, which run up the Kura and its tributaries from the Caspian at different times, mainly in the period from October to March. Some of these species spawn

directly on arrival, others later. In practice, a number of species may be migrating up or down river or spawning in any month.

Table 1-18 lists the 10 species of fish, which are of conservation importance which are found within the Kura river and its tributaries. The Kura holds all of these species, while its tributaries will hold at least one species. The Djeyrankechmes and the Pirsagat do not hold any Red Data Book fish species.

Table 1-18 Fish of conservation importance which may occur along the proposed SCP

SPECIES	STATUS	OCCURRENCE
White-eyed bream (<i>Abramis sapa</i>)	pRDB	Probable
Blackbrow (<i>Acanthalburnus microlepis</i>)	pRDB	Probable
Sturgeon ship (<i>Acipenser nudiiventris</i>)	pRDB, le	Probable
Barbel spp (<i>Barbus brachycephalus</i>)	pRDB	Probable
Chanari barbel (<i>Barbus capito</i>)	pRDB	Probable
Murtsa barbel (<i>Barbus mursa</i>)	pRDB	Probable
Caspian lamprey (<i>Caspiomyzon wagneri</i>)	RDB	Probable
Chub (<i>Leuciscus cephalus</i>)	pRDB	Probable
Bleak spp (<i>Pelecus cultratus</i>)	RDB	Probable
Brown trout (<i>Salmo trutta fario</i>)	RDB	Probable

1.6.7 Invertebrates

The desk study (AIOC, 1997) found records of over 1,700 arthropod invertebrate species including nearly 1,600 insect species in the vicinity of the proposed pipeline. In addition, several hundred Protozoans are listed. In total, nine Azerbaijan Red Data Book Species may occur on the proposed pipeline route (Table 1-19). This includes two species of bumble bee (*Bombus persicus* and *Bombus daghestanicus*), two species of beetle (*Megacephalus euphraticus* and *Anchylocheria salmoni*), two species of butterfly (*Colias aurorina* and *Tomares romanovi*) and two species of hawk moth (*Manduca atropos* and *Daphnis nerii*). The crayfish (*Astacus pyzłowi*) was listed in the Red Data Book of the USSR and is known to exist in one of the rivers to be crossed by the proposed pipeline.

As with the other faunal groups, there is a particularly rich invertebrate fauna found within the Tugay forest areas. Many in the area of the proposed pipeline are included in the Red Data Book of the USSR and include the Lepidopterans: death's-head hawkmoth (*Manduca atropos*), heath species of butterfly (*Coenonympha saad*), swallowtail (*Papilio machaon*) and scarce swallowtail (*Iphiclides podalirius*) and the Hymenopterans: *Mellituga clavicornis*, *Xylocopa valga*, *Bombus lagsus*, *Bombus muscorum*, *Anthrophora nigriceps* and *Bombus argillaceous* the latter two being Caucasian endemics. However, of these species only death's-head hawkmoth (*Manduca atropos*) has been included in the Red Data Book of Azerbaijan.

Table 1-19 Red Data Book Species which may occur on the proposed SCP route

SPECIES	STATUS	OCCURRENCE
Bettle spp (<i>Anchylocheria salmoni</i>)	RDB	Possible
Crayfish (<i>Astacus pyzolwi</i>)	USSR RDB	Probable
Daghestan bumble-bee (<i>Bombus daghestanicus</i>)	RDB	Possible
Bumble-bee spp (<i>Bombus persicus</i>)	RDB	Possible
Clouded yellow spp (<i>Colias aurorina</i>)	RDB	Possible
Oleander hawkmoth (<i>Daphnis nerii</i>)	RDB	Possible
Death's-head hawkmoth (<i>Manduca atropos</i>)	RDB	Confirmed (ERM, 2000)
Bettle spp (<i>Megacephalus euphraticus</i>)	RDB	Possible
Hairstreak spp (<i>Tomares romanovi</i>)	RDB	Possible

The field surveys in 1996 (AIOC, 1997) and 2000 (ERM, 2000) noted many invertebrate species including molluscs, spiders, grasshoppers and bush-cricket, beetles, flies, bees, ants, dragonflies and butterflies. No invertebrates were recorded during the AETC, 2001 survey because in January very few species are active.

The ERM 2000 survey recorded the death's-head hawkmoth (*Manduca atropos*) (RDB), which can have a length of up to 15 cm at KP 140.5 and 397.5.

It is also likely that the crayfish (*Astacus pyzolwi*) is present in many of the watercourses.

In practice, it is almost impossible to undertake a complete invertebrate survey, even over a small area, because many hundreds of species may be present, including communities in the soil, in rock crevices, within plant stems and concealed in other areas.

Further, many are active for only a few days in the entire year. Thus the normal practice is to look for uncommon habitat types or scarce plants which may have associated invertebrates that are rare by reason of the scarcity of the habitat or food plant. Measures to minimise the impact on important habitats and plants along the route will safeguard any scarce invertebrates, which occur in association with them.

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1 REGULATORY REVIEW ON ENVIRONMENTAL AND SOCIAL ISSUES

1.1 INTRODUCTION

The SCP project will be designed, built and operated in conformance with a number of legislative requirements, policies and guidelines including:

- BP corporate environmental policy and management system
- Host government agreements (HGA)

The laws and procedures that apply to the SCP pipeline will ultimately be determined by the Host Government Agreement (HGA) between the proponent, BP and the government of Azerbaijan. This sets out the national legislation and international regulations applicable to the project, and the responsibilities of governmental departments and other organisations in relation to the project.


The relevance of each of these to the SCP project is discussed below.

1.2 CORPORATE ENVIRONMENTAL POLICY AND MANAGEMENT SYSTEM

BP has operations in more than 90 countries and employs some 100,000 people. It is BP's policy to carry out all its operations in a safe and environmentally responsible manner. The corporate health, safety and environmental (HSE) policy (Figure 1) reflects the commitment to high standards throughout all phases of a project.

Figure 1 BP's Corporate Health Safety and Environmental Policy

Health Safety & Environmental Policy




We fully endorse the BP Group Policy and are committed to our worldwide corporate goals: no accidents, no harm to people and no damage to the environment. Getting HSE right is a fundamental part of our business in the Caspian Sea Region and BP through our operations in exploration, development, extraction and transporting of oil & gas fully supports its goals and requirements.

In meeting with this policy we will:

1. Expect all personnel to demonstrate commitment to, and leadership in, health, safety and environmental (HSE) protection, performance and compliance.
2. Manage HSE performance in compliance with the expectations in the BP "Getting HSE Right" management system.
3. Audit the environmental management system against ISO 14001.
4. Inform our employees, contractors, partners, stakeholders, government agencies and the public of relevant HSE aspects of our operations. Openly listen, consult and respond to their concerns.
5. Endeavour to continuously improve HSE performance.
6. Meet or exceed applicable HSE legislation, regulations and company requirements.
7. Ensure our employees and contractors are familiar with our HSE systems, and are competent and trained to carry out their work safely and with due regard for the environment.
8. Provide employees with a safe place to work.
9. Maintain a commitment to incident and pollution prevention, maintain emergency response plans and resources, and manage emergency situations resulting from our activities.
10. Set annual HSE objectives and targets and openly report our performance. Audit compliance with our policies and take corrective action where appropriate.

No task is so important that we cannot take time to plan and implement it in a safe and environmentally responsible manner.



David Woodward
Business Unit Leader BP Azerbaijan
September, 2001

1.3 CORPORATE SOCIAL POLICIES AND REQUIREMENTS

1.3.1 BP business policies

BP has 3 Business Policies related to social aspects of the project:

- Ethical Conduct
- Employees
- Relationships
- Health and Safety and Environmental Performance

- Control & Finance

Contractors will be required to comply with these BP policies. Potential contractors will be asked to set out in their response to the Invitation To Tender for construction how they propose to achieve this compliance.

The relevant Health and Safety and Environmental Performance policies are covered in the URS BP Shah Deniz Mid Stream Pre Host Government Agreement Regulatory Review.

The full set of BP Business policies can be found in the BP booklet, What We Stand For.

1.3.2 Ethical conduct policy

We will pursue our business with integrity, respecting the different cultures and the dignity and rights of individuals in all the countries where we operate.

BP supports the belief that human rights are universal. They are enshrined in the UN Universal Declaration of Human Rights (UDHR), which we support. The Charter sets out the obligations to promote universal respect for and observance of human rights and fundamental freedoms for all, without distinction as to race, gender, language, or religion. The promotion and protection of all human rights is a legitimate concern of business.

In our actions and our dealings with others, we will:

- Respect the rule of law
- Promise only what we expect to deliver, make only commitments we intend to keep, not knowingly mislead others and not participate in or condone corrupt or unacceptable business practices
- Fulfil our obligations and commitments, treat people according to merit and contribution, refrain from coercion and never deliberately do harm to anyone
- Act in good faith, use company assets only for further company business and not seek personal gain through abuse of position in the company
- We will expect the same commitments from third parties acting directly on BP's behalf.

Policy Expectations

- We will respect the law in the countries and communities in which we operate
- We will never offer, solicit, or accept a bribe in any form
- BP's preference is not make facilitation payments
- We will hold no secret or unrecorded funds of money or assets
- We will only give or accept gifts and entertainment that are for business purposes and are not material or frequent
- We will avoid situations where loyalty to the company may come into conflict with personal interests or loyalties
- BP supports the principles set forth in the UN Universal Declaration of Human Rights and will respect the 1977 International Labour Organisation 'Tripartite Declaration of Principles Concerning Multinational Enterprises and Social Policy' and the 1976 OECD 'Guidelines for Multinational Enterprises'
- BP will not employ forced labour or child labour
- Before we make major investments in a new area, we will evaluate the likely impact of our presence and activities
- BP will make political contributions only when they are lawful, of modest size and properly recorded
- Fees for services rendered by third parties, including agents and consultants, must be for legitimate business purposes that are demonstrably commensurate with the service provided

- We will not choose business partners who contravene these commitments.

1.3.3 Employees Policy

Our approach to managing people and developing their skills is consistent with the principles of our brand.

We respect the rights and dignity of all employees. Everyone who works for BP contributes to our success and to creating a distinctive company. Working together, drawing from our diverse talents and perspectives, we will stimulate new and creative opportunities for our business. Collectively we will generate a more exciting and rewarding environment for work in which every individual feels responsible for the performance and reputation of our company.

We commit to creating a work environment of mutual trust and respect, in which diversity and inclusion are valued, and where everyone who works for BP:

- Knows what is expected of them in their job
- Has open and constructive conversations about their performance
- Is helped to develop their capabilities
- Is recognised and competitively rewarded for their performance
- Is listened to and involved in improving the team's performance
- Is fairly treated
- Feels supported in the management of their personal priorities

1.3.4 Relationships Policy

We believe that long-term relationships founded on trust and mutual advantage are vital to BP's business success.

Our commitment is to create mutual advantage in all our relationships so that others will always prefer to do business with BP.

We will do this by:

- Understanding the needs and aspirations of individuals, customers, contractors, suppliers, partners, communities, governments, and non-government organisations
- Conducting our activities in ways that bring benefits to all those with whom we have relationships
- Fulfilling our obligations as a responsible member of the societies in which we operate
- Demonstrating respect for human dignity and the rights of individuals

We will work to build long-term relationships founded upon:

- High performance standards
- Delivering on our promises
- Openness and flexibility
- Learning from others
- Mutual interdependence
- Sharing success

Policy Expectations

In specific relationships:

With Individuals

- We will respect their rights, culture and dignity
- We will act fairly and justly

With Customers

- We will provide our customers with high-quality goods and services that meet their needs
- We will deliver what we promise

Partners, Contractors and Suppliers

- We will seek partners whose policies are consistent with our own
- We will combine complementary skills, appropriate technology and experience to create greater effectiveness
- We will make our contractors and suppliers aware of our own commitments and expectations, and of their responsibilities in implementing them

With Communities

BP is committed to achieving the following through our relationships with communities:

- Our aim is that countries and communities in which we operate should benefit directly from our presence - through the wealth and jobs created, the skills developed within the local population and the investment of our time and money in people rather than in things so that we create sustainable human progress
- We will work toward improvements that are measurable and contribute to the real, independent growth of communities where we operate
- Wherever we operate, we will strive to minimise any disruption to the environment arising from our activities
- We will conduct our activities with a standard of care in which our employees can take pride
- We will take into consideration the specific developmental needs of communities in which we operate through a process of open dialogue and consultation

With governments

- We will respect national sovereignty
- We will work constructively with governments in the development of policy
- We recognise changing public expectations of the extent to which companies should put pressure on the governments on human rights issues and will seek, working in partnership with others, to resolve any tensions or conflicts arising between international expectations and national or local practices in a sensitive manner

With non-governmental organisations

- We will seek to create mutual understanding and build constructive relationships with non-governmental organisations who have a genuine interest in our business and concerns about its impact upon individuals, society and the environment

With the media

- We will seek to form a constructive and productive relationship with all branches of the media: television, radio, newspapers and the Internet

With trade bodies

- We will seek to influence trade bodies for the mutual benefit of the industry and society

With Employee Representative Bodies

- We will seek to work in good faith with trade unions and other bodies that our employees collectively choose to represent them within the appropriate local legal framework

1.4 HOST GOVERNMENT AGREEMENT

The HGA between SCP partners and the government of Azerbaijan will ultimately determine the laws and procedures that apply to the SCP. An HGA is an agreement between the Government of Azerbaijan and the SCP partners detailing the precise legal framework for the design, construction and operation of the pipeline. This will set out the national legislation and international regulations applicable to the project, and the responsibilities of government departments and other organisations in relation to the project.

The HGA will become a legally binding document, and will carry the force of law. The HGA specifies the work programme that the operator must undertake, including environmental work and specific environmental standards that the Contractor must accomplish.

The HGA also states that the SCP partners will comply with present and future Azerbaijani laws and regulations with respect to protection and restoration of the environment. These laws and regulations are not different from or more stringent than the standards and practices generally prevailing in the international Natural Gas pipeline industry for comparable projects.

The HGA also states that existing pollution is not liability of the SCP partners.

1.4.1 EIA under the HGA

Relevant sections of the HGA outline environmental protection and safety measures to be employed during the pipeline operations of the SCP partners.

According to the provisions, the SCP partners must develop an 'Environmental Strategy Product'. The Environmental Strategy Product will include and implement the standards and practices prevailing in the international oil pipeline industry and Applicable Technical Standards, as appropriate.

The environmental Strategy Product will comply with the principles of EC directive 85/337/EEC (as amended by EC Directive 97/11/EC) and will include all of the following general environmental principles:

- There will be no discharging of Petroleum
- Waste petroleum, sludge, pigging wastes, polluted ballast waters and other wastes will either be recycled, treated, burned or buried employing the best environmental option
- All waste streams will be disposed of in an acceptable manner and concentration as determined during the course of the EIA
- Emission monitoring programs will be developed to ensure environmental compliance

The 'Environmental Strategy Product' will comprise the following:

- A scoping study
- An environmental risk assessment that will serve to highlight potential environmental risks and costs impacts to the engineering design requirements of the project
- A contaminated land Baseline Study to provide a qualitative assessment of the existing pollution and contamination in the areas within the Territory relevant to pipeline activities as of the effective date. The Baseline Survey will include:

1. A desk study review of the relevant and available information
 2. An audit of existing operations and practices and the collection of relevant environmental data from the areas surrounding the location of the Facilities, including information on:
 - Surface and subsurface geology
- Geomorphology
 - Rock permeability and the presence of aquifers
 - Assessment of existing quality of surface waters
 - The effect of any existing contamination on flora, fauna, landscapes and ecosystems; and
 - A qualitative assessment of any pollution, environmental damage and contamination in respect of the Facilities
 - An environmental impact assessment (EIA) that will assess the potential environmental impacts of pipeline activities (whether from pipeline activities within or without the Territory). The EIA will include:
 1. A project description
 2. An environmental and socio-economic description of the relevant areas of possible impact
 3. An evaluation of the impact to the environment of the proposed construction and operation of the Facilities, including an estimate of those emissions and discharges into the environment (eg associated air emissions, aqueous discharges and solid waste produced) that are reasonably foreseeable
 4. A plan for the identification and implementation of practicable mitigation measures for each identified impact
 5. An assessment of the environmental risks associated with pipeline activities; and
 6. The formulation of a monitoring programme to verify that mitigation measures are effective, and in the event that additional impacts are identified to ensure that additional mitigation measures are effected
 - An Emergency Response Plan that will prepare a plan for emergency response capability as to leaks or emissions of natural gas within or that could threaten life or property or adversely affect the Territory. The Emergency Response Plan will include:
 1. Environmental mapping of habitats vulnerable to potential natural gas leaks or emissions in the entire SCP system
 2. Plans of the deployment of relevant equipment and emergency response notification details of the organisation required to handle natural gas leaks, emissions, explosions and fires
 3. Plans of the treatment and disposal of resulting contaminated materials
 5. The Emergency Response plan sets out the equipment, personnel and management systems needed to respond to an incident along the pipeline. This is developed in outline as part of the ESIA and completed prior to commissioning
 6. An abandonment plan must be completed less than 30 days after termination of the HGA, describing proposed actions associated with abandonment

1.4.2 Land and associated issues

Article 4 of the Host Government Agreement sets forth the Rights to Land for Project Participants that are further outlined in the Appendix 2 of the Agreement. Appendix 2 entitles Project Participants exclusive and unrestricted Rights to use and possess land within project activities. Thus, it supersedes the current applicable land legislature and requires amendments or adoption of new laws as set out in Article 6 of the Agreement:

“The State Authorities have, or have the legal authority to obtain in a timely manner, sole and exclusive jurisdiction respecting Rights to Land (including the Permanent Land) and the full power, authority and right under Azerbaijan Law to grant the rights and privileges provided in Article 4, which rights are transferable by an SCP Participant in accordance with this Agreement”

Appendix 2 provides the following land rights to the SCP Participants:

“Right to transport all construction material, plant and equipment within the Territory and cross border by land or air without hindrance, including the right to construct and maintain temporary and permanent roads and to use such airfields as are designated, from time to time, by the SCP Participants

Right to designate and use other areas of land, both in the vicinity of the proposed Facilities and remote from the Facilities, for the conduct of all Project Activities, including for pipe storage dumps, site compounds, construction camps, fuel storage dumps, parking areas, roads and other activity sites

Right to install generation and transmission equipment and to connect to any existing electricity supply and, where necessary, the right to lay cables from such supply to the Construction Corridor.

Right to receive confirmation that each affected landowner and/or occupier has been made aware of and has consented to and/or has been compensated under Azerbaijan Law for the rights acquired by the SCP Participants through the State Authorities

The right to the exclusive use, possession and control, and the right to construct upon and/or under, and peaceful enjoyment of, these Rights to Land without hindrance or interruption”

Acquisition of a non-state land

Article 7 of the Host Government Agreement specifies the procedures and principles to be applied for the acquisition of non-state (private) land. It is a government responsibility to acquire and transfer such land to the project participants. State authorities are obliged to acquire such land at a possible reasonable cost in line with the standards and procedures set forth in Land Code of Azerbaijan Republic (June 25, 1999), the Law of Azerbaijan Republic on Land Market (May 7, 1999) and any Decrees of the President and/or the Cabinet of Ministers of Azerbaijan Republic implementing the Land Code and Law. The Project Participants pay the State Authorities (through an appropriate escrow account mechanism) the amount of all actual, verifiable costs to be incurred by them in acquiring such Non-state Land within thirty (30) days before such costs are required to be paid.

Acquisition of a state land

Appendix 2 of the HGA provides that the SCP Participants shall have no obligation to pay to the State Authorities any compensation in respect of any land or Rights to Land in relation to State Land that is not Agricultural or Forestry. The latter should however be compensated in accordance with the Rules of Assessment and Compensation of Agricultural and Forestry Productive Losses and Damages (approved by Resolution No. 42 of the Cabinet of Ministers of the Azerbaijan Republic dated 15 March 2000, and as in effect on 31 July 2001).

It is also the Government obligation to protect, defend and indemnify each of the Project Participants and other affected Project Participants from and against any loss or damage in respect of the Rights to Land and any and all third-party claims or demands.

1.4.3 Public Consultation and Disclosure

Section 3.9 of Appendix 4 sets forth the requirements for public review and comment in accordance with the procedures outlined therein. The HGA requires that affected public and non-governmental organisations be notified about the nature of the operation of the Facilities during the development of the EIA through dissemination of information to these organisations through meetings and exhibitions.

Following the completion of the EIA, the public is to be provided with information on the environmental aspects of the Project to enable it to comment. To facilitate this process, the EIA and an executive summary (in the Azeri language) are to be made available in a public place for review and comments. In addition, an information copy of the executive summary shall be submitted simultaneously to the Government.

A maximum of sixty (60) days are allowed for public comments, which are then to be provided to the Government by the SCP Participants within thirty (30) days after the expiration of the sixty (60)-day period. Demonstration that the SCP Participants have reasonably addressed public concerns (through modification of the EIA, if necessary) is to be included in a final executive summary that to be submitted to the Government.

1.4.4 Labour and Employment

Article 4, Article 7, and Article 18 of the Host Government Agreement cover regulatory aspects for labour and employment within the project. The provisions of these articles authorise Project Participants and Project Contractors to select and determine the number of employees to be hired in connection with the project. All citizens of Azerbaijan hired in respect of the Project will be hired pursuant to written employment contracts that specify the hours of work required of the employees and the compensation and benefits to be paid or furnished to them and other material terms of employment. Consistent with their respective employment contracts, such employees may be located wherever deemed appropriate in connection with their employment. Subject to requirement that no Project Participant shall be required to follow any employment practices or standards that exceed those international labour standards or practices which are customary in international Petroleum transportation projects or are contrary to the goal of promoting an efficient and motivated workforce, all employment programmes and practices applicable to citizens of Azerbaijan working on the Project in-country, including hours of work, leave, remuneration, fringe benefits and occupational health and safety standards, shall not be less beneficial than is provided by the Azerbaijan labour legislation generally applicable to its citizenry.

1.4.5 Ethics

Ethical standards and principles are outlined in Appendix 4 of the HGA and referred as Best Endeavours. Best Endeavours are to be used to minimise potential disturbances to the environment, surrounding communities and the property of inhabitants thereof during the conduct of any project activities. The order of priority for actions shall be protection of life, environment and property.

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1 ATMOSPHERIC EMISSIONS INVENTORIES – METHOD AND ASSUMPTIONS

This appendix details how the estimated figures for atmospheric emissions in Section 10.3.3 were calculated.

1.1 CONSTRUCTION EMISSIONS – PIPELINE SPREAD

This section considers the emissions associated with the pipeline spread. Construction of the AGIs is not included as no information is available at this stage.

1.1.1 Non-road vehicles and equipment

The exhaust gases of vehicles and equipment used in construction are the major source of air pollutants during this phase of the project. Emissions were estimated as follows:

The total number of each vehicle/equipment type to be used was determined from the mobilisation/demobilisation report of the engineering design contractor. Vehicles and equipment were categorised according to available emission factors in the US EPA's Non-road Engine and Vehicle Emission Study (NEVES) as shown in Table 1, below.

Table 1 Inventory of non-road vehicles and equipment

Basic description of project	Corresponding NEVES category	Total number
Dozers	Dozer (rubber tyred)	21
Sidebooms	Other construction equipment	29
Backhoes, loaders and tractors	Tractor/loader/backhoe	80
Athey Wagon	Off-highway truck	4
10 ton forklift	Forklift	3
Graders	Grader	12
Dump Truck	Dumper	38
Compactor	Roller	4
Ditcher	Trencher	2
Crane	Crane	19
Pumps	Pump	18
Generators, light plant	Generator set <50 hp	32
Road boring machine	Bore/drill rig	1
Air compressor	Air compressor	29

NEVES lists average horsepower ratings for each of its equipment types. For the generator sets, however, the power rating was given in the mobilisation/demobilisation report - 2 x 10 kWe generators, 30 x 12.5 kWe light plant. An average power rating per unit was calculated from this information. Generators associated with operation of the construction camps are covered in Section 1.2. Table 2 below lists the horsepower ratings and pollutant emission factors from NEVES. The factor for CO₂, however, is derived from AP-42 Table 3.3-1 (diesel industrial engines) as NEVES does not give factors for CO₂.

Table 2 Power ratings and emission factors for non-road vehicles and equipment

Equipment Type	hp rating	Pollutant emission factor, g/hp-hr					
		HC	CO	NOx	PM	SO ₂	CO ₂
Dozer (rubber tyred)	356	0.86	2.80	9.60	0.66	0.93	522
Other construction equipment	161	1.44	9.20	11.01	1.44	0.93	522
Tractor/loader/backhoe	77	1.43	6.80	10.10	1.05	0.85	522
Off Highway truck	658	0.86	2.80	9.60	0.80	0.89	522
Forklift	83	1.60	6.06	14.00	1.60	0.85	522
Grader	172	1.57	3.80	9.60	1.00	0.87	522
Dumper	23	0.86	2.80	9.60	1.44	0.89	522
Roller	99	0.82	3.10	9.30	0.78	1.00	522
Trencher	60	1.57	9.14	10.02	1.44	0.93	522
Crane	194	1.29	4.20	10.30	1.44	0.93	522
Pump	23	1.22	5.00	6.00	1.00	0.93	522
Generator set <50 hp	17	1.22	5.00	6.00	1.00	0.93	522
Bore/drill rig	209	1.44	9.20	11.01	1.44	0.93	522
Air compressor	23	1.22	5.00	6.00	1.00	0.93	522

Every unit was assumed to operate for 12 hours per day, every day for the duration of the 14 month construction period (ie 5,112 hours in total, note that this is a conservative assumption). Hence the calculation to derive the mass emission for each equipment type and each pollutant over the entire construction period is:

$$\text{Mass emission} = \text{number of units} \times \text{hp rating of each unit} \times \text{pollutant emission factor} \times 5,112$$

Table 3 below presents the results of this calculation for each equipment category and pollutant.

Table 3 Total emissions for non-road vehicles and equipment

Equipment Type	Emission (tonne) over construction period					
	HC	CO	NOx	PM	SO ₂	CO ₂
Dozer (rubber tyred)	33	107	367	25	36	19,942
Other construction equipment	34	219	263	34	22	12,454
Tractor/loader/backhoe	45	214	318	33	27	16,431
Off-highway truck	12	38	129	11	12	7,021
Forklift	2	8	18	2	1	664
Grader	17	40	101	11	9	5,506
Dumper	4	13	43	6	4	2,331
Roller	2	6	19	2	2	1,056
Trencher	1	6	6	1	1	320
Crane	24	79	194	27	18	9,832
Pump	3	11	13	2	2	1,104
Generator set <50 hp	3	14	16	3	3	1,412
Bore/drill rig	2	10	12	2	1	557
Air compressor	4	17	20	3	3	1,779
Total	185	780	1,519	162	139	80,410

1.1.2 Road-going vehicles

Vehicles that were judged to be road-going were categorised according to the UK Emission Factors Database (UKEFD) as shown in Table 4, below.

Table 4 Inventory of road-going vehicles

Basic description of project description	Corresponding UKEFD category	Total number
Trucks, lowboys, flatbeds, concrete mixer trucks	Artic HGV	157
Pickups, 4x4s, carryalls, ambulances, crew cabs	Diesel LGV	155
Buses	Bus	53

Emission factors from the UKEFD were used to estimate emissions. The vehicles were assumed to be of 2003 specification and the usage type was assumed to be 'rural single carriageway'. Each vehicle was assumed to travel 500km/day for the entire 426 day construction period (ie 213,000km in total, note that this is a conservative assumption).

Table 5 presents the emission factors and the estimated emissions for each vehicle type over the construction period, calculated by:

$$\text{Mass emission} = \text{Number of vehicles} \times \text{emission factor} \times 213,000 \text{ km}$$

Table 5 Emission factors and total mass emissions for road-going vehicles

Vehicle type	Emission factors, g/km						
	NM VOC	CO	NOx	PM ₁₀	SO ₂	CO ₂	CH ₄
Artic HGV	1.00	1.54	7.48	0.23	0.26	1155.00	0.06
Diesel LGV	0.13	0.46	0.35	0.10	0.05	228.80	0.00
Bus	1.11	2.22	5.98	0.28	0.19	855.10	0.06
Vehicle type	Emission over construction period, tonne						
	NM VOC	CO	NOx	PM ₁₀	SO ₂	CO ₂	CH ₄
Artic HGV	33	51	250	8	9	38,609	2
Diesel LGV	4	15	12	3	2	7,551	0
Bus	13	25	67	3	2	9,649	1
Total	50	92	329	14	12	55,810	3

1.1.3 Large generators

There were two categories of generator whose power rating was outside the NEVES category (generator sets <50 hp). Emission factors from the USEPA's Compilation of Air Pollutant Emission Factors, AP-42, Volume 1, Table 3.3-1 (diesel industrial engines) were used for these. They are 317 kWe and 60 kWe generators respectively. Generators associated with operation of the construction camps are covered in Section 1.2.

Table 6 below presents the emission factors and total mass emissions from these generators over the construction period. Each unit is assumed to operate for 12 hours per day throughout the entire 426 day construction period (ie 5,112 hours in total). The calculation is:

$$\text{Mass emission} = \text{Number of units} \times \text{power rating of each unit} \times \text{emission factor} \times 5,112 \text{ hours}$$

Table 6 Emission factors and total mass emissions for large generators

		Emission factors					
		HC	CO	NOx	PM₁₀	SO₂	CO₂
		lb/hp-hr	0.003	0.007	0.031	0.002	1.150
		Kg/kW-hr	0.002	0.004	0.019	0.001	0.699
Generator type	Number	Emission over construction period, tonne					
		HC	CO	NOx	PM₁₀	SO₂	CO₂
317 kWe	3	7	20	92	7	6	3,398
60 kWe	3	1	4	17	1	1	643
	Total	9	23	109	8	7	4,041

Emissions for all other powered equipment listed in the mobilisation/demobilisation report were not estimated as it was assumed they would be powered by the generator sets.

1.2 CONSTRUCTION EMISSIONS – CONSTRUCTION CAMPS AND PIPE STORAGE YARDS

There are two main sources of emissions associated with the construction camps: waste incineration and power generation.

1.2.1 Waste incineration

Emissions from waste incineration at the construction camps were estimated on the basis of the total mass of waste to be incinerated, estimated as 2,281 tonnes. This total tonnage of waste to be incinerated was applied to emission factors from AP-42 Vol 1 Chapter 2.1 'Refuse Combustion'. It is assumed that the incinerator will be of the mass burn type, with uncontrolled emissions – ie no emissions abatement technology incorporated, although it should be noted that the incinerator will be fitted with emissions control technology and will comply with the project emission standards as discussed in Section 10.3. However, insufficient detail is available at this stage to calculate emissions from this information and hence worst case assumptions are employed.

Table 7 below details the emission factors and the predicted mass emissions over the entire construction period. Note that no emission factor is published for hydrocarbons, VOC or methane.

Table 7 Emission factors and total mass emissions from construction phase waste incineration

Pollutant	Emission factor (kg/tonne of waste combusted)	Total mass emission (tonne)
PM	12.6	29
SO ₂	1.73	4
Nox	1.83	4
CO	0.232	1
CO ₂	985	2,247

1.2.2 Power generation

The requirement for power at the construction camps and pipe storage yards is estimated based on the mobilisation/demobilisation report of the engineering design contractor. Included in this are 2 x 480 kWe and 6 x 775 kWe Camp Generators. These, operating

together, produce 5.61 MWe of power. It is anticipated that the 775 kW generators will be used at the accommodation camps – either 3 sets at each of 2 camps or 2 at each of 3 camps. The 480 kW generators are to be used at the double-jointed pipe storage yard (double jointing will take place at only one location in Azerbaijan at a time).

Emission factors from AP-42 Volume 1 Chapter 3.3 ‘Gasoline and Diesel Industrial Engines’ were used to estimate emissions. The generators are assumed to run on diesel fuel and operate continuously for the entire 14 month construction period (ie 10,220 hours). The calculation to determine the total mass emission of each pollutant is as follows:

$$\begin{aligned} \text{Mass emission} &= \text{emission factor} \times \text{total power output of generators} \times \text{hours of operation of} \\ &\quad \text{each generator} \\ &= EF \times 5610 \times 10,220 \end{aligned}$$

Table 8 below details the emission factors and the resulting mass emissions.

Table 8 Emission factors and total mass emissions from power generation at the construction camps and pipe storage yards

Pollutant	Emission factor (kg/kW-hr)	Total emission (tonne)
Nox	0.019	1,081
CO	0.004	233
SO ₂	0.001	71
PM ₁₀	0.001	77
CO ₂	0.699	40,088
HC	0.002	88

1.3 SUMMARY OF CONSTRUCTION EMISSIONS

Table 9 below summarises the emissions from the construction phase. Hydrocarbon emissions from non-road vehicles and equipment are split into methane/non-methane according to the ratio of total methane: total NMVOC emissions from road-going vehicles. Hydrocarbon emissions from power generators >50 hp are split according to the ratio of methane: non-methane emission factors from the UKOOA Guidelines for the Compilation of an Atmospheric Emissions Inventory (UKOOA 1999) as below:

Emissions from diesel combustion in engines (tonnes/tonne of fuel burnt):

Methane: 0.00018

Non-methane VOCs: 0.002

Table 9 Summary of estimated atmospheric emissions arising from construction phase

Source	Total emission over 14 month construction phase (tonne)						
	NMVOC	CO	NOx	PM ₁₀	SO ₂	CO ₂	CH ₄
Pipeline construction	233	896	1,957	184	159	140,261	14
Waste incineration	No data	11	44	2929	44	2,2472,247	No data
Power generation (camps and pipe storage yards)	80	233	1081	77	71	40,088	7
TOTAL	313	1,129	3,041	289	234	182,596	21

1.4 OPERATIONAL EMISSIONS – AGIS

Operational emissions are limited to fugitive emissions of natural gas from the block valve stations and occasional testing of the gas-actuated valves as all block valves will be linked to the national grid for power.

1.4.1 Fugitive emissions

Annual emissions of carbon dioxide and methane have been estimated using UKOOA (UK Offshore Operators Association) emission factors for onshore gas facilities. There are to be 5 block valves, with 20 valves and 50 connections at each (information provided by engineering design contractors). Composition of the gas includes 88.55% methane and 0.5458% CO₂ (information provided by engineering design contractors).

UKOOA emission factors for fugitive emissions:

- Valves: 33.9 kg/component/year
- Connections: 2.4 kg/component/year

5 block valve stations x 20 valves at each = 100 valves

5 block valve stations x 50 connections at each = 250 connections

1.4.2 Gas-actuated valves

The design engineers have estimated that each gas actuated valve (there is one at each site) will be stroked once per year for testing. Each stroke is estimated to result in a release of 128 scf (or 3.62 m³). The density of the gas at standard conditions is 0.76 kg/m³.

Therefore, emissions from all five block valve stations are:

- From valves $100 \times 33.9 = 3390$ kg/year
- From connections $250 \times 2.4 = 600$ kg/year
- From gas-actuated valves $5 \times 3.62 \times 0.76 = 14$ kg
- Total annual emission of process gas = 4004 kg
- 88.55% methane = 3545 kg
- 0.5458% carbon dioxide = 22 kg

SUMMARY OF REINSTATEMENT PLAN

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1 INTRODUCTION

Reinstatement of land disturbed by pipeline construction activities (eg ROW, construction camps, pipe yards, etc.) to a condition similar to its original pre-construction character is a specific project objective designed to meet BP's goal of 'no harm to the environment'. This objective has associated benefits that include:

- Minimised risk to pipeline integrity because the erosion risk is reduced
- Maintenance of natural landscapes and consequently their value as a tourism resource
- Preservation of soil fertility in both natural and agricultural environments
- Protection of water catchments and water quality
- Sustained bio-diversity
- Reduced risk of desertification

This plan summarises the specific requirements that have been developed for reinstatement of areas disturbed by the project. Issues addressed include topographic reinstatement, erosion control and bio-restoration, as well as requirements for the extraction, re-use and, if necessary, disposal of material excavated from the pipeline trench.

The reinstatement specification is based on the following principals:

- Use of erosion classes as targets for reinstatement
- Identification of bio-restoration targets
- Definition of final reinstatement conditions
- Protecting topsoil resources by ensuring separation and storage in a manner that maximises the ongoing integrity of soil structure, seedbank resources and vegetative material and minimises the risk of topsoil loss
- Achieving key bio-restoration objectives, including:
 - (a) restoration of the pre-existing ecology (ie that existing prior to construction), so far as is practicable, particularly in terms of the variety and distribution pattern of indigenous plant species
 - (b) establishment of sufficient vegetation cover to reduce erosion and achieve the performance target of Erosion Class 3 (see Section 3) or better through restoration of the local plant communities, where practicable
- Use of indigenous flora for long-term cover. The bio-restoration strategy is based on supplementing the topsoil seedbank and vegetative material resource within the reinstated topsoil
- Disposing of excess spoil in a environmentally acceptable manner
- Minimising adverse impacts on sensitive habitats outside of the ROW from construction activities, in particular when forming cuts on side slopes

This summary plan describes the reinstatement of the ROW and all other temporary project areas which are used to support construction, including (but not limited to) construction camps, pipe dumps, maintenance areas, roads and other transport facilities, waste management and disposal sites.

2 DOCUMENTATION

The contractor will produce method statements, inspection plans and record portfolios for all erosion control and reinstatement works for approval by SCP Co. The documentation will comply with project specifications, pre-entry agreements and the requirements of the ESIA and relevant Authorities.

The contractor will prepare a photographic / video record of condition of the ROW before works commences and after final reinstatement is complete.

The contractor will prepare site-specific method statements and schedules for reinstatement of:

- Environmentally Sensitive Areas ie those areas with high ecological sensitivity, landscape value or erosion risk
- Watercourse crossings that have detailed crossing drawings associated with them, or occur in environmentally sensitive or special agricultural, sections
- Special agricultural areas that support more complex agricultural systems such as canals and irrigation systems.

The contractor's documentation will also detail temporary and permanent measures to stabilise and control erosion.

3 EROSION CLASSES

Erosion classes have been used as the basis for determining erosion targets for permanent reinstatement. Table 3-1 defines these erosion classes. The objective is to achieve erosion class 3 or better, wherever practicable. This represents moderate erosion, which is defined as the release of < 10tonnes of sediment per hectare during a one hour, 10 year return period, storm.

As a minimum the following standards will be achieved:

- No risk of reduction of the depth of cover above the pipeline
- Very low risk of release of eroded soil beyond the confines of the ROW (Note: sediment interception devices will be installed at locations where there is a risk of such sediment significantly impacting water bodies)
- Low risk of damage to bio-restoration schemes through washing-out of seeds and plants

An erosion risk assessment has been undertaken along the route. This assessment identified areas of potential erosion and assigned erosion control measures for each area of the route.

Table 3-1 Erosion classes

EROSION CLASS	VERBAL ASSESSMENT	EROSION RATE (t ha ⁻¹)	VISUAL ASSESSMENT
1	Very slight	< 2	No evidence of compaction or crusting of the soil. No wash marks or scour features. No splash pedestals or exposed roots or channels.
2	Slight	2-5	Some crusting of soil surface. Localised wash but no or minor scouring. Rills (channels <1m ² in cross-sectional area and < 30cm deep) every 50-100m. Small splash pedestals where stones or exposed roots protect underlying soil.
3	Moderate	5-10	Wash marks. Discontinuous rills spaced every 20-50m. Splash pedestals and exposed roots mark level of former surface. Slight risk of pollution problems downstream.
4	High	10-50	Connected and continuous network of rills every 5-10m or gullies (> 1m ² in cross-sectional area and > 30cm deep) spaced every 50-100m. Washing out of seeds and young plants. Reseeding may be required. Danger of pollution and sedimentation problems downstream.
5	Severe	50-100	Continuous network of rills every 2-5m or gullies every 20m. Access to site becomes difficult. Revegetation work impaired and remedial measures required. Damage to roads by erosion and sedimentation. Siltation of water bodies.
6	Very severe	100-500	Continuous network of channels with gullies every 5-10m. Surrounding soil heavily crusted. Integrity of the pipeline threatened by exposure. Severe siltation, pollution and eutrophication problems.
7	Catastrophic	> 500	Extensive network of rills and gullies; large gullies (> 10m ² in cross-sectional area) every 20m. Most of original surface washed away exposing pipeline. Severe damage from erosion and sedimentation on-site and downstream.

4 SITE CLEAN-UP

On completion of construction activities the contractor will clean-up all areas affected by construction operations in preparation for the replacement of stockpiled materials (subsoil and rock from grading and benching, topsoil from topsoil stripping). Clean-up includes removal of all plant, equipment and materials not required for replacement of soil or for subsequent bio-restoration activities.

In agricultural and industrial areas the condition achieved following clean-up will be equivalent to, or better than, the condition prior to construction.

No waste materials, other than excess soil and rock, will be left, buried or disposed of on any project area. All waste will be disposed of at approved waste disposal sites that will be selected by the project and approved by the relevant authorities.

5 REINSTATEMENT OF LAND OTHER THAN ROW

5.1 Land at construction support facilities

Temporary construction support facilities include construction camps and pipe dumps and together with other areas used, or affected by construction support activities. Such areas will be reinstated to a condition as good as, if not better than that existing prior to establishment of the facilities and will be reinstated to the satisfaction of the owner and/or relevant Authority. In environmentally sensitive areas, as far as practicable, the original conditions and character will be restored.

5.2 Waste disposal sites

The contractor will be required to ensure that all waste disposal sites are appropriately closed, capped and landscaped prior to demobilisation, unless otherwise agreed with SCP Co. and the relevant Authorities. With the exception of waste soil/rock sites, this will be in accordance with the relevant requirements of the European Community relating to the management and reinstatement of waste disposal facilities. Bio-restoration will be undertaken as necessary to ensure that the reinstated site is in keeping with the local surroundings.

Sites that are used only for the disposal of excess soil and rock will also be closed, capped and landscaped. Each site will be vegetated as necessary to meet the erosion control requirements and to ensure that the reinstated site is in keeping with the local environment.

5.3 Roads and access tracks

Existing roads will be reinstated to their original condition or better following completion of construction activities.

New and upgraded roads or tracks and other project areas in Environmentally Sensitive Areas will be removed and the land re-instated to its original condition, unless otherwise agreed following consultation with all interested parties.

6 REINSTATEMENT PROCEDURES

The following subsections discuss activities that will take place prior to and during reinstatement of the disturbed areas.

6.1 Topsoil stripping and storage

Topsoil, can be defined as the upper layer of material on the land surface, which is capable of supporting plant growth; it contains the seedbank and vegetative material resources. Maintenance of topsoil quality, structure and integrity is vital to both bio-restoration and erosion control.

The following principles will apply to removal and storage:

- In general, the width to be topsoil stripped will be the working width required for construction and installation of the SCP, but will exclude the area that will be used to store topsoil. The contractor may apply for relaxation of this requirement where the ground is solid rock (ie where there is no soil) taking into consideration the local conditions, pre-entry agreements and the need to satisfactorily reinstate the pipeline route
- Where topsoil stripping is necessary, the depth of the topsoil will be established and up to 300mm will be removed and stored. Topsoil below 300mm will only be stripped if this is specifically required. Topsoil will generally be stored on areas where the topsoil has not been removed
- Storage locations will be sited so that they are not compacted by vehicles, or contaminated, or otherwise treated in a manner that will cause losses and/or degradation
- Stored topsoil will not be mixed with subsoil. In general topsoil will be stored on the opposite side of the ROW to subsoil. In cases where there is insufficient storage space, both topsoil and subsoil may be stored on the same side provided mixing is prevented by physical means eg geotextile sheeting
- Topsoil stacks will be structured to ensure that they are free draining and do not impound water. Where possible, topsoil stacks will not more than 2m high with side slopes of <45° and will be drained with open ditches and berms as necessary.
- Gaps will be left in the topsoil stack to permit reasonable access across the ROW
- The surface of the topsoil stacks may be compacted to restrict rainfall penetration, but not so much that anaerobic conditions will occur
- The stockpile will be treated where appropriate to prevent weed growth
- Under no circumstances will topsoil be used as padding material or for trench breakers
- Topsoil handling during inappropriate ground / weather conditions will be avoided for soils that are susceptible to damage (eg soils with a high clay content)

6.2 Subsoil removal and storage

During construction, subsoil will be excavated from the pipe trench and, at some locations, from the cutting of level working platforms ('benches') on the side of slopes. Subsoil will be managed so that it does not contribute directly or indirectly to excessive erosion or sedimentation. The following principles will be applied to the removal and storage of sub-soil:

- Subsoil will be stored separately from topsoil, and will not be mixed

- Stockpiles will be kept stable from collapse and will drain freely
- Drainage will be provided to manage appropriately the water and sediment loads emanating from the subsoil stacks (eg gaps will be left or flumes installed, etc)
- Subsoil will be returned to the area from which it was excavated, as far as practicable
- Subsoil which cannot be reused, ie returned to the trench or corridor ROW, will be placed in stockpiles pending disposal. The disposal of excess subsoil is discussed in the Section 6.4

6.3 Trench excavation and pipeline padding

The creation of excess excavated material will be minimised and excess material will be recovered and re-used to the greatest extent possible.

Fill materials will not be imported unless it can be demonstrated that such fill is required and that it cannot be won from the project areas (eg by crushing trench arisings). All importation of fill will be approved in advance by SCP Co.

Generally, all excavated materials will be returned to the excavated areas. Where materials are unsuitable for return to the trench (eg certain types of rock) they will be disposed of safely in accordance with environmental requirements.

6.4 Management of surplus spoil and rock

Priorities for managing excess spoil are as follows:

1st priority - ROW Reuse:

Where generated spoil is suitable for use as a construction material it will re-used on the ROW or temporary works areas.

2nd priority - ROW / Project-Area Disposal:

- Localised increase in finished surface height of ROW
- Increase in finished level of AGIs

All disposal/reuse in the project areas will be done without environmental impact to off-project areas.

3rd priority - Off ROW Reuse:

Transfer to a third party for re-use purposes as raw or semi-finished materials, eg crushed rock may be suitable for road construction materials or for rail ballast.

4th priority - Off ROW Disposal: (All sites to be agreed prior to use with SCP Co.)

Potential disposal sites will be identified and any necessary consents obtained. These sites will be planned, designed, developed, operated and re-instated as appropriate by the contractor. The contractor will be responsible for the technical and environmental assessment of such sites and for obtaining regulatory approval.

In principle, excess material disposal sites will not be:

- in Environmentally Sensitive Areas (except with prior project approval)
- in areas adjacent to special agricultural sections
- in watercourses or valley bottoms
- in windrows over the pipe
- on side slopes below benches or ridge cuttings where the side slope exceeds 45°
- where they will potentially interrupt concentrated overland flow
- in such a way as to cause unacceptable landscape (visual) impact
- on any open area where the slope exceeds 30°

Sites for the disposal of excess excavated material will, in general, comply with the requirements for 'inert' waste disposal sites. However, provided a number of conditions are met, a reduced specification for the design of the site may apply. Conditions include the requirements that:

- the site is stable and appropriately drained
- only natural materials are deposited and
- the transport vehicles do not transport other types of wastes

6.5 Reinstatement of soils

6.5.1 Reinstatement of subsoil

Two situations are considered: standard reinstatement and special reinstatement.

- **Standard reinstatement:** On return of the subsoil to the trench or ROW, the subsoil will be compacted to levels similar to the adjacent undisturbed area. The depth of subsoil after settlement will not be above that within the surrounding ground. After the subsoil has been returned and the land levelled, the subsoil will be ripped to a depth of 350-400mm, rendered to a loose and workable condition and contoured in keeping with the adjacent undisturbed ground.
- **Special Area reinstatement:** Special Area Reinstatement will be applied where it has been necessary to cut a bench into the hillside in order to lay the pipe and the intention is to restore the original contours. This will be achieved by filling-in the bench, thereby removing any visual impact on the landscape. Locations where this is required relate to defined Environmentally Sensitive Areas and special agricultural areas.

Upon completion of reinstatement of subsoil, disturbed areas will be inspected jointly by the contractor and SCP Co. for slope stability, relief, topographic diversity, acceptable surface water drainage capabilities and compaction.

6.5.2 Reinstatement of topsoil

Topsoil will not be mixed with subsoil during replacement. Only topsoil (and equivalent materials as permitted by the Reinstatement Specification) will be re-spread over the surface. Topsoil will not be used for bedding material in the trench and topsoil from

unstripped/undisturbed areas will not be used to cover adjacent disturbed areas. Topsoil will not be handled under wet conditions or at times when the ground or topsoil is frozen.

All disturbed areas will be graded and left sufficiently rough to promote new vegetation growth which will protect the stability of the topsoil.

6.6 Temporary erosion control measures

6.6.1 General

Temporary erosion control measures will be installed by the contractor to provide protection to the local environment and to achieve the required performance standards. The measures will facilitate stabilisation of reinstated areas, minimise erosion and ensure that watercourses are not adversely impacted. Such measures include:

- Flow breakers, or plugs of material (hard and soft) installed at appropriate intervals within trenches on longitudinal slopes to prevent scouring of the trench bottom
- Water bars constructed on the ROW to control surface water runoff and erosion. Water bars will be designed to simulate the slope contour and direct and diffuse surface water away from the disturbed area
- Flumes or other similar methods to allow drainage and migration of water where cross drainage is necessary (ie where slopes are cut)

The ROW will be monitored for:

- Subsidence of the pipeline trench
- Slope wash
- Slumping and soil movements
- Loss of stored topsoil, subsoil or cuttings
- Areas of disturbed ground off the ROW
- Status and success of re-vegetation

6.6.2 Erosion matting

Erosion matting will be installed to:

- provide immediate protection to the ROW on slopes, etc.
- minimise washing-out of seeds
- enhance the micro-climatic conditions of the soil for plant germination and growth

Once installed, erosion mats will be regularly inspected for degradation and installation integrity. Mats will be maintained and replaced as required to achieve project requirements.

6.6.3 Sediment control

Where the ROW intersects or is parallel to an environmental receptor (eg watercourse, wetland, water body or other environmentally sensitive area), sediment controls will be installed to

prevent sediment run-off significantly affecting the receptor. Sediment control will be used and maintained until the ROW has been stabilised and project requirements are achieved.

Sediment interception devices include:

- Silt fences - installed in areas of low sheet flow
- Straw bale barriers - installed in areas where small amounts of sediment require temporary interception
- Filter berms - installed where there is a requirement to temporarily retain runoff water after a storm event to allow sediment to settle
- Sediment traps - installed as required at outlets of ROW drainage systems, at the outlet of any structure which concentrates sediment-laden runoff and above storm water drains which are in line to receive sediment-laden runoff

6.6.4 Soil stack control

In certain instances, such as in areas of side slope and along steep ridges, wooden fences will be installed and maintained alongside the ROW to retain stockpiled topsoil and arisings during construction and reinstatement. Fences will be designed for the anticipated and will be removed during final reinstatement of the ROW.

6.7 Permanent erosion control devices

Permanent erosion control measures are outlined in this section. They will be installed to:

- facilitate maintenance of stability in reinstated areas
- minimise erosion
- ensure that watercourses are not adversely impacted.

6.7.1 Diverter berms

Diverter berms will be placed across the slope of the ROW to intercept runoff and direct it to a safe outlet. Berms will be constructed in accordance with a detailed specification.

6.7.2 Berm outlets

Water outlets will be provided to allow controlled disposal of runoff generated along the ROW. The runoff will be managed so as to not cause erosion or sediment transportation.

Outlets will be installed at the end of each diverter berm. Outlets will effectively dissipate the energy of runoff from the ROW and take the water to a disposal point that is both safe and minimises environmental impact.

6.7.3 Gabions

Gabions will be used where there is a requirement to form large, flexible but permeable structures such as retaining walls and revetments for earth retention. Gabion walls may be constructed to facilitate permanent recovery of the ROW and associated areas and to prevent or stabilise landslides.

Gabions structures will be designed and constructed in accordance with the manufacturer's specifications and project approved method statements.

6.7.4 Trench breakers

Trench breakers will be installed within the trench at locations along the pipeline route where the natural profiles, drainage patterns and backfill materials may cause the trench to act as a drain. They may also be required at the base of slopes adjacent to watercourses and wetlands and where it is necessary to prevent the SCP trench acting as a drain.

6.8 Watercourses

International best practice will be used for watercourse crossings. For significant crossings, in environmentally sensitive or special agricultural sections, special section designs and method statements will be developed and implemented to ensure site-specific environmental and social issues are considered appropriately.

The disturbed portion of the watercourse, the bed and banks, will be returned to pre-construction contours where possible with the backfill over the pipe at least as scour-resistant as the original bed material. Where practicable, watercourse banks will be stabilised within 48 hours of backfilling. Erosion and sediment control devices will be installed and maintained until new vegetation is sufficiently established. Where unstable channels exist downstream in the vicinity of the pipeline crossings, bed stabilisation work will be carried out to minimise the risk of bed erosion compromising the integrity of the pipeline.

Watercourse crossings will be regularly inspected until adequate stability has been achieved. After this, routine inspections will be made approximately every three weeks until the end of the maintenance period.

7 BIO-RESTORATION

7.1 Objectives

The objectives of bio-restoration are to:

- Restore the ecological characteristics, and in particular the variety and distribution pattern of plant species
- Achieve sufficient vegetation cover to reduce erosion to meet the performance target of Erosion Class 3 or better

In areas of natural and semi-natural habitat, the aim will be to achieve long-term vegetation cover comprised of the native flora. The strategy for achieving this will be the use the native seedbank and vegetative material resource that will remain in the topsoil when it is replaced, supplemented by re-seeding and planting with local species.

7.2 Targets

The original percentage vegetation cover will be estimated from the photographic record of the route, or, in case of doubt, by reference to adjacent undisturbed areas. Against this record

appropriate targets and timeframes for achieving established growth will be set in agreement with the specialist bio-restoration contractors. In this context 'established' means showing an initial healthy growth that would be expected for the particular species.

Soil, slope, perspective, and climatic conditions all affect rates of growth. Aftercare (watering, weeding, application of fertiliser, etc) will be carried out during the maintenance period in order to meet the re-vegetation targets.

The bio-restoration progress for each section of the route, and other project areas, will be reported quarterly against the performance criteria agreed. Where the criteria are not met, or it appears that they will not be met within the reasonable timeframes, corrective action will be taken, that may include watering, weeding, over-seeding, fertiliser application, replacement of failed trees, etc.

7.3 Scheduling

Bio-restoration work will be carried out during the appropriate growing seasons. Sowing or planting will be scheduled for a period that is likely to be followed by sufficient rain to promote germination and establishment.

7.4 Procedures to be followed by the contractor

Preliminary approaches for seeding and planting and have been developed as guidance for the construction contractor. However, these are optional and may be developed or substituted by other procedures by the construction contractor. The procedures developed relate to various habitat types (eg meadows, desert) as well as to specific locations or species that are encountered along the route. The procedures include guidance on factors such as:

- Seed storage
- Seed bed preparation
- Seeding/planting rates
- Seeding/planting methods eg trenches, pit planting, slot planting
- Soil additives, eg fertiliser
- Watering requirements
- Use of erosion matting
- Optimum planting/seeding times

8 SPECIAL AREAS

Special Areas will be considered separately within the reinstatement plan and method statements. Special areas include:

- **Side Slopes & Cuttings** - At environmentally sensitive locations or special agricultural areas, the side slope will be restored, as far as practicable to the original contours.
- **Special agricultural areas** – where canals, or irrigation channels, etc. are encountered these will be addressed in land use / system method statements.

9 RESTRICTING ACCESS

Measures will be taken to prevent unauthorised use of the ROW as a roadway to prevent rutting, subsequent erosion problems, damage to riparian areas and disturbance of the reinstated areas. Access will be blocked at specific locations defined by the project.

10 HANDOVER AND POST-CONSTRUCTION MAINTENANCE

Before it relinquishes responsibility for the reinstated areas to the operating company, the project will:

- Complete a final inspection of all project areas in conjunction with land owners to ensure that the pre-agreed standards of reinstatement have been met
- Undertake remedial work to the satisfaction of the landowners where any shortfalls exist.

During the contract maintenance period the project will be responsible for maintaining the standard of reinstatement and ensuring that the required erosion class and bio-restoration targets are met.

PUBLIC CONSULTATION AND DISCLOSURE PLAN – BTC AND SCP PIPELINE PROJECTS, AZERBAIJAN

1 INTRODUCTION

The Azerbaijan Republic, Georgia and the Republic of Turkey have come to an agreement to support the implementation the Baku-Tbilisi-Ceyhan Pipeline Project. The project consists of an oil pipeline from the Caspian terminal at Sangachal in Azerbaijan, through Georgia, to Turkey where it will supply international markets. A second, gas pipeline, known as the South Caucasus Pipeline (SCP), is also planned to run from Sangachal to Erzurum, in Turkey, where it will feed the Turkish domestic gas market.

Having completed the Basic Engineering Phase, the Pipeline Projects have reached the Detailed Engineering Phase. One of the main objectives of this phase is to undertake a full Environmental and Social Impact Assessment (ESIA¹) in accordance with national and international standards and practices. Within this context, extensive Public Consultation is being carried out according to World Bank standards.

1.1 THIS DOCUMENT

This document is a Public Consultation and Disclosure Plan (PCDP) for the environmental and social impact assessments (ESIAs) of the Azerbaijan section of the BTC and SCP pipeline projects. Although there are two pipelines each requiring its own ESIA, the consultation process has been combined as far as possible to ensure a consistent and coordinated approach to stakeholders. The PCDP is designed to outline a plan for public consultation which will: provide timely information about the projects and their potential impacts to pipeline affected communities² and other stakeholders³; provide opportunities to those groups to voice their opinions and concerns in a way which is most appropriate to their circumstances; and provide an opportunity for feedback to, and discussion with, those communities concerning measures proposed.

The PCDP presents the plan for public consultation through the project planning, construction, operation and decommissioning stages of the pipeline. The PCDP is a 'living' document and

¹An Environmental and Social Impact Assessment is undertaken to examine the potential impacts of a project on the physical and human environments, to develop measures to reduce the potential negative impacts and to enhance the positive impacts. It is designed to ensure the implementation of those measures through changes in project design and the development of an environmental and social action or management plan for use during project implementation.

² Pipeline Affected Communities are defined for the purposes of this project as those within 2km of the pipeline or a pipe yard, within 100m of an access road, and within 5km of a Pump or metering station or a construction camp.

³ For the purposes of this project, Stakeholders are defined as any persons or parties with an interest in the project as follows: 'Local' refers generally to the pipeline affected communities and other interested parties close to the pipeline including local government; 'National' refers to interested parties within Azerbaijan who are not 'local' including regional and national NGOs, academics, Government, media etc; International includes international NGOs, World Bank and other IFIs, UN Agencies etc.

may be revised over time to reflect information gained through the consultation process. This draft has been developed for release to stakeholders with a particular interest in the project in May 2002 as part of the ESIA disclosure process.

Given the size of the project and the issues associated with it, BTC Owners and SCP Partners (hereafter, the sponsor companies) are committed to undertaking public consultation on three levels: international, national, and local. However, because of the potential interactions between, and cumulative effects of, the oil and gas projects in the Caspian region, separate terms of reference have been prepared for a strategic or macro level study titled “Environmental and Social Aspects of the ACG Full Field Development and Export in a regional context”. This additional study addresses the overall regional costs and benefits of the offshore and export developments, and includes some international consultation on related issues.

Information gathered through the consultation process, at both the route level and the international level, is being shared as far as possible within the timetables for the two studies. Significant policy developments emerging from the macro level study will influence the implementation of commitments in the ESIA reports.

This document therefore provides an outline for consultation at the national and local levels to address issues relating directly to the pipelines including:

- Identification of project stakeholders and mechanisms for stakeholder feedback and information sharing
- An outline for consultation at the local and national levels starting at the project planning stage, and continuing throughout construction, operation and decommissioning of the pipelines
- Ensuring that issues raised by project stakeholders are addressed in the ESIA reports as well as in project decision-making and design
- Identification of the resources required to implement the plan, and development of procedures to monitor implementation
- Grievance mechanisms for local stakeholders

This PCDDP contains the following sections:

- *Section 2:* Brief description of the project and the project participants
- *Section 3:* Summary of the regulatory context for public consultation
- *Section 4:* Consultation Plan for ESIA and pre-construction phases
- *Section 5:* Consultation Plan for construction and operational phases
- *Section 6:* Summary Table of consultation and disclosure activities
- *Section 7:* Resource Issues related to implementation of the plan
- *Section 8:* Grievance Mechanism for local stakeholders

It also includes two Appendices:

Appendix 1 – Materials used in different phases of the consultation process

Appendix 2 – List of stakeholders

2 PROJECT DESCRIPTION

2.1 ROLES AND RESPONSIBILITIES

BP is leading work on the BTC and SCP Projects on behalf of the Sponsor companies. International consultants have been contracted to carry out ESIA's for both the BTC and the SCP pipelines, in association with national partners. As part of this work the national and international consultants are supporting the sponsor companies in carrying out consultation.

The sponsor companies are leading consultation with stakeholders in relation to the Pipeline Projects, and will participate in the design of all consultation activities. While the environmental and social components of the ESIA's have been contracted separately, consultation has been integrated, wherever appropriate, including during the production of a single ESIA report for each pipeline.

The international consultants for the social component of the ESIA's are the Social Strategies division of Environmental Resources Management (ERM). ERM's role is to assist in the co-ordination of the social impact assessment (SIA) and consultation process to ensure that they meet the required international standards. The national consultants, Synergetics, as well as being integrally involved in the SIA, have coordinated and facilitated field surveys and community meetings along the pipeline route.

The EIA contractor, AETC, in association with the sponsor companies, have carried out consultation on environmental impacts. They have met with environmental stakeholders at the national level during project scoping, and will also participate in community consultation during disclosure.

2.2 PROJECT COMPONENTS

The BTC Pipeline will transport Caspian crude oil via Azerbaijan, Georgia and the Republic of Turkey to the Mediterranean Sea and international markets. The South Caucasus Pipeline (SCP) will be constructed to transport gas from the Shah Deniz off-shore gas field in Azerbaijan to markets in Georgia and Turkey. The Azeri section of both the gas and oil pipelines will start at the Sangachal Terminal in Eastern Azerbaijan and cross into Georgia in the province of Akstafa, a total of approximately 442 kms.

The entire pipeline route is shown in *Figure 1*. More detailed route maps can be found in both the BTC and SCP route level ESIA's.

Figure 1: Map of Routes for BTC, SCP, WREP and NREP



One alternative option studied during the project scoping of the SCP involved the refurbishment of the existing Azerigas pipeline from Hadgiqabul to the Georgian border. ESIA's were initially conducted on both options, prior to a decision on the preferred option. The decision was made to build a new SCP pipeline adjacent to BTC and work has therefore progressed in parallel.

The proposed route follows a similar corridor to the existing Western Route Export Pipeline (WREP). Baseline survey data from the WREP dates from 1997 and is therefore relevant. For the BTC and SCP baseline, this data has been supplemented by a significant amount of additional survey work undertaken as part of the SCP and BTC ESIA's.

The following have also been considered in the ESIA and supporting consultation process:

- Permanent facilities and other Above Ground Installations for the oil line (e.g. a pump station, 2 intermediate pigging stations, approximately 21 valve stations, and permanent access roads)
- Permanent facilities and other Above Ground Installations for the gas line (e.g. approximately 5 valve stations, and permanent access roads)
- Temporary facilities (e.g. temporary access roads and construction facilities such as material yards, and worker construction camps)
- Effects on existing infrastructure and resources (e.g. use of existing roads, extraction of construction materials, use of water and disposal of waste)

2.3 PROJECT TIMETABLE

During the Basic Engineering Phase potential route options were analysed. Consideration of financial, security, technical, environmental and social factors led eventually to the identification of a preferred 500-metre pipeline corridor.

The next phase, Detailed Engineering will continue until 18th June 2002. Environmental and social impacts are being assessed and fed into the detailed engineering process through the ESIA.

Construction of the facilities is due to start in January 2003. The BTC pipeline is scheduled for commencement in early 2003, and SCP a year later. The design life of the pipelines will be 30-40 years.

3 REGULATORY CONTEXT

3.1 INTRODUCTION

Public consultation activities identified in this PCDP and undertaken to support the development of the BTC and SCP Pipelines Projects in Azerbaijan will conform to:

- The standards and practices set forth in Azerbaijan Host Government Agreements (HGAs) for the BTC and SCP pipeline projects
- Azeri regulations
- Guidelines established by international financing institutions, specifically the World Bank, International Finance Corporation (IFC), and the European Bank for Reconstruction and Development (EBRD)
- European Commission Directives (though not required by law)
- Relevant International Conventions for Public Participation

The main requirements are set out in the following sections.

3.2 HOST GOVERNMENT AGREEMENTS

Article 12 of the Azerbaijan Host Government Agreement for BTC sets forth the standards and principles for Public Consultations and Disclosure outlined in Appendix 3 of the Agreement.

Section 3.9 part (iii) of Appendix 3 sets forth the requirements for public review and comment in accordance with the following procedures:

- Affected public and non-governmental organisations will be notified about the nature of the operation of the Facilities during the development of the EIA through dissemination of information to these organisations through meetings and exhibitions
- Following the completion of the EIA, the public will be provided with information on the environmental aspects of the Project to enable it to comment with respect thereto. To facilitate this process, the EIA and an executive summary (in the Azeri language) will be made available in a public place for review and comments; additionally, an information copy of the executive summary shall be submitted simultaneously to the Government
- A maximum of sixty (60) days will be allowed for public comments, which will be provided to the Government by the project sponsors within thirty (30) days after the expiration of said sixty (60) day period. Demonstration that the Project Participants have reasonably addressed public concerns (through modification of the EIA, if necessary) will be included in a final executive summary that will be submitted to the Government

3.3 NATIONAL REGULATORY REQUIREMENTS

Environmental Assessment in Azerbaijan is based upon the 1996 UNDP Guidelines⁽¹⁾, which include requirements and systems for consulting the public. Although the Guidelines are adopted in practice, they have no formal status in law as they have not been through the ratification procedures of *Milli Mejlis* (Parliament).

3.3.1 REQUIREMENTS FOR PUBLIC CONSULTATION

The national system refers to the 'public' as anyone who is in any way affected by a specific proposal or shows a genuine interest in it. NGOs, as representative bodies of the public, have the right to request access to comprehensive information on the state of the environment and the use of natural resources in any part of the country.

The main requirements for public consultation are addressed under the following pieces of framework legislation:

- The *1999 Environmental Protection Act* (and its predecessor, the *1992 Act on the Protection and Utilisation of Nature Resources*)
- The *Health Act of 1992* which establishes the right of the public to participate in 'the protection of the environment' and have access to relevant information

If national legislation is in contradiction to international treaties to which Azerbaijan is a party, the provisions of international law are used.

Present requirements have evolved through the system of *Ecological Expertise*. This is addressed under articles 50-58 of the 1999 Environmental Protection Act. Article 50 states that '*Expertise is conducted by the relevant body of executive power and public organisations,*' while other Articles focus on the role of the state and the power in law of the *Expertise* decision.

However, Article 58 also provides for independent involvement in the process:

- Public organisations and other public groups can conduct public ecological review
- The organisation of the public ecological expertise and the responsibilities of public organisations in the field of ecological expertise are determined by legislation
- The conclusions of the public ecological expertise may only be used for information and recommendation purposes

The Act also states that citizens of Azerbaijan have the right to participate in discussion of issues related to projects which may have a harmful impact on the environment. The public also has the right to demand punishment for persons responsible for environmental pollution.

EIA requirements provide for public participation from the period when an operating permit is obtained until construction is completed as part of the environmental expertise process. Project proponents are required to advertise their proposed development in the printed media and to

(1) Handbook for the Environmental Impact Assessment Process in Azerbaijan. SCE, UNDP, Baku (1996).

The function of the Guidelines is to provide a framework for the EIA process in-line with international norms, though adapted to the Azeri context. In doing so, they lay out the basic principles for the EIA process, together with the relevant clauses of existing legislation in relation to the conduct of 'Environmental Expertise'.

notify any person or organisation who will be directly affected by the project. It is also mandatory for the proponent to demonstrate how, and to what extent, the public has been consulted within its Environmental Impact Assessment Statement (EIS).

3.3.2 ENFORCEMENT

Compliance with the requirement for public participation is regulated by the Ministry of Environment and Natural Resources.

Compliance with legislation on information is monitored by the State Committee on the Press on the basis of *Law on the Mass Media*. Legislation on political and public organisations, as well the *Laws on Nature Protection and Nature Use Management* and on *Sanitary and Epidemiological Safety* provide for the use of all democratic mechanisms of public participation.

Concealment of information can lead to sanctions under the Administrative Code, the *Law on Sanitary and Epidemiological Safety*, Article 39, *Liability for Violation of Sanitary Legislation*, and the *Regulation for Investigation and Registration of Production Accidents*, Resolution of the State Central Trade Union Council No 8-12 dated August 17, 1989.

3.4 INTERNATIONAL STANDARDS ON PUBLIC CONSULTATION

3.4.1 WORLD BANK GROUP (INCLUDING THE IFC)

The World Bank Group's *Environmental Assessment policy (OP 4.01, January 1999)* requires that project-affected groups and local non-governmental organisations (NGOs) be consulted about the project's potential environmental and social impacts during the ESIA process. The purpose of this consultation is to take local views into account in designing the environmental and social management plans as well as in project design. For complex projects where the environmental impacts and risks are high, the policy requires public consultation at least twice: first, shortly after environmental screening and before the terms of reference for the ESIA are finalised and secondly, once a draft ESIA Report has been prepared. Consultation during project execution is also required. Section 6 of this PCDP summarises the consultation programme for the ESIA, and confirms that the project meets and indeed exceeds these requirements.

The IFC's manual '*Doing Better Business Through Effective Public Consultation and Disclosure: A Good Practice Manual*' provides action oriented guidelines aimed at ensuring that consultation is both effective and meaningful. The guidelines emphasise the need for the project sponsor to ensure that the process of public consultation is accessible to all potentially affected parties, from national to local level. Emphasis is placed on the engagement of local stakeholders, namely people who are likely to experience the day-to-day impacts of a proposed project. On a practical level, the sponsor has to ensure that: i) all stakeholders have access to project information; ii) the information provided can be understood; iii) the locations for consultation are accessible to all who want to attend; and iv) measures are put in place which ensure that vulnerable or minority groups are consulted.

The consultation requirements for projects requiring physical or economic displacement are covered by the World Bank ***Operational Directive 4.30: Involuntary Resettlement*** and outlined in the IFC's '***Handbook for Preparing a Resettlement Action Plan***'. The pipelines do not involve any physical resettlement, but the project is developing a Resettlement Action Plan (RAP) to address the economic displacement associated with the projects.

The project sponsor is required to initiate and facilitate a series of consultations with project stakeholders throughout the planning and implementation of the RAP. The objective of these consultations is to ensure the participation of affected parties in their own resettlement planning and implementation. In particular, the following areas require consultation:

- Alternative project design
- Assessment of project impacts
- Resettlement strategy
- Compensation rates and eligibility for entitlements
- Choice of resettlement site and timing of relocation
- Development opportunities and initiatives
- Grievance redress procedures and dispute resolution
- Methods and mechanisms for monitoring and evaluation and implementing corrective actions

Other relevant World Bank Group policies include:

- ***Operational Policy 14.70: Involving Non-Government Organisations in Bank-Supported Activities***
- ***Operational Policy 4.04: Natural Habitats***
- ***Operational Policy 4.11: Safeguarding Cultural Property***

These also include provisions for public consultation. The requirements focus on early consultation with affected people and NGOs, early disclosure of information and providing information in a way that allows informed consultation with stakeholders.

In addition to the requirement for consultation with stakeholders, the World Bank Group has specific requirements for disclosure of documentation resulting from the ESIA process. This includes:

- Preparation and publication of a Public Consultation and Disclosure Plan (PCDP) for consultation
- Disclosure of the draft ESIA in public places in-country and the World Bank Infoshop (at least 60 days prior to the IFC board date¹), including a non-technical summary in the local language to local stakeholders
- Preparation of an Environmental Action Plan (EAP) containing social as well as environmental measures designed to manage, mitigate and monitor the impacts identified during development of the ESIA. This must also be released to the World Bank Infoshop and be made available locally prior to presentation of the project to the IFC board

¹ The Pelosi amendment to the World Bank procedures for disclosure requires a 120 day disclosure period at the World Bank Info Shop prior to the project Board date to ensure a positive vote at the board from the US Executive Director.

3.4.2 EUROPEAN BANK FOR RECONSTRUCTION AND DEVELOPMENT (EBRD)

The EBRD's principles of public consultation are documented in the Bank's Environmental Policy (EP), Environmental Procedures (EPr), and the Public Information Policy (PIP). While the EBRD requirements reflect some of the other international financial institution requirements (e.g., World Bank for public sector and IFC for private sector), there are some important additional requirements with reference to European Union requirements and international conventions and treaties.

The EBRD standards require that projects are held to the more stringent of national and European Union standards. For those areas where there are not European Union standards, the EBRD relies on the more stringent of national and World Bank Group standards. In the area of public consultation, the European Union requirements are set out in the EIA Directive. In addition, the EBRD requires that the Public Information policy and Environmental policy of the Espoo Convention is followed for any project that may have transboundary impacts, regardless of whether the countries involved are party to the convention or are members of UNECE. This is in line with EU standards. The EBRD also concurs with the principles of the Aarhus Convention, which is specifically mentioned in the Public Information Policy.

A-level requirements

In the case of significant "greenfield", major expansion or transformation-conversion operations which have been classified as requiring an Environmental Impact Assessment, those potentially affected must have the opportunity to express their concerns and views about issues such as operation design, including location, technological choice and timing, before a decision on EBRD financing is made. At a minimum, sponsors must ensure that national requirements for public consultation are met and that EBRD's own public consultation procedures are met. The Bank's Board of Directors will take into account the comments and opinions expressed by consultees, and the way these issues are being addressed by sponsors, when considering whether to approve an operation.

Scoping

Both the EBRD Environmental Procedures and the Public Information Policy require a thorough scoping procedure for all "A" level operations, which will involve the Project Sponsor consulting with representatives of the locally affected public and with government agencies, as well as with other organisations.

Disclosure of EIA Documentation

Following the completion of environmental investigations, EBRD requires that the public is provided with adequate information on the environmental aspects of the operation to enable them to provide the Project Sponsor with comments on the proposals. To facilitate this, the Project Sponsor must make the EIA and an Executive Summary publicly available, in accordance with relevant national legislation, and allow sufficient time for public comment prior to the Bank's Final Review of an operation and its consideration by the Board. For private sector operations there will be a minimum of 60 days between the release of the EIA and the date of Board consideration.

The EBRD strongly encourages project sponsors to place EIAs on their websites to improve public accessibility to the documents, and to otherwise release information in electronic, as well as written format. Where an EIA has been released on a website, the EBRD's website will provide a direct link to the project sponsor's website.

The EBRD encourages project sponsors to leave EIAs in the public domain indefinitely, and at least for the life of the Bank's involvement with the project. In no case should the EIA be removed prior from the public domain prior to Project Completion, and will in any event, remain permanently in the public domain through the EBRD offices in London and the country in which the project is located.

Project Summary Documents

A Project Summary Document (PSD) will be prepared for each project, and will be released on the Bank's website with an Environmental Annex which summarises the results of environmental due diligence and the environmental action plan, at least 30 days prior to consideration by the Board of Directors.

On-going Consultation and Disclosure

For projects that have raised significant environmental or health and safety issues, or which have aroused the particular interest of the public or NGOs, the EBRD encourages the commitment to on-going information and communication programmes. For example, the Bank may require the results of ongoing environmental monitoring to be made available to the public.

International Conventions and Treaties

The EBRD, within the framework of its mandate, supports the Espoo Convention on EIA in a Transboundary Context. In this context, the Environmental Policy and the Public Information Policy state that the requirements outlined in the Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention) must be followed regardless of whether the country affected has ratified the convention.

In addition, the EBRD takes into account the Aarhus Convention, along with other relevant international conventions, in the implementation of its Environmental Policy.

3.4.3 *EUROPEAN COMMISSION*

Although European Commission legislation does not apply to Azerbaijan, this is included here as best practice and because these standards have been adopted by EBRD. European requirements for stakeholder involvement in the EIA process are specified in the 1985 Directive (85/337/EEC) on Environmental Assessment, as amended by Directive 97/11/EEC. The review of the implementation of the Directive 85/337/EEC is provided in Directive 85/337/EEC.

The 1985 Directive ensures that the Member States make information on proposed activities available to the public. The public concerned is given the opportunity to express an opinion before the project is initiated. The Directive requires that the Member States determine detailed arrangements for such information and consultation including identification of the public concerned, places where the information can be consulted, ways in which the public can be informed and consulted, and timeframe during which the consultation should be conducted.

The 1997 Directive supports the requirements put forward in the 1985 Directive, and adds a requirement to conduct public consultation for projects that are likely to have significant transboundary environmental effects. The Directive specifies that it is the responsibility of both a Member State in whose territory the project is intended to be carried out, and a Member State likely to be affected by the proposed project, to inform the public of the Member State likely to be affected by the proposed project.

3.5 *INTERNATIONAL CONVENTIONS ON PUBLIC PARTICIPATION*

3.5.1 *AARHUS CONVENTION: ON ACCESS TO INFORMATION, PUBLIC PARTICIPATION IN DECISION MAKING AND ACCESS TO JUSTICE IN ENVIRONMENTAL MATTERS*

The Convention was signed in Aarhus, Denmark in 1998 by the European Commission and governments of 36 countries, including Azerbaijan. The Convention was ratified in Azerbaijan in 1999. The objective of the Convention is to guarantee the rights of access to information, public participation in decision-making, and access to justice in environmental matters, in order to protect people's rights to a healthy environment.

The Convention obliges public authorities to make sure that environmental information is available to the public upon request without discrimination and without having to state an interest. Although provisions are made for limitation of access to certain types of environmental information, this limitation is not strict and should take into account the public interest served by the disclosure. The Convention encourages public authorities to collect environmental information regularly and disseminate it in the form of a computerised and publicly accessible database.

The Convention entitles the public to participate in environmental decision-making concerning a wide range of economic activities, not only those covered by environmental impact assessment procedures. Public authorities ensure that the public is involved at as early a stage of the project planning as possible and that various project options are open for discussion. Any activities that may lead to environmental deterioration are to be subject to consideration in public and to the public's consent. Public participation also takes place in the preparation of environmental plans and programmes and, with a lesser degree of commitment, in the preparation of policies.

Under the Convention the government ensures that anyone who considers that his or her request for information has been inadequately dealt with has access to court for a review procedure.

3.5.2 *ESPOO CONVENTION "ON ENVIRONMENTAL IMPACT ASSESSMENT IN A TRANSBOUNDARY CONTEXT"*

The Convention was signed in Espoo, Finland in 1991 by governments of European Countries, the United States, and European Community. Azerbaijan joined the Convention in 1999. The main objective of the Convention is to promote environmentally sound and sustainable

economic development through the application of environmental impact assessment, especially as a preventive measure against transboundary environmental degradation. Under the terms of this Convention, Azerbaijan is required to notify other states if there is a potential impact upon their environment resulting from a development on the territory of Azerbaijan including its waters.

Although the Convention does not specifically deal with public participation in environmental decision-making, it provides the requirement for a country conducting a proposed activity to provide an opportunity to the public of a country(ies) likely to be affected to participate in the process of environmental impact assessment regarding the proposed activity.

The Espoo Convention is only applicable if both the party conducting a proposed project and the affected party have ratified the Convention. Currently Armenia is the only Caucasus state that borders with Azerbaijan by land, and Kazakhstan is the only Caspian state that borders with Azerbaijan by water that have ratified the Espoo Convention. As per the Convention, Azerbaijan should notify Kazakhstan and Armenia about the proposed project as soon as possible and no later than informing its own public. This notification should include information about the proposed project. Armenia and Kazakhstan will be expected to respond to this notification indicating whether they wish to participate in the environmental impact assessment process. Should these countries wish to participate, Azerbaijan will ensure that the public of these countries be provided with the opportunity to participate in the EIA process equivalent to that provided to the public of Azerbaijan.

3.5.3 CONVENTION ON THE PROTECTION AND USE OF TRANSBOUNDARY WATERCOURSES AND INTERNATIONAL LAKES

The main objective of this Convention is to prevent, control or reduce any transboundary impact resulting from the pollution of transboundary waters caused by human activity. Article 16 of the Convention contains requirements for public information. Under these requirements, the Parties have to ensure that information on the conditions of transboundary waters, measures taken to control, reduce and mitigate transboundary water pollution, and effectiveness of these measures are made available to the public. The information that has to be made available to the public includes:

- Water quality objectives (see Guidelines for Developing Water Quality Objectives and Criteria in Annex III of the Convention)
- Permits issued and the conditions required to be met
- Results of analysis of water sampling carried out for monitoring and assessment, and results of checking compliance with water quality objectives

The Parties have to ensure that the information is made immediately available to the public of their States, and is free of charge. Copies of the information will be provided to the riparian Parties for reasonable payment.

Table 3.1 International Standards on Public Consultation

	World Bank Group (including the IFC)	European Bank for Reconstruction and Development (EBRD)	European Commission
Policy Requiring Public Consultation	Operational Directive 4.01 Environmental Assessment and its successor documents. Operational Directive 4.30 Involuntary Resettlement	Public Information Policy, Environment Policy, and Environmental Procedures.	Directive 85/337/EEC on Environmental Assessment, as amended by Directive 97/11/EEC and Directive 90/313/EEC on Freedom of Access to Information on the Environment
Requirements			
Who should be consulted?	Directly and indirectly affected stakeholders, and those with an interest who feel they may be affected.	The public should be informed of ongoing project developments supported by EBRD	Directly and indirectly affected stakeholders, or representatives of affected groups.
Why involve the public?	Minimises conflict and delays; increases transparency; empowers people ensuring that their views are taken into account during project design and development of environmental and social management plans;	Minimises conflict and delays; increases transparency; empowers people ensuring that their views are taken into account during project design and development of environmental and social management plans;	Improves the quality and effectiveness of EIAs and project design and operation.
When should stakeholders be involved?	At a minimum, during scoping and screening phases, before the ToR for the ESIA is finalised and on the draft ESIA. For complex projects where the environmental impacts and risks are high consultation during project execution is also required.	A project summary document (PSD) must be prepared for each private sector project and released at least 30 days prior to the consideration by the Board of Directors; An Environmental Impact Statement (EIA) must be prepared for Category 'A' projects (includes offshore gas and oil production) and released at least 60 days prior to consideration by the Board of Directors.	As early as possible in the EIA/project process and throughout the EIA/project cycle.

	World Bank Group (including the IFC)	European Bank for Reconstruction and Development (EBRD)	European Commission
What areas require consultation?	Alternative project design; assessment of project impacts; resettlement strategies; compensation rates and eligibility for entitlement; choice of resettlement sites and timing of relocation; development opportunities and initiatives; grievance redress procedures and dispute resolution; methods and mechanisms for monitoring, evaluation and implementing corrective actions.	Operation design, including location, technological choice and timing.	Transboundary environmental effects.
Responsibilities for Public Consultation	<p>Responsibilities should be allocated clearly and early on. Project sponsor should ensure that:</p> <ul style="list-style-type: none"> • All stakeholders have access to project information; • The information provided can be understood; • The locations for consultation are accessible to all who want to attend; • Vulnerable or minority groups are consulted. 	<p>It must be ensured that:</p> <ul style="list-style-type: none"> • The EIA Executive Summary is made available in the local language; • The EIA and EIA Summary are made available in the EBRD's business Information Centre (BIC) in London (notice of this should be posted on the EBRD website); • Clients are recommended to place EIAs on their own websites. 	<p>The Member carrying out the project and the Member State(s) likely to be affected by the project must inform the affected public. It must be ensured that detailed arrangements within the Member States is made for:</p> <ul style="list-style-type: none"> • Identifying the public concerned; • Providing places where information can be consulted; • Providing suitable methods for informing and consulting the public; • A suitable timeframe for consultation is developed
Other World Bank Group policies	<ul style="list-style-type: none"> • Operational Policy 14.70: Involving Non-Governmental Organisations in Bank-Supported Activities • Operational Policy 4.04: Natural Habitats • Operational Policy 4.11: Safeguarding Cultural Property 		

	World Bank Group (including the IFC)	European Bank for Reconstruction and Development (EBRD)	European Commission
Requirements of these OPs	Early consultation with affected people and NGOs; early disclosure of information; providing accessible information.		
Comments	<p>Specific requirements for disclosure of documents relating to the ESIAs on projects seeking international funding include:</p> <ul style="list-style-type: none"> • Preparation and publication of a Public Consultation and Disclosure Plan (PCDP) for consultation; • Disclosure of draft ESIA (at least 60 days before IFC board date) including a non-technical summary in public places (in-country and are WB infoshop); • Preparation of an Environmental Action Plan containing social and environmental measures to manage, mitigate and monitor the impacts identified in the ESIA. 		The European legislation does not apply to Azerbaijan. It is included as an example of best practice.

Table 32 International Conventions for Public Participation

	Aarhus Convention: <i>On Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters</i>	UNECE (Espoo Convention): <i>On Environmental Impact Assessment in a Transboundary Context</i>	Convention on the Protection and Use of Transboundary Watercourses and International Lakes
Policy Requiring Public Participation	No explicit policy Convention signed in Aarhus, Denmark in 1998 by the European Commission and governments of 36 countries	Parties to the Convention should take measures to facilitate Public Participation in decision-making. Convention signed in Espoo, Finland in 1991 by governments of European Countries, the United States and European Community. Azerbaijan ratified the Convention on 25.03.99.	No explicit policy
Objective	To guarantee the rights of access to information, public participation in decision-making and access to justice in environmental matters.	To promote environmentally sound and sustainable economic development through the application of EIA, especially as a preventative measure against transboundary environmental degradation.	To prevent, control or reduce any transboundary impacts resulting from the pollution of transboundary waters caused by human activity.
Requirements			
Who should be consulted?	The public. This means individuals or groups that request information. They do not have to state an interest.	The public. This means individuals or groups, without discriminating on the grounds of citizenship, nationality or domicile.	The public.
When should the public be informed?	As early in the project planning as possible; in the preparation of environmental plans and programmes (and to a lesser extent policies).	The responsible authority should inform affected parties in its own country and abroad as early as possible.	Information should be made immediately available to the public. It must be free of charge.

	Aarhus Convention: <i>On Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters</i>	UNECE (Espoo Convention): <i>On Environmental Impact Assessment in a Transboundary Context</i>	Convention on the Protection and Use of Transboundary Watercourses and International Lakes
What areas require participation/provision of information?	The public are entitled to participate in environmental decision-making, including economic activities.	The EIA process regarding the proposed activity.	Information that must be made available to the public includes: Water quality objectives; Permits issued and their conditions; Results of water analysis carried out for monitoring and assessment.
Responsibilities for Public Participation	Public Authorities are encouraged to collect environmental information regularly and to disseminate it in the form of a computerised and publicly accessible database	Parties to the Convention (i.e. government). The public also has a responsibility to take participation seriously and to organise itself for this process. Countries must provide an opportunity for the public to participate in the EIA process.	Parties subject to the Convention must ensure that information on the conditions of transboundary waters, measures taken to control, reduce and mitigate transboundary water pollution and effectiveness of these measures are made available to the public.
Comments		Only applicable if both the party conducting a proposed project and the affected party have ratified the Convention. (In this context, currently Armenia and Azerbaijan in the Caucasus)	

4 CONSULTATION DURING ESIA AND PRE-CONSTRUCTION PHASE

4.1 INTRODUCTION

This section outlines the main phases in the ESIA public consultation process prior to construction. Consultation during this period is focused on the development and publication of the ESIAs. However, many other areas of the project are also engaged in what could be classed as consultation activities, including the engineering team discussing project design issues with State Authorities, and the land team who are actively consulting with land owners and users on possible acquisition and compensation. The consultation process is designed to enable communities and other stakeholders to make a meaningful contribution towards the ESIA and hence toward the pipeline project, in particular through the development of potential mitigation measures.

Box 4.1 Objectives of the Consultation Process 1

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1. All stakeholders have access to project information
 2. The information provided can be understood
 3. Locations for consultation are accessible to all who want to attend
 4. Measures are put in place which ensure that vulnerable or minority groups are consulted
 5. Establish a high level of awareness among communities and other stakeholders about the nature of the project, its likely impact and proposed mitigation measures
 6. Secure input from stakeholders on proposed mitigation measures, in particular through consultation with a representative sample of communities along the pipeline route and in relation to specific types of project activities
 7. Manage expectations among communities and other stakeholders
-

A range of materials used during different phases of community consultation are attached in *Appendix I*.

4.2 OVERVIEW OF CONSULTATION PROCESS

The SCP ESIA was initiated through consultation and information disclosure at both national and community level in October 2000. The consultation process was formally expanded to cover the BTC pipeline in August 2001. While many of the issues are common to both projects and almost the same set of communities are affected, additional consultation was undertaken with each community to identify differences in attitudes related to the oil pipeline, and also to the construction of two pipelines, instead of just one.

(1) Objectives 1 - 4 are those identified by IFC in their guide 'Doing Better Business Through Effective Public Consultation and Disclosure: A Good Practice Manual.'

The key consultation milestones are as follows:

- ***Identification of Stakeholders: October 2000***
- ***SCP Consultations: October 2000 – April 2001***

Phase 1: October 2000 – November 2000 - Meetings with key officials

Phase 2: November 2000 to December 2000 – Introductory workshops and meetings with NGOs and other stakeholders. Scoping of environmental and social issues, including first round of community level consultation and baseline data collection.

Phase 3: March 2001 to April 2001 - Second round of community level consultation and preliminary development of mitigation options

- ***Combined SCP and BTC Consultations: August 2001 – May 2002***

Phase 4: August 2001 – Consultation and baseline data collection with communities in the vicinity of potential sites of construction camps and pipeyards, including meetings with village leaders, migratory herders and interviews with a sample of community members

Phase I: October 2001 to November 2001 – Introductory workshops with NGOs and Interest Groups for BTC, combined with issues management workshops with national and international NGOs on BTC and SCP in Baku and Ganja

Phase II: December 2001 – January 2002 – Consultation on proposed mitigation:

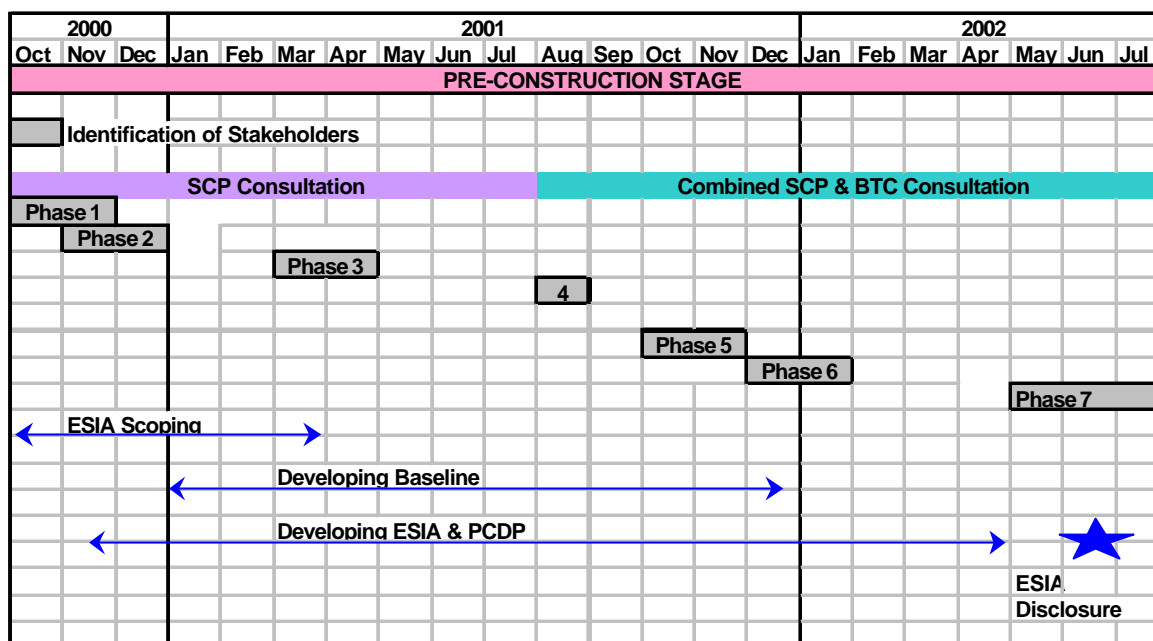
- Community visits to raise awareness of the additional BTC pipeline, to carry out consultation, baseline data collection and testing of mitigation measures (December 2001)
- Meetings with specialist organizations to canvas views on specific mitigation measures (January 2002)

Phase III: April to May 2002 – Consultation on ESIA findings, after disclosure of the ESIA (during April 2002). This comprises two parts:

- Meeting with national stakeholders, including international NGOs (April 2002)
- One-day road shows at approximately ten communities along the pipeline route (May 2002)

The consultation schedule is illustrated in *Figure 4.1*

Figure 4.1 Consultation Schedule



4.3 IDENTIFICATION OF STAKEHOLDERS

The sponsor companies have worked with consultants to identify the key stakeholders who should be consulted with at various stages of the project:

- **Authorities** comprising national, regional and local government bodies, of primary political importance to the project and to the ESIA process
- **National and Local non-governmental organizations** which have a direct interest in the project, and which may have useful data or insight into the local and national challenges faced by the project
- **Interest Groups** including for example, media, academics, institutions, foundations and community groups
- **Residents** of communities adjacent to the pipeline corridor, landowners and land users (including migratory herders) of the towns and villages within a 4 km corridor around the pipeline who would be directly affected by the project
- **IFIs** including IFC and EBRD
- **BTC and SCP Partner Organisations**

A full list of the stakeholders identified is presented in *Appendix 2* of this PCDP.

The project has established a consultation tracking database that is being used to log all meetings with stakeholders at national, regional and local level. At the local level this is limited to discussions with village leaders during the ESIA process, but it will include meetings with individual landowners at later stages in the pre construction period. The database is held centrally by BP.

4.4 SCP CONSULTATION, OCTOBER 2000 TO APRIL 2001

Table 4.1 below summarises the consultation carried out for the SCP pipeline between October 2000 and April 2001. Phases 1 to 3 took place during the ESIA scoping phase. Phase 4 (discussed in *Section 4.5*) formed part of the baseline assessment.

Table 4.1 Summary of SCP Consultation

Phase	Date	Consultation Activity
Phase 1	Oct 2000	Introductory workshop and meetings with NGOs and other stakeholders
Phase 2	Nov – Dec 2000	Scoping of environmental and social issues and first round of community level consultation
Phase 3	Mar – Apr 2001	Second round of community level consultation and preliminary development of mitigation options

4.4.1 PHASE 1: MEETINGS WITH NGOS AND OTHER STAKEHOLDERS

October 2000

Introductory workshops and meetings with government authorities took place in October, led by the sponsor companies, and focussed on informing stakeholders of the status of the SCP project, explaining the ESIA activities and schedule. The views of these key organizations were sought regarding the proposed ESIA process with the aim to establish an effective and supportive working relationship throughout the project.

In addition, the sponsor companies led meetings with NGOs and Interest Groups, focusing on providing more detailed information on the project scope, ESIA activities and schedule. Feedback was solicited on topics of interest in relation to environmental and social impacts and the consultation process. The meetings also ascertained which organisations might wish to become actively involved in the process. Detailed minutes of the workshops were circulated to attendees, and are available on request.

4.4.2 PHASES 2 TO 3: COMMUNITY CONSULTATIONS

Prior to the start of any village-level consultation, the consultation team met with the Head of each Regional Administration to explain the proposed consultation process, and seek their support and assistance.

November to December 2000

In November 2000, ERM and its national sub-contractor, Synergetics, embarked on detailed community level consultation. 74 communities were visited within a 4 km corridor centred on the proposed route options (i.e. the refurbishment of the existing Azeri Gas line, or the building of a new pipeline along a slightly different route). The aim was to consult with community

leaders and with a sample of individual householders who owned, used or had rights to land on the potential right of way (ROW) or in the construction zone. This formed part of the scoping process.

Quantitative Interviews were held with the 73 most senior government representatives, or the person who is commonly understood to be the community leader or key information source in each settlement or group of settlements. These community leaders were interviewed on a range of quantitative demographic questions, as well as qualitative questions designed to solicit their views and attitudes to pipeline construction, and to identify their key concerns.

814 semi-structured **Qualitative Interviews** were also held with a sample of the householders in every one of these 74 communities. The number of interviews in each community reflected the settlement size. The sample size was as follows:

- at least 5 people in small villages (below 1,000)
- at least 10 people in medium size villages (1,001 to 5,000)
- at least 20 people in large settlements (above 5,000)

Respondents were chosen using a combination of random and stratified selection. Groups of households were chosen to represent a range of living conditions. Households within these clusters were then selected by taking every third house on the left and then interviewing an equal number of men and women, old and young.

Village level stakeholders were provided with written information about the project in Latin and Cyrillic Azeri or Russian as appropriate.

Results of the interviews were used to populate a database, linked to a GIS, for subsequent analysis and presentation in the ESIA reports (see *Appendix I*).

ERM has worked with Synergetics and others to determine that the methods of consultation proposed are culturally acceptable and socially appropriate, and to adapt the proposed approach to local circumstances ⁽¹⁾. ERM also ensured that the consultation team was fluent in local languages and included an appropriate mix of men and women in order to avoid appearing threatening upon arrival in the villages, and to ensure that the team was able to talk to a full cross-section of the population. *Table 4.2* lists all stakeholders contacted during the scoping phase.

Information obtained via consultation in Phases 1 to 3 was used to

(1) For example, before approaching individuals in villages we made sure that their "daily context" was normal, i.e. no big festivals, holidays, religious celebrations, or funerals.

When interviewing people we approached the "representative" of the household which in Azerbaijan means the senior male except in female headed households.

When interviewing groups, or in workshops, materials were presented in an appropriate language to ensure understanding of a level of technical information, or in two languages where necessary (Azeri, and Russian).

Village leaders were always informed of our presence and the aims of our interview prior to starting the interview process. Where the village leader was absent, other officials were consulted.

All comments and views expressed in specific villages were kept confidential along the route, despite frequent questions.

Individuals were always given the option to refuse an interview, or to refuse to answer questions if they felt that questions were too sensitive or difficult.

Local goods and services were purchased in communities where the team stayed during field work to assist in maintaining good relationships with the villagers.

- establish a route level baseline
- develop appropriate mitigation measures, which were then tested with communities and NGOs in following rounds of consultation
- define socio-economic clauses needed in the Construction Contractor Invitation to Tender

Table 4.2 Summary of Stakeholders Consulted During the Scoping Phase

Stakeholder Groups
<i>Authorities – consulted through one-to-one meetings</i>
SOCAR
Azerigas
AzETLGaz
Azerigaznagl
Minister of Internal Affairs
Key Members of Parliament
<i>Authorities, NGOs and Interest Groups – consulted through meetings</i>
Ministry of Culture
Geipromorneftegas
Former State Committee for Ecology
State Caspian Inspectorate
State Committee for Geology
Department of Nature Reserves
State Land Committee
Division for the Control of Land Utilisation
Caspian Environment Programme
Women and Development
Greens Movement
Great Silk Road Project
BP Research and Monitoring Group
Wide range of Academics from:
Institute of Archaeology and Ethnography, Azerbaijan Academy of Sciences
Institute of Botany
Institute of Geography
Institute of Geology
Baku State University
ISAR
Ruzigar Society
Ecoenergy Academy
<i>NGOs and Interest Groups - consulted through workshops</i>
Greens Movement
Information analytical centre ECORES
TETA "HAZRI"
Environmental Juridical Centre ECOLEX
International Public Centre of Study of Local
Folk Lore and Ecological Tourism "Caucasus"
Azerbaijan Centre of Birds Protection
Scientific and Research Society "ECOIL"
For Clean Caspian Sea
ECOSCOP
Pilgrim
Group of Rehabilitation of Nature
Hydrologist programme

Public Ecological Foundation
Voice of Azerbaijan
Centre "Human & Environment"
Hayajan
Azerbaijan Greens Movement
Ruzigar Society
Mammologists of Azerbaijan

Residents - consulted through survey

All local communities along ROW options

March to April 2001

Following the scoping phases and analysis of route options, a further round of community level consultation was required within the re-defined corridor. The aim was to identify all those communities that were no longer within 2kms of the ROW and to remove these results from the project specific baseline. The consultation also aimed to highlight where new communities were now affected, and to include these within the overall consultation framework.

4.4.3 PHASE 4: COMMUNITY CONSULTATIONS ON PIPEYARDS AND CONSTRUCTION CAMP

Additional consultations were also carried out in August 2001 to identify communities and households that may be in direct proximity to sites proposed for potential worker construction camps or storage yards for construction equipment and pipe. Villages within 2kms of potential locations for pipe yards and villages up to 5kms from a potential site for a major construction camp were consulted. The purpose was to capture any communities that may witness project activities although they fall outside the 4km corridor, and also to consult people on the specific issues that may be associated with living close to one of these developments. Consultations also identified households on access roads that may be affected by an increase in traffic flows between these sites and the spread. Households were selected for interview on the same basis as above (though from more specific target locations). These questionnaires were also designed to feed into the same database.

In addition, consultation was undertaken with migratory herders whose migratory routes cross or temporary camps are close to the ROW to ensure that relevant mitigation measures could be put in place to ensure minimum disruption to their lives and livelihoods.

4.5 PHASE 5, OCTOBER TO NOVEMBER 2001

The BTC ESIA was initiated through consultation and information disclosure at the national and community levels in August 2001 and October – November 2001.

Project leaflets were distributed to every location on a number of occasions, specifically informing the inhabitants about the pipeline projects or construction camp/yard developments or AGI developments, depending on the actual activities likely to be witnessed at the settlement.

4.5.1 CONSULTATION AT THE NATIONAL LEVEL

Introductory workshops for the BTC pipeline were held in Baku and Ganja in October/November 2001, combined with issues management workshops for both BTC and SCP. Participants in each workshop represented some 15 national and international NGOs, in addition to members of the local administration. The format included a first presentation of the BTC project, update on SCP, results of the consultation to date and subsequent roundtable discussions on the key issues of concern to project stakeholders and proposed mitigation. The outcomes of these discussions were fed back into the refinement of the proposed mitigation. The attendees at the two issues management workshops are listed below in *Tables 4.3* and *4.4*.

Table 4.3 Stakeholders Participating In Issues Management Workshop, (Baku, 30 October 2001)

Organisation	Activity
AREAT Research Centre	Conflict prevention and resolution
Azeri Sociological Association	Developing social science. Disseminating sociological research
Inam Centre for Pluralism	Freedom of speech and press, civil society
Azerbaijan Woman and Development Centre	Family planning
Ecolex – Azerbaijan Environmental Law Centre	Rehabilitation services to vulnerable groups Encouraging public participation in environmental decision making
Human and Environment Azerbaijan Public Association	Health and environmental problems
Azerbaijan AIDS Association	Overcoming denial of AIDS and preventing the spreads of HIV/AIDS
Women in the Oil Industry of Azerbaijan	Protecting the rights of women oil workers and their families
Ruzigar Ecological Social Union	Unifying ecologists, economists, sociologists, lawyers, journalists
Himayadar Humanitarian Organization	Human rights
Legal Education Society	Legal services to vulnerable groups
Caspian Environment Programme (international)	Marine Environment (Public Participation Advisor)
ISAR (international)	Co-ordination and capacity building of national NGO groups
CHF (international)	Community Development
Save the Children (international)	Health and education, Community Development
OXFAM (international)	Working to reintegrate IDPs
ACDI-VOCA	Farmer to Farmer program - US volunteers

Organisation	Activity
(international)	

Table 4.4 Stakeholders Participating In Issues Management Workshop (Ganja, 1 November 2001)

Organisation	Activity
Ana Kur International	Ecology of the Kura River
Ganja Agrobusiness	Agriculture and environment, providing assistance to
The Centre of Young	Education, protection of youth rights.
Tomris Mother Society	Women's rights, gender, social protection, democratic
Debate in Civil Society	Education, building civil society
Bridge to the future	Organizing leisure activities for children.
Helsinki Citizen's	Encouraging accordance with the main tenets of the Helsinki
Odjag Humanitarian	Providing humanitarian assistance to refugees and IDPs
City Hall (Mayor's Office),	Ganja city administrative authority
AIDS organization in	Raising AIDS awareness
Technological University	One of Ganja's respected higher learning institutions.
"Avicenna" medical NGO,	Health Education.
Municipality, chairman	Ganja's municipal authority
Helsinki Assembly on	Human rights
ACDI-VOCA	Farmer to Farmer program - US volunteers
ISAR (international)	Co-ordination and capacity building of national NGO groups

4.6 PHASE 6 BTC AND SCP COMBINED CONSULTATION (MITIGATION) NOVEMBER 2001 TO JANUARY 2002

The BTC ESIA process was initiated at community level through a visit to each of the communities potentially affected by the BTC pipeline in November/December 2001. These visits served several purposes: to test whether the earlier SCP data was valid for both projects; to assess changes in perceptions or cumulative perceptions as a result of the construction of an oil, as opposed to a gas, pipeline first as well as the construction of two pipelines rather than just one; to raise awareness of the BTC project; to collect baseline data and carry out consultation specifically in relation to BTC. Interviews were conducted in one settlement from each of the ten regions along the route, using a slightly modified version of the questionnaire previously used for SCP. The sample size was 10% of the original number of interviews done for SCP. The whole process built on the community consultation carried out in relation to SCP during the previous year. Informal users of any potentially affected lands, i.e. migratory herders, were also consulted during this process.

In addition to the above, the following community level activities were undertaken:

- Targeted consultation with a sample of individual householders/land users in each community close to (or close to access roads for) any other AGIs associated with the project (i.e. pump and pigging stations)
- Provision of project information through a 1 - 2 hour visit to every community in the corridor and discussions with community members on proposed mitigation measures, in

addition to the further identification of potential opportunities for community investment ⁽¹⁾. These meetings began with an introduction to the projects (summarising general information) followed by a question and answer session to outline proposed mitigation on any of the project issues (including employment, land-use during construction, and safety) that most interested community members. General project leaflets were also distributed during these meetings.

4.6.1 MEETINGS WITH SPECIALIST ORGANISATIONS (NATIONAL AND INTERNATIONAL)

The sponsor companies will meet with specialist organizations to canvas views on mitigation measures for particular issues, both environmental and social. *Table 4.5* identifies organizations having specialist knowledge of benefit to the project. Many of those meetings have already taken place.

Table 4.5 Specialist Organisations

Environmental Consultees	Social Consultees
Former State Committee for Ecology	Health Ministry
State Committee for Geology	Labour and Social Welfare Ministry
Department of Nature Reserves	UNICEF
Caspian Environment Programme	Oxfam
Research and Monitoring Group	Save the Children Fund
Institute of Botany	International Red Cross
Institute of Geography	International Alert
Institute of Geology	Ministry of Culture
Ecoenergy Academy	Women and Development
Greens Movement	Azerbaijani Sociological Association
Environmental Juridical Centre	Azerbaijan Woman and Development Centre
ECOLEX	CHF
Folklore and Ecological Tourism 'Caucasus'	Human and Environment Azerbaijan Public Association
Azerbaijan Centre for Birds Protection	Women in the Oil Industry of Azerbaijan
Scientific and Research Society "ECOIL"	
For Clean Caspian Sea	
ECOSCOP	
Group of Rehabilitation of Nature	
Public Ecological Foundation	
Centre "Human & Environment"	
Mammologists of Azerbaijan	
Ruzigar Ecological Social Union	

(1) During the social survey work for SCP and BTC the survey teams have also worked to understand some of the key needs of each community beyond project mitigation. This information is being fed into a separate programme addressing opportunities for Community Investment.

Environmental Consultees

Social Consultees

Flora Fauna International
Birdlife International
WWF (international)
Conservation International;
IUCN;
Wetlands International

4.7 *PHASE 7 BTC AND SCP COMBINED CONSULTATION (DISCLOSURE OF DRAFT), MAY TO JULY 2002*

The draft ESIA's will be publicly disclosed in May 2002 and will be available for comment until July 2002. The document will be made available in Baku, Ganja and other centres along the route in the following types of locations:

- Government offices
- Public libraries
- Community centres
- Selected NGO headquarters
- BP offices
- The worldwideweb

Precise locations will be advertised in advance.

The non-technical summary will be disclosed and discussed with interested stakeholders and communities at national, regional and local level, in order to raise awareness of the project and obtain feedback on mitigation measures. This consultation process will include discussion on both environmental and social issues.

4.7.1 *INVOLVEMENT OF NATIONAL STAKEHOLDERS*

The sponsor companies will hold at least three formal public meetings along the route plus meetings for NGOs and academics in Baku to discuss the findings of the draft ESIA. These will be publicised through national media, both radio and printed media. These meetings will also be publicised directly to potentially interested stakeholders, including organisations invited to workshops at earlier stages of the ESIA process. The public meetings will take place in June 2002 in Yevlakh, Ganja and Akstafa.

4.7.2 *COMMUNITY LEVEL*

The project will conduct a "road show" to highlight and discuss the findings of the draft ESIA's at ten locations along the route in June 2002. These will be chosen in co-operation with Synergetics and will be based on identifying appropriate locations along the route that ensure accessibility for all affected communities, as well as any cultural sensitivity factors. The primary objective of this phase of the consultation will be to enable representatives of all communities affected by the project to participate. The aim will be to get generalized agreement with stakeholders that the most important issues have been identified and properly analysed, and that the proposed mitigation and/or compensation measures are appropriate. The

road show will spend half a day in each location and will include a presentation and display with information on the project. Leaflets and exhibition panels will be prepared in Azeri and English.

An advance team will visit all communities to raise awareness of the date and nearest venue for the forthcoming road show and to distribute information leaflets. Dates and locations of meetings will be advertised via posters placed in each community. The advance team will also ensure that public meetings during disclosure are accessible to all potentially affected parties. Should this prove problematic, the project will consider other options for enabling village representatives to attend these meetings wherever possible.

Additional Consultation

There may be consultation on specific issues that were not fully defined prior to the first phase of community consultation in December 2001. This will take place either prior to or during this phase of consultation. It could include the following:

- Construction of access roads
- Traffic management practices
- Sourcing of construction materials

4.7.3 DOCUMENTATION OF DISCLOSURE

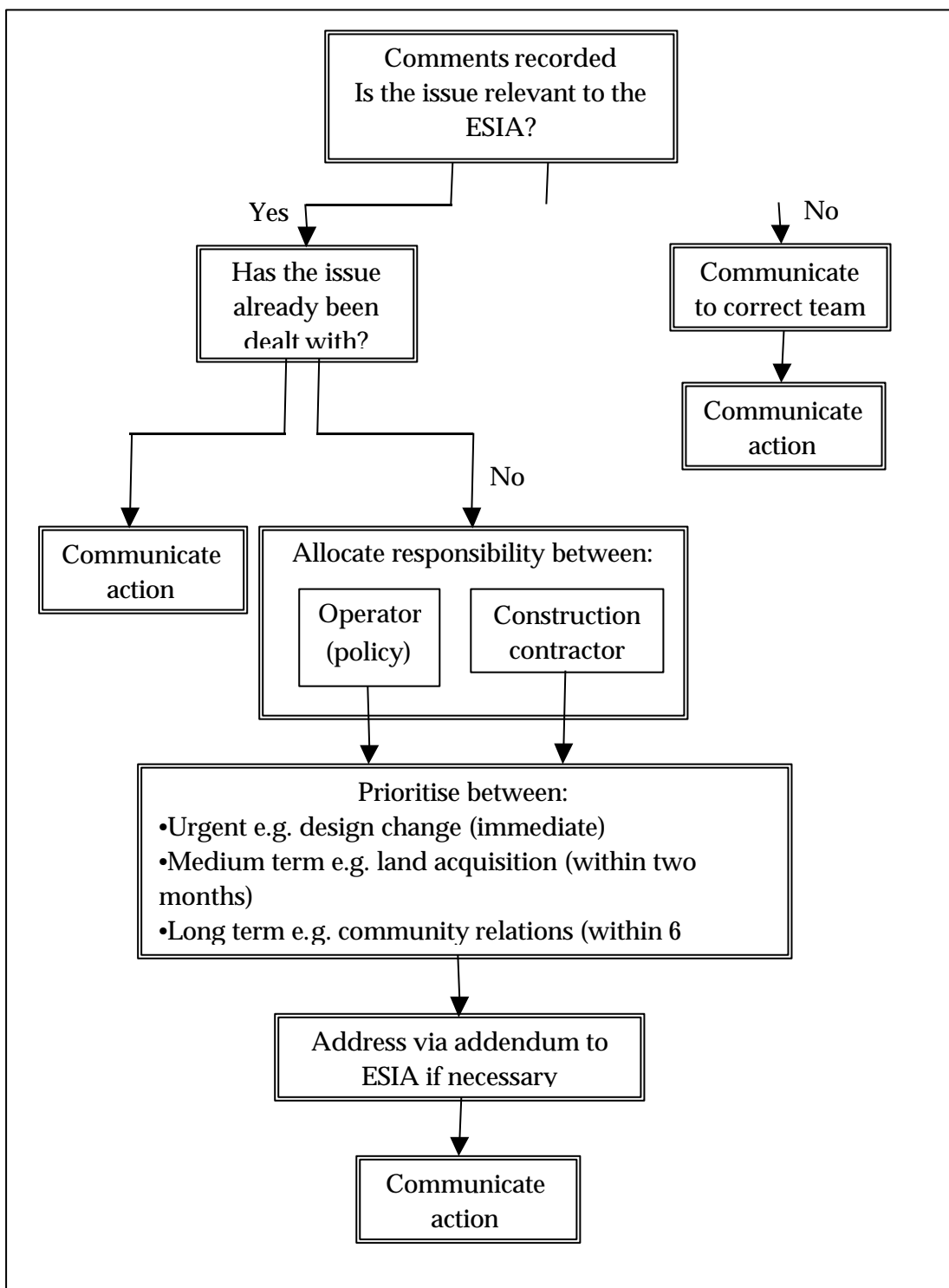
All comments on the ESIA during disclosure, whether written or oral, through meetings or Road Show events, will be dealt with according to the procedure below. Comments during meetings will be systematically recorded by the team (i.e. ERM, Synergetics, the sponsor companies) leading the meeting.

These comments will be assessed on whether they fall within the scope of the project. If comments don't fall within the scope of the project but concern other related issues such as community investment, they will be passed on to relevant teams. Explanation will be provided to respondents whose comments are not relevant to either the ESIA or related activities.

Where project relevant comments are raised they will be checked to ascertain whether they have already been dealt with. If not, they will be included in the consultation tracker and responsibility for them will be allocated between the ESIA team, operator or the construction contractor. Where the responsibility lies with the ESIA team comments will be addressed during the revision of the ESIA. Where comments are not addressed reasons for this will be recorded within the consultation tracker.

For comments that are the responsibility of the project sponsors or the construction contractor, issues will be prioritised for required actions in the immediate, medium term or long term.

Summary of Documentation of Disclosure Process



4.7.4 REVISION OF ESIA

The sponsor companies and their consultant will revise draft ESIAs in July –August 2002, on the basis of comments received at national, regional and local level. The final ESIA reports will summarise the results of the consultation and how comments were addressed. This report will then be submitted to the Government of Azerbaijan, for review and approval.

4.8 CONSULTATION WITH INTERNATIONAL ORGANISATIONS AND NGOS

The involvement of international organisations and NGOs is an essential component of the ESIA. Consultation with specialist organizations (including international organizations and NGOs) took place during the initial development stages of the ESIA and will take place during the disclosure phases of the ESIA. These consultations have been described in the preceding Sections.

In addition to these consultations, there will be consultation with international NGOs on macro issues related to the project. This will take place through an independent regional review.

5 ONGOING CONSULTATION & COMMUNITY RELATIONS

5.1 COMMUNITY RELATIONS IN CONSTRUCTION PHASE

This section set outs the proposed mechanisms for liaison with communities affected by the project during the construction phase and operational phase. It identifies the approach to, and frequency of, consultation with affected communities.

The pipeline operator will be ultimately accountable for relations with the pipeline affected communities and the primary responsibility for daily liaison with communities will be borne by the construction contractor. The operator will therefore require the contractor to develop its own plan and more detailed proposals for community liaison. This will build on the approach outlined by the operator and discussed in this section. All potential contractors are required to draw up this plan as part of the tender process and the review of the plan by the sponsor companies will form part of the bid evaluation process.

5.1.1 OBJECTIVES AND DIVISION OF RESPONSIBILITY

The objectives of the community relations programme will be to:

- Provide communities affected by the project with regular information on the progress of work and implications for these communities
- Inform the pipeline operator of any community related issues that may impact on construction
- Monitor implementation of mitigation measures and the impact of construction via direct monitoring and feedback from communities
- Identify any significant new issues that may arise during the construction period
- Manage any complaints against the operator / contractors and communities

Table 5.1 below sets out the number and role of community liaison staff that will be employed in Azerbaijan.

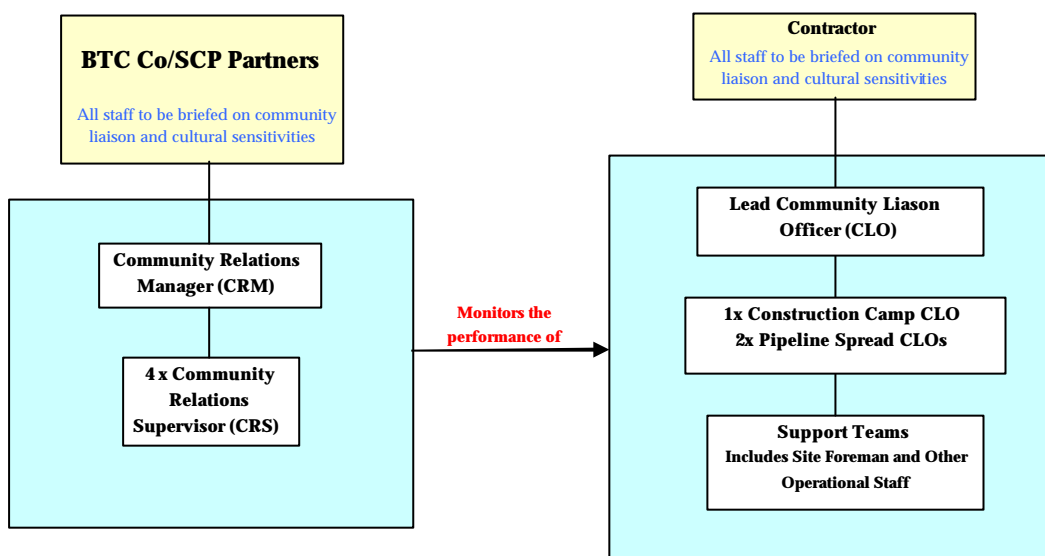
Table 5.1 Community Liaison Teams

Company	Management	Spread 1	Spread 2 (1)	Construction Camps	Total
Construction contractor		1	1	2	4
Operator	1	0	0	2	3

(1) If only one spread is used, only 1 pipeline spread CLO will be necessary.

The construction contractor will be the first point of contact with affected communities. He will appoint a team of three/four dedicated Community Liaison Officers (CLOs), supported by operational staff with specific responsibilities in relation to Community Liaison. This team will comprise 2 Construction Camp CLOs (one of whom will be the lead CLO) and 2 Pipeline spread CLOs.

The operator will establish a project management team on behalf of the project sponsors (for each project) that will monitor the contractor's performance. This team will employ a Community Relations Manager (CRM) with overall responsibility for liaison with affected communities (*see Section 5.1.3 below*), and two Community Relations Supervisors (CRSs).



5.1.2 RECRUITMENT AND TRAINING

The Community Liaison team will be predominantly made up of country nationals. The position of CRM and the lead CLO will be open to both national and international applicants.

The CRM will be appointed when preparatory work with a significant potential construction impact begins. The CLOs will be appointed once the construction contract is in place.

All other members of the Community Liaison team will be in post at least two months prior to the commencement of construction. This will be necessary in order to enable them to be fully briefed, integrated into the project team, given adequate training and be in a position to provide training for other staff with community liaison responsibilities.

The operator and the construction contractor will brief all staff on community liaison and cultural sensitivities as part of the overall project induction training.

5.1.3 THE OPERATOR'S ROLE IN COMMUNITY LIAISON

The CRM will have overall responsibility for community liaison during the construction period, ensure that the contractor carries out their responsibilities in relation to the social impact of the

project, and that smooth relations with communities are maintained. As part of this role the CRM's responsibilities will include:

- collecting and analysing the reports submitted by the CLOs and dealing with issues arising, alerting the operator as appropriate
- tracking the overall levels of complaints reported and ensuring that the processes for dealing with those complaints and other related disputes are prompt and effective
- organising pipeline attitude surveys (as required by the management and monitoring plan) and ensuring that the results are analysed and appropriate management responses implemented
- ensuring that there is an appropriate balance in community liaison between the pipeline spread itself and the construction camps and pipeyards, encouraging the reallocation of resources by the contractor as appropriate

The role of the two Community Relations Supervisors (CRSs), based at two of the construction camps will be as follows:

- Provide regular information to the project team for communication to external audiences on the social impact of the project and community liaison activities
- Monitor implementation of the management plans for community relations, construction camps, and traffic, through liaison with the contractor and meetings with communities
- Identify breaches of management plans, and recommend corrective action
- Represent the operator at community meetings on occasion, as requested by the construction contractor
- Provide support to the contractor in the development of their CL teams, in particular prior to construction
- Agree a dispute resolution process between the operator, the contractor and communities, based on the grievance procedure attached
- Develop community relations procedures consistent with the operators and project social and security policies, and ensure that CLO training is consistent with this approach

5.1.4 CONSTRUCTION CONTRACTOR ROLE IN COMMUNITY LIAISON

This section sets out the requirements that are currently envisaged by the operators. The construction contractor will be required to produce a Community Relations Plan that sets out in detail their community relations strategy. This will be reviewed and finalised by the operator.

Successful community liaison will be achieved through sharing this responsibility throughout the construction team. Each work team will allocate primary responsibility for community liaison to an individual. These individuals will liaise with the team of four dedicated CLOs, and involve them as necessary.

Lead CLO

The lead CLO will have overall responsibility for the following:

- Implementation of the management plans for community relations, construction camps, and traffic
- Training of all contractor staff with community liaison responsibilities
- Communication with communities affected by the project
- Provision of reports to the operator
- Management of contractor CLOs to carry out roles listed below

Construction Camp CLOs

The project currently anticipates that there will be up to four construction camps in Azerbaijan. This will be finalised following the appointment of the construction contractor. There will be one CLO attached to two of these construction camps. Their role will be to:

- Hold regular meetings with communities throughout the lifetime of their host camp, and a second camp closest to their host camp
- Support implementation of the construction camp management plan
- Advise the lead CLO and construction camp management, on changes required to the camp management plan
- Meet with communities close to smaller camps and AGIs on a monthly basis, and advise contractor management and the lead CLO on issues arising from these meetings
- Produce fortnightly reports on implementation of the camp management plan, specific incidents, and action taken to address community concerns

Movement around the pipeyards will be the major focus of traffic associated with the project, since line pipe and other project materials will be stored at the pipeyards and transported to the point of use. The project currently envisages that there will be approximately five pipe yards in Azerbaijan, and that three yards may be operational at any one time. These locations will be finalised following appointment of the construction contractor.

The construction camp CLO will therefore be responsible for:

- Monitoring implementation of the traffic management plan, through liaison with other contractor staff
- Implementing the dispute resolution and grievance procedures where required
- Holding meetings, on a monthly basis, with communities identified in the traffic management plan as most affected
- Producing a quarterly report on implementation of the traffic management plan
- Raising issues of concern in relation to the implementation of the traffic management plan on a fortnightly basis

Pipeline Spread CLOs

The construction teams in each spread will be working approximately along a 50-kilometre length at any one time. One CLO will therefore be required on each spread to liaise with communities along the pipeline route. Their role will be to:

- Meet village leaders and speak at village meetings prior to arrival of construction teams in a given locality, to inform them of the nature and length of activities in their area

- Hold fortnightly meetings with village leaders and communities while construction teams are present in their area
- Liaise with contractor staff with primary responsibility for community liaison in each work team
- Provide a focus for negotiation and resolution of specific complaints from communities if / when they arise, using the dispute resolution or grievance procedure
- Provide short weekly updates to the Community Relations Manager
- Liaise with the management of the spread team on major issues arising, and provide feedback to communities on responses to these issues

5.2 COMMUNITY RELATIONS IN OPERATIONAL PHASE

The objective of the community relations programme in this phase will be to:

- Maintain constructive relationships between communities and the pipeline operators, to assist in the operation of the pipeline
- Maintain awareness of safety issues among communities along the pipeline route
- Ensure compliance with land use constraints among land owners along the pipeline route
- Monitor community attitudes to the pipeline and operating company

There will be a telephone “hotline” that anyone with concerns about the pipeline can call. There will also be an email address and a postal address to which written comments or complaints can be sent. Clearly, however, the telephone, email and postal contacts will be of limited use to residents outside Baku and larger settlements. The Community Liaison Officer will therefore be an important link for individuals at the village level, both for registering opinions and comments and for keeping communities informed of developments, up-coming meetings and consultations.

The operator will maintain a Community Liaison team during the operational phase. The precise nature of this team has not yet been finalised. It is currently envisaged that the team will be managed by an operator staff member based in Baku, and that field members of the team will be recruited from villages along the pipeline route to perform a dedicated Community Liaison role. Members of this team during the operational phase will be required to:

- Hold quarterly meetings with communities along the pipeline route, reducing to six monthly or annual as appropriate
- Patrol the pipeline route, to ensure compliance with land use constraints
- Provide monthly reports to the pipeline operating company on issues arising from liaison with communities
- Inform the operating company immediately of major breaches of safety or land use constraints, or serious complaints from communities along the pipeline route
- In the event of decommissioning of the pipeline, liaise with communities in the 3 – 5 years prior to de-commissioning. This role would complement work carried out by the operating company and community investment team to reduce the negative impact of pipeline de-commissioning

6 **SUMMARY TABLE: CONSULTATION AND DISCLOSURE TIMETABLE**

Table 6.1 below summarises the consultation and disclosure activities that will be carried out until the end of Disclosure of the draft ESIA in mid July 2002. These are broken down for each stakeholder group. Consultation activity includes both the BTC and SCP pipelines, unless otherwise mentioned.

Table 6.1. Summary Table of Consultation and Disclosure Activities

Stakeholder Type	Environmental	Social
Authorities	<ul style="list-style-type: none"> • Preliminary (pre-scoping) consultation through meetings October 2000. • Written feedback on ESIA after disclosure, May 2002 	<ul style="list-style-type: none"> • Preliminary (pre-scoping) consultation through meetings. Written feedback on ESIA after disclosure, May 2002
Authorities, Academics, National and Local non-governmental organisations	<ul style="list-style-type: none"> • November and December 2000 • Participation in SCP scoping workshops. • Consultations on mitigation measures with specialist organisations, January 2002 • Written feedback on ESIA after disclosure, May 2002 	<ul style="list-style-type: none"> • November and December 2000 - Participation in SCP scoping workshops. • October and November 2001 - • Issues Management Workshops in Baku and Ganja • Consultations on mitigation measures with specialist organisations, January 2002 • Written feedback on ESIA after disclosure, May 2002

Stakeholder Type	Environmental	Social
Other Interest Groups	<ul style="list-style-type: none"> • One to one meetings with key academics and NGOs (intermittent) • Presentation to environmental NGOs, December 2001 • Written feedback on ESIA after disclosure, May 2002 	<ul style="list-style-type: none"> • One to one meetings with key academics and NGOs (intermittent) • Written feedback on ESIA after disclosure, May 2002
Residents	<ul style="list-style-type: none"> • General environmental questions included within baseline consultations • Environmental issues addressed in "Road Show" to ten locations on the pipeline route to discuss findings and proposals in draft ESIAs 	<ul style="list-style-type: none"> • Meetings with community leaders and representatives of every community within 4km of the proposed pipeline routes, November to December 2000 • Once the project corridor was defined, new communities that would be affected were also consulted (March and April 2001) • Consultation targeting communities in direct proximity to potential construction camps and pipe yards (August 2001) • Consultation to raise awareness of BTC and discuss proposed mitigation measures and to consult with householders/land users adjacent to AGIs (December 2001) • Consultation with communities located down stream of a proposed BTC river crossing (February 2002) • "Road shows" at 10 communities along the pipeline route to present findings from ESIA, May 2002

7 RESOURCE ISSUES: STAFF TIME AND COSTS ASSOCIATED WITH CONSULTATION

This section sets out the estimated resource implications of the proposals set out in this PCDP. It includes both staffing levels and costs associated with consultation, and has been divided into the period prior to and during construction and the post construction phases.

7.1 PRE CONSTRUCTION

The focus of consultation prior to this period is the development of the ESIA. *Section 4* outlined the specific consultation activities that have been or are planned to be carried out as part of this process.

7.1.1 STAFF TIME

The sponsor companies employ a dedicated staff of four during the pre construction phase to oversee the ESIA process and related project activity and decisions. This staff comprises 75% Azeri nationals. This team devotes a significant proportion of its time to involvement in, and support for, the public consultation process. The team is committed to participating directly in all consultation at the national level, and to participating as team members in consultation activity at local level.

The sponsor companies also employ a team of approximately 18 land staff. This team, which is 100% Azeri national, will take the lead in liaising and negotiating with individual landowners in the period immediately prior to construction. The team has been recruited at this early stage to carry out preparatory work and to enable them to familiarise themselves with affected communities. This team currently undertakes consultation activities with landowners and occupiers.

7.1.2 RESOURCE IMPLICATIONS

The SIA consultants (national and international) are responsible for public consultation at local level and also for consultation on social issues at national level. Over a period of 18 months during which the consultation has taken place, the size of the team will have varied from one permanent person to 12 people working full time at peak periods of consultation and data collection.

7.2 CONSTRUCTION AND OPERATIONAL PHASES

Section 5 outlined the consultation and public information activities that have been identified to date for the construction and operational phases. The approximate resource implications of this activity are summarised below.

7.2.1 STAFF TIME

Liaison with affected communities during the construction phase will require a team of at least seven Community Liaison Officers, employed by the Construction Contractor and the operator as discussed in *Section 5*. It is estimated that one of these will be an expatriate and that the remainder will be Azeri nationals.

The precise staff implications for the operational phase have not yet been defined. The sponsor companies are committed to maintaining a presence along the pipeline route through a smaller Community Liaison team. The current analysis is that this team will employ approximately ten staff, of whom one will be an expatriate and the remainder will be Azeri nationals, recruited from communities on the pipeline route. This level of local recruitment is consistent with both the approach and staffing levels on the Western Route.

7.2.2 RESOURCE IMPLICATIONS

The team of Community Liaison Officers will be provided by the sponsor companies.

8 GRIEVANCE MECHANISM

8.1 LOCAL COMMUNITIES COMPLAINTS PROCEDURE

8.1.1 PURPOSE & SCOPE

To ensure all complaints from local communities are dealt with appropriately, with corrective actions being implemented and the complainant being informed of the outcome. It will be applicable to all complaints received from any pipeline-affected communities.

8.1.2 RESPONSIBILITIES

The Community Liaison Officers will be responsible for collating written complaints and co-ordinating responses to all complaints.

8.1.3 PROCEDURE

General Complaints

All complaints shall be handled in accordance with the flowchart below. Both verbal and written complaints are to be entered on the Complaints Log and the Complaints Action Form (see below).

Upon receiving a complaint, all employees shall refer the complainant to the Community Liaison Officer or the HSE department. Any members of the HSE department receiving a complaint shall ensure that a Complaint Action Form is completed. The form shall then be forwarded to the Community Liaison Officer who will assign it a number. The Community Liaison Officer shall ensure that all actions are completed to close out the complaint.

If the CLO is not able to respond to or deal with a complaint directly, he/she will refer the complaint to the appropriate manager, through the CRM, or to the Construction Contractor, via the lead CLO. However, the CLO remains responsible for tracking the complaint and ensuring that it is dealt with.

Complaints Log

Ensures that each complaint has an individual number and that tracking and recording actions are carried out. It also contains a record of who is responsible for an individual complaint and records dates for the following actions:

- Date the complaint was reported
- Information on proposed corrective action sent to complainant (if appropriate)
- The date the complaint was closed out
- Date response sent to complainant

Complaints Action Form

This specifies the information required to ensure the complaint is dealt with. The form is split into four parts:

Part A Information about the complainant, the number of the complaint (taken from the Complaints Log)

Part B The complaint section, where all the details relevant to the complaint are recorded

Part C For recording the immediate action required and identifies any long term corrective action required

Part D Details how the corrective action shall be verified and signed off

8.2 RESPONDING TO A COMPLAINT

All complaints shall be responded to in writing, though a verbal response will be provided as well, if this is more appropriate under the circumstances (e.g. where the complainant can not read)

All complaints must be responded to within two weeks of being received, even if the response is just a summary of what is planned and when it is likely to be implemented. Further correspondence should be given once the complaint is closed out.

8.3 MONITORING COMPLAINTS

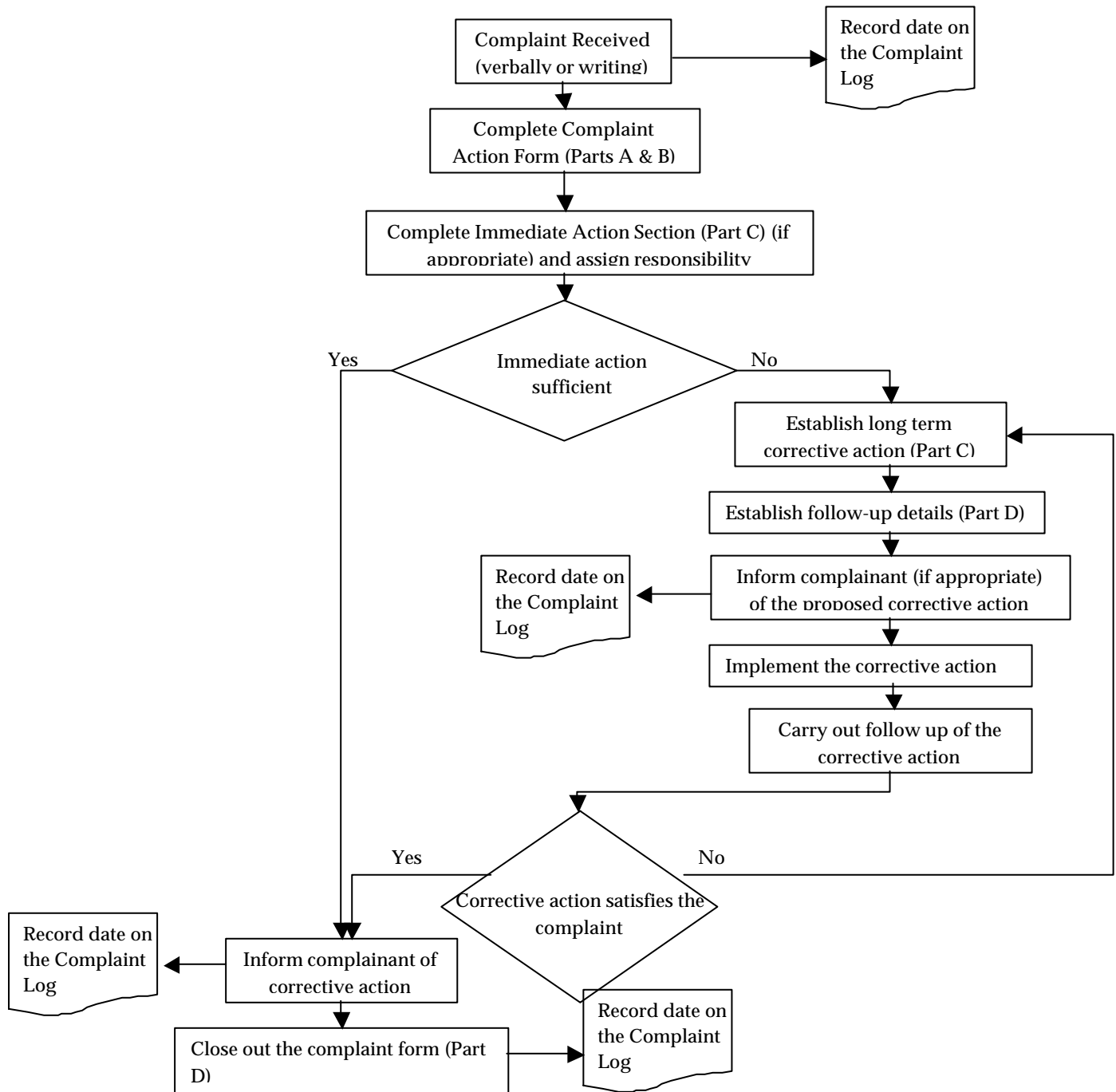
The lead CLO will be responsible for providing the sponsor companies with a weekly report detailing the number and status of complaints and any outstanding issues to be addressed and monthly reports, including analysis of the type of complaints, levels of complaints and action taken to reduce complaints.

8.4 RECORDS

The Community Liaison Officer shall file all documentation related to complaints in a file in his office. All complaint documentation shall be kept on file for two years and then archived.

Levels and types of complaints will be monitored through the Social Management and Monitoring Plan, as well as the speed which complaints are dealt with.

Figure 8.1 Complaints Procedure Flowchart



ANNEX 1

Public Consultation Materials

Questionnaire for Village Level Data (1)

This questionnaire is designed for use with community leaders as a tool for rapid acquisition of community profile data. It is estimated that completing this pro-forma will take one to two hours in meetings and village walks with village leader(s). The pro-forma should be introduced after the pipeline project and the ESIA and consultation have been introduced.

The information collected using this questionnaire will be entered onto a database and subsequently be part of the GIS system used for pipeline design and management.

1. Basic Data

1. Name of respondent(s)
2. Name of settlement ('*naselyonnogo punkta*')
3. Name of district ('*rayon*')
4. Distance from administrative (district - '*rayon*') centre
5. Nearest town (if different to this settlement)
6. GIS reference (precise geographic coordinates of the settlement)
7. Are there any separate houses in the vicinity of your village?
8. Approximate distance from the pipeline to
 - (a) nearest land plot of your settlement
 - (b) nearest house in your settlement
9. Number of houses in this settlement:
 - (a) with permanent residents
 - (b) with temporary residents
 - (c) with no residents
10. Population (including children):
 - (a) permanent resident
 - (b) temporary resident
 - (c) Internally Displaced Person/refugee
11. Population Analysis (residents)

	<i>Male</i>	<i>Female</i>	
Total			data ⁽¹⁾ / estimate
Under 5			data ⁽¹⁾ / estimate
5-18			data ⁽¹⁾ / estimate
19-59			data ⁽¹⁾ / estimate
60+			data ⁽¹⁾ / estimate

⁽¹⁾Please provide reference

12. Has the population of the village changed over the last 5 years or so?

	<i>Code</i>	<i>Reason</i>
Grown	1	
No changes	2	
Decreased	3	

2. Ethnic structure (by individual)

<i>Ethnic Groups</i>	<i>Yes</i>	<i>No</i>		<i>Number (estimate)</i>
Azeri	1	2		
Russian	1	2		
Other (specify)				

3. Religious structure (by individual)

<i>Religious Affiliations</i>	<i>Yes</i>	<i>No</i>		<i>Number (estimate)</i>
Muslim	1	2		
Christian	1	2		
Other (specify)				

4. How do people in this settlement secure their livelihood (multiple responses possible)?

	<i>Most households</i>	<i>Some households</i>	<i>No households</i>
Crops	1	2	3
Animal husbandry	1	2	3
Hunting, fishing, gathering	1	2	3
Industry	1	2	3
Trade	1	2	3
Salaries paid from state budget	1	2	3
Material aid provided by family members living outside the village	1	2	3
Social benefits (excluding Humanitarian aid)	1	2	3
Humanitarian aid	1	2	3
No permanent source of livelihood	1	2	3

5. What is the form of land ownership in the settlement (for villages only)?

	<i>Most land</i>	<i>Some land</i>	<i>None</i>
State owned	1	2	3
Municipally owned	1	2	3
Privately owned (farming, etc.)	1	2	3

6. Agriculture/fishing : Scale of settlement production

1. Please list the main agricultural products produced in the village.
2. Is agricultural produce mostly used in the village or sold outside?
3. Does the village use temporary/seasonal irrigation? If so, are irrigation canals dug in the same places every year?

7. Industry/ Commerce in the settlement

1. Please list the industry/commerce/crafts in the village (e.g. workshop, restaurants, taxis, hairdressers etc.)

8. Labour force

1. In your opinion, are there people in the settlement who take on temporary work or could take on temporary work?
2. If villagers were offered a temporary job, would they take it?
3. Are there people in this settlement qualified/experienced in pipeline construction?
4. What kind of skills do people have that could be useful to pipeline construction?
5. Are there people who belong to this settlement who have gone away for work? Approximately how many?

9. Education

1. How many students from your settlement enrolled in universities/higher education institutes this year?
2. How many schools are there in the settlement, and what are their names?
3. Where are the schools located in relation to the pipeline route?
4. Do children from the settlement go to schools outside the village? If so, where?
5. Are there any educational issues in the community, e.g. condition of schools; need for children to travel long distances to school?

10. Health

1. What are the health services in this settlement?

	Yes	No
Polyclinic	1	2
Medical Post	1	2
Private Doctor(s)	1	2
Pharmacy	1	2
Traditional medicine ('znachar')	1	2
Other (please specify)		

2. How far is the nearest hospital?

3. Are there any problems with health services/care in your settlement?

4. In your opinion, how has the health of the local population changed during the past five years?

Worsened	1
Improved	2
Remained the same	3

5. If health has deteriorated, what do you think could be the causes of this? (*Multiple responses possible*)

Insufficient food	1
Poor quality of food products	2
Poor quality drinking water	3
Inadequate sanitation	4
Ageing	5
Reduced quality in health care	6
Psychological stress	7
Worsening economic conditions	8
Other (specify)	
Don't know	9

11. Community services

1. Is electric energy provided to your settlement?

Permanently	1
Provided, but with interruptions	2
Depending on season	3
Not at all	4

2. Is there a gas line to this settlement? If yes, how regular is your supply?

Permanent	1
Provided, but with interruptions	2
No supply	3

3. Do villagers purchase gas canisters? If not, why?

Yes	1
No, we have supplies from the gas line	2
No, not available locally	3
No, too expensive	4
No, we do not use gas at all	5
Other (specify)	

4. Does your village receive water from communal supply (*vodoprovod*)? If yes, how regular is the supply?

Yes, we always receive water	1
Yes, but with interruptions	2
No, we do not receive water from communal supply	3

5. If your settlement does not regularly receive water from communal supply (vodoprovod), where do you get water from ?

Household well	1
Neighbourhood / community well	2
Stored water supply	3
Spring	4
Other (specify)	

6. Is there a communal sewerage line in this village?

Yes	1
No	2

7. Is your settlement connected to a telephone line?

Yes, most households have a telephone connection	1
Yes, but it is available only at communal points (e.g. post office, local government office, school)	2
No	3

8. How reliable are the telephone lines?

Reliable	1
Not reliable	2

9. What is the percentage of people in the settlement who use mobile phones?

10. How do the residents of this settlement dispose of their garbage?

11. Please list and describe services and infrastructures in your area:

	Yes, working	Yes, not working	No	DK
Police	1	2	3	9
Fire department	1	2	3	9
Health clinic/hospital/ emergency healthcare services (ambulances, etc.)	1	2	3	9
Schools	1	2	3	9
Child care services (kindergarten)	1	2	3	9
Post Office	1	2	3	9
Community Centre/Club	1	2	3	9
Banks /(sberkassa)	1	2	3	9
Shop/market	1	2	3	9
Public bath	1	2	3	9
Telecommunications	1	2	3	9
Sanitation (sewerage, garbage services, etc.)	1	2	3	9
Local government office	1	2	3	9

12 Problem solving

1. How are the decisions affecting the whole settlement taken (e.g. local meeting)?

13 Information sources

1. How do people in the settlement normally receive information about local and national issues and events? (*multiple choices possible*)

Television	1
Radio	2
Newspaper	3
Family and/or friends, neighbours	4
Other sources (specify)	

14. Local development

1. What are the plans for use of the land adjacent to the area for the next three years?

15. For settlements close to existing pipeline routes, worker camps, pipe yards only (less than 2 km)

	No	Yes	If yes, please describe
1. Has safety/emergency response information been provided?	1	2	
2. Have there been any incidents?	1	2	
3. Are markers all in place?	1	2	
4. Are there any issues/concerns related to the site	1	2	

5. What sort of contact do you have with the pipeline company?

16. For all settlements

1. What information do you have about the pipeline project near here?

No information before this meeting	1
Had heard rumours	2
Had heard from other sources (please specify)	3

2. What benefits, if any, do you think the construction of a new pipeline would bring to this settlement?
3. What problems, if any, do you think the construction of a new pipeline would bring to this settlement?
4. What information does this community need if a new pipeline is to be built nearby?
5. If an oil pipeline construction goes ahead, there will be a few construction personnel camps and workers may be located in the vicinity. What benefits would the village derive from construction personnel living nearby?

Money	1
-------	---

Employment opportunities	2
Other (specify)	

6. What do you think would be the main problems from their stay ? *(Please ask first without prompts, then provide examples)*

Noise	1
Increased traffic	2
Increased crime	3
Take jobs away from locals	4
Take land	5
Other (specify)	

7. If an oil pipeline is to be constructed near here, what do you think the main involvement of this settlement could be? *(Please ask first without prompts, then provide examples)*

Provide skilled labour	1
Provide unskilled labour	2
Provide food/services to workers	3
Rent house/room to workers	4
Offer specialist contribution (advice, expertise, etc.)	5
Other (specify)	

17. Summing up

1. What, in your opinion, are your settlement's **three most important problems**?
(Please ask without prompts, then show card)

<i>Problem</i>	
Poor roads - inadequate access	1
Inadequate health care	2
Inadequate schools	3
Inadequate housing	4
Inadequate child care services	5
Poor drinking water supply	6
Unsafe sanitation	7
Poor drainage	8
Inadequate irrigation	9
Inadequate telecommunications	10
Crime	11
Political problems	12
Ethnic conflicts	13
Land conflicts	14
Lack of employment opportunities	15
Lack of money	16
Other (specify)	

2. What are the **three best things** about (settlement name)?

Thank you very much for your co-operation and for spending your time answering our questions.

Individual Qualitative Interview

Oil Vs Gas Pipeline
Guide and Questionnaire (5)
Azerbaijan-November/December 2001

Introduction

The Government of Azerbaijan and BP (international petroleum and petrochemicals group) are discussing the possibility of constructing two pipelines (one oil and one gas) from terminals near the Caspian Sea, through Azerbaijan, and subsequently to Georgia and Turkey. The pipelines will be located side by side, largely along a route common to the existing Western Route Export Pipeline (WREP).

Before any decisions can be made it is important for all involved to learn more about life in your and others' towns/settlements, both near to the suitable sites and close to any adjoining roads.

This interview is part of a major study being done in Azerbaijan that looks at both environmental and social issues and concerns for the entire pipeline project. In addition to interviews like these, we are also collecting data through meetings with community leaders, and we have also interviewed people in all the settlements close to the actual route of the pipelines.

So, although a number of the pipeline route questions may not be applicable to you, we would be interested in your views concerning both the oil and gas pipelines. Your input will be very valuable to the decision-making process, and because any information you provide will be kept anonymous, all of your answers will be strictly confidential.

General Information

First, I'd like to ask you a few questions about yourself, your household, and your town.

1. How long have you been living in this settlement? In this house? *(If respondent was born in the settlement, also ask how long their family has lived there.)*

Ask people who have been living in the settlement for over 5 years

2. Have there been any big changes in this settlement over the last five years? For example did certain groups of people leave the settlement? Are there people who have moved to the area from other areas?

Unless otherwise mentioned: Do you think population in this town has increased or decreased over the last five years or so?

Ask every interviewee

3. How do you assess your families' standard of living? Do you think the standard of living of your family is better, same or worse than that of the majority of families in this area?
4. What provides the main income to your family?
5. What are the main items of expenditure for your family?
6. Do you think that there are possibilities for economic development in this town? What are they?
7. Do you or any members of your household take work outside this town? If so, what types of work? Where? Would you or other members of your settlement like to work outside your settlement?
8. Does any member of your family live or work permanently outside of this settlement? Where - elsewhere in Azerbaijan or outside the country?
9. What do you consider as the best thing about living here? Why?
10. Are there any cultural or historical monuments here or are there any important environmental sites?
11. Do people get on well together in this region? How do disputes get resolved?
12. What do you think are the biggest problems in this town and why do you think so? How do you think they might be solved?
13. What do you consider to be the best sources of information about local and national issues here? What kind of information seems most reliable to you?
14. How do people here usually communicate with each other? Do they have any permanent gathering places?
15. How do people usually communicate with members of the local government?

Infrastructure

Now I'd like to ask you about your opinions on local services and infrastructure.

16. Do you have regular access to electricity? If so, what do you use it for? If not, do you consider the lack of electricity a big problem for your household?
17. Do you use gas? Piped or from canisters? If you use gas, what do you use it for (e.g. cooking, lighting)? If you do not use gas, is this a problem for you?
18. How do you get water? How would you describe your water situation: do you have enough for household purposes? How about for agricultural purposes?
19. How would you describe the conditions of roads in and around your town? Are roads, or the lack of them, a problem for your household? Why?
20. Do members of your household usually receive medical care locally? If so, from where (e.g. polyclinic, traditional doctors)? If not, where and how do you receive medical care? How would you describe local healthcare services? What is most problematic about medical treatment here? What is best about healthcare here?
21. Are fires a problem in your area? If yes, how do you deal with them? Are you capable of extinguishing fires? If yes, how: through family, fire brigade or neighbours?
22. Do you have schools in your settlement? What kind of problems does your settlement have with education? Are the schools in this area getting better, worse or remaining the same?
23. What kinds of industrial facilities are there in your area? Are these facilities still operational?
24. Is there a sewerage system in your area of residence? If not how do you dispose of waste water? Is this a problem?
25. Where do you dispose of garbage/ waste? Is this a problem?
26. What would you say the biggest infrastructure problems (including schools, medical care) are here? What are the things that work best?

Land Issues

Let's talk about land - I'd like to ask you about how your and other households here use land.

27. Does your household own land here? How do you use this land? For example, do you grow any kinds of crops or raise animals on it? What is your land ownership form?
28. Do you or any members of your family hunt or fish? Are hunting and fishing important sources of food for your household? What time of year is most profitable for these activities?
29. Does most of your food come from your own farming and fishing or is it purchased?
30. Is there a forest in the vicinity of your settlement? How do you use the forest resources?

Oil pipeline first, then possible a gas pipeline second

As I mentioned earlier, it is possible that construction of an oil pipeline will begin in your area late next year, rather than a gas pipeline which had been proposed earlier. A second pipeline for gas may then be built immediately after the completion of the oil pipeline. This means that there could be construction in your area for up to three years. However, following construction, both the pipelines will be buried.

I would like to ask you about your opinions regarding the potential oil pipeline construction process and the idea of the two pipelines themselves.

31. Are there any pipelines in your area now?
32. Aside from what I've told you, have you heard anything about plans for building an oil pipeline in your area? What kinds of things have you heard? Where have you heard them?
33. In general, would you support the presence of an oil pipeline in your area? Why or why not?
34. In general, would you support the presence of a natural gas pipeline in your area? Why or why not?
35. How do you think the presence of an oil pipeline could benefit you and your village?
36. What problems do you think a new oil pipeline could bring to this settlement or to you?
37. Understanding that a lot of work will be carried out to construct a pipeline and facilities here, what are your biggest concerns about the potential

construction process? For example, would you be worried about noise or other possible disruptions?

38. What do you think would be the main concerns in your settlement(s) in relation to the use of land during the construction phase?

39. If the pipeline is to be constructed in your settlement area, what do you think should be your involvement or the involvement of others?

Now I'd like to ask you about the possible construction of two pipelines.

40. What do you think the main impacts would be (positive and/or negative) if two pipelines are constructed?

41. What do you think the main impacts would be (positive and/or negative) if the use of land in the pipeline corridor for construction of the pipeline continues for up to three years?

42. How could the impact of the construction of two pipelines be improved?

43. How would you like to receive information in future about the possible pipelines and their construction?

44. Do you have any further comments about any of the things we've discussed today?

Thank you very much for your time.

AGT Project Leaflet: English

Some common concerns:

Will the pipelines be safe?

Yes. The pipelines will be built to the highest international standards, and will pose no threat to nearby residents.

Will the pipelines be visible after it has been built?

No. The pipelines will be buried and the land will be restored. There may also be several above ground facilities on the pipeline route, such as compression and valve stations. No trees or large shrubs will be allowed to grow on the pipeline route.

What will happen to the land following construction of the pipeline?

The land will be restored to minimise environmental impacts along the route, and an ongoing programme of monitoring and reporting will be implemented. Owners of adjacent land will be consulted and informed with respect to access to the pipeline route following construction.

Will local people benefit from the pipeline?

Yes. There may be employment opportunities during construction. In addition, local communities will benefit from indirect employment opportunities through the provision of

Contact BP:

For further information, please contact the following BP representative.

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Project Development
Manager, AGT Pipelines
Project**

**BP Group
ADDRESS to COME**

**Baku
Azerbaijan**

**Tel: (994 12) ;
97 90 00 (switchboard)**

**Fax: (994 12) ;
97 97 37**

Your comments will help us to ensure that we act in an environmentally and socially responsible manner, in accordance with the laws of Azerbaijan and with our own high standards and corporate policies.

INSERT BP LOGO

Insert SD and BTC Logos also

BP Exploration

**Environmental and
Social Impact
Assessment of the
Azerbaijan, Georgia
and Turkey (AGT)
Pipelines.**

This leaflet forms part of BP's ongoing programme of public information and consultation in Azerbaijan. This consultation is being undertaken as part of an overall programme of environmental and social impact assessment on the AGT pipelines project.

Further opportunities to provide comment through additional consultation will be advertised in due course.

services to construction teams.

Project description:

The Azerbaijan-Georgia-Turkey (AGT) Pipeline Project comprises two pipelines (one oil and one gas) from the Caspian Sea, through to Turkey. Within Azerbaijan, the pipelines will be located side by side, largely along a route common to the existing Western Route Export Pipeline (WREP - see map). The construction of the two pipelines will take approximately 3 years assuming the construction of the gas pipeline follows on immediately from the oil pipeline construction.

Construction of the gas pipeline is scheduled to start in the Spring of 2003.

About BP:

BP is one of the world's largest petroleum and petrochemicals groups, with well-established operations in over 100 countries in Europe, North and South America, Asia, Australasia and Africa.

Our main activities are exploration and production of crude oil and natural gas; refining, marketing, supply and transportation of oil and gas; and manufacturing and marketing of petrochemicals. We have growing activities in gas production and power generation, including solar power.

BP is leading the engineering work for the AGT pipelines project on behalf of its corporate Partners for both the oil and gas pipelines.

BP's policy on social and environmental protection:

BP aims to operate in a socially and environmentally responsible way, respecting the cultures and rights of individuals in the different countries in which we work.

We seek to create mutual understanding and build constructive relationships with local people and non-governmental organisations with an interest in our business and concerns about its impact on individuals, society and the environment.

BP also supports social development initiatives all over the world, including community development, education and environment projects.

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ANNEX 2

Stakeholder Listing

Stakeholder Organisations

SOCAR

Azerigas

AzETLGaz

Azerigaznagl

Minister of Internal Affairs

Key Members of Parliament

Ministry of Culture

Geipromorneftegas

Former State Committee for Ecology

State Caspian Inspectorate

State Committee for Geology

Department of Nature Reserves

State Land Committee

Division for the Control of Land Utilisation

Caspian Environment Programme

Research and Monitoring Group

Institute of Archaeology and ethnography, Azerbaijan Academy of Sciences

Institute of Botany

Institute of Geography

Institute of Geology

Baku State University

ISAR

Ruzigar Society

Ecoenergy Academy

Women and Development

Greens Movement

Great Silk Road Project

Greens Movement

Information analytical centre ECORES

TETA "HAZRI"

Environmental Juridical Centre ECOLEX

International Public Centre of Study of Local

Folk Lore and Ecological Tourism "Caucasus"

Azerbaijan Centre of Birds Protection

Scientific and Research Society "ECOIL"

For Clean Caspian Sea

ECOSCOP

Pilgrim

Group of Rehabilitation of Nature

Azerbaijan National Committee on International

Hydrologist programme

Public Ecological Foundation

Voice of Azerbaijan

Stakeholder Organisations

Centre "Human & Environment"

Hayajan

Azerbaijan Greens Movement

Ruzigar Society

Mammologists of Azerbaijan

AREAT Research Center

Azerbaijani Sociological Association

Inam Center for Pluralism

Azerbaijan Woman and Development Center

Ecolex – Azerbaijan Environmental Law Center

Human and Environment Azerbaijan Public Association

Azerbaijan AIDS Association

Women in the Oil Industry of Azerbaijan

Ruzigar Ecological Social Union

Himayadar Humanitarian Organization

Legal Education Society

Caspian Environment Programme (international)

ISAR (international)

CHF (international)

Save the Children (international)

OXFAM (international)

ACDI-VOCA (international)

Ana Kur International Ecological Society

Ganja Agrobusiness Association

The Center of Young Leaders

Tomris Mother Society

Debate in Civil Society Resource Center

Bridge to the future Youth Union

Helsinki Citizen's Assembly

Odjag Humanitarian Union

City Hall (Mayor's Office), deputy mayor for social and economic affairs

AIDS organization in Sanitary and Epidemic Station of Ganja, doctor-in-chief

Technological University

"Avicenna" medical NGO, head

Municipality, chairman

Helsinki Assembly on Women

Rights, head

ACDI-VOCA (international)

ISAR (international)

PART 1: PROJECT CODES AND STANDARDS

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1. PROJECT DESIGN CODES AND STANDARDS

1.1 PRIMARY CODES

The primary codes for the design and construction of the SCP pipeline are:

- ASME B31.8 Gas Transmission and distribution pipeline systems (1999 Edition).

Generally the API / ASME & BSI codes will be utilized..

1.2 SUPPLEMENTARY CODES

The principal supplementary codes and standards upon which the engineering phase has been based are listed below in terms of:

- a) the principal codes/standards being used for design
- b) the principal national standard from where additional codes/standards may be obtained

Table 1-1: Supplementary codes and standards

Witness
OREDA-97 (Offshore Reliability Data)
OREDA – Phase IV, 2001 (Offshore Reliability Data)
Mechanical
American Society of Mechanical Engineers (ASME)
• ASME VIII Latest Edition
American Petroleum Institute (API)
Supplemented by the following where appropriate:
• National Fire Protection Association (NFPA)
• NFPA 20
• National Association of Corrosion Engineers (NACE)
• American Society of Testing of Materials (ASTM)
• International Standards Organisation (ISO)
• ISO 3046 Diesel Engines
• British Standards Institute (BSI)
• Chartered Institution of Building Services Engineers (CIBSE)
Loss Prevention
Institute of Petroleum (IP)
National Fire Protection Association (NFPA)
British Standards Institute (BSI)
Underwriters Laboratory (UL)
Factory Mutual (FM)
Industrial Risk Insurers (IRI)
American Petroleum Institute (API)
MET (Material Engineering Technology)
The design codes used by during the engineering design programme to date are as follows:

Table 1-1: Supplementary codes and standards

<ul style="list-style-type: none"> • API 5L: Specification for Line Pipe – 42nd Edition Jan 2000 • ISO 12094: Welded Steel Tubes for Pressure Purposes – Ultrasonic Testing for the Detection of Laminar Imperfections in Strips/Plates used in the Manufacture of Welded Tubes. • SNT-TC-1A: American Society of Non-Destructive testing, Standard for Qualification and Certification of Non-Destructive Testing Personnel
Principal National Body
American Petroleum Institute (API)
Supplemented by the following where appropriate:
<ul style="list-style-type: none"> • American National Standards Institute (ANSI) • American Society of Mechanical Engineers (ASME) • American Society of Non-Destructive Testing (ASNT) • American Society of Testing and Materials (ASTM) • International Standards Organisation (ISO) • Manufacturers Standardisation Society (MSS) • National Association of Corrosion Engineers (NACE) • Steel Structures Painting Council (SSPC)
Process / Hydraulics
American National Standards Institute (ANSI)
Piping
<ul style="list-style-type: none"> • Institute of Petroleum, Model Code of Safe Practice, Part 19, Fire Precautions at Petroleum Refineries and Bulk Storage Installations • IM 2.5.2 June 3 1996 Hazard Classification of Process Operations for Spacing Requirements
Supplemented by the following where appropriate:
<ul style="list-style-type: none"> • American National Standards Institute (ANSI) • American Petroleum Institute (API) • American Society of Testing and Materials (ASTM)
Control Systems
American Petroleum Institute (API) Hardware Installation
International Electrotechnical Commission (IEC) Electrical Installation & certification
National Fire Protection Association (NFPA)
<ul style="list-style-type: none"> • IEC 61508
Supplemented by the following where appropriate:
<ul style="list-style-type: none"> • American Society of Testing and Materials (ASTM) • American Society of Mechanical Engineers (ASME) • British Standards Institute (BSI) • European Economic Community (EEC) • Instrument Society of America (ISA) • International Standards Organisation (ISO)
Electrical
IP 15
IEC
BSI when above are not applicable

Table 1-1: Supplementary codes and standards

Telecommunications
International Telecomms Union (ITU)
• ITU-T ReC G707: Synchronous Digital Hierarchy
• ITU-T G705: Characteristics Required to Terminate Digital Links on a Digital Exchange
• ITU-T G703: Physical / Electrical Characteristics of Hierarchical Digital Interfaces
• ITU-T G652: Characteristics of Surface Mode Simple Mode Optical Fibre Cable
Supplemented by the following where appropriate:
• International Electrotechnical Commission (IEC)
• International Standards Organisation (ISO)
• European Telecommunications Standards Institute (ETSI)
• Normalised Standards of the European Union (Euronorms) (EN)
• British Standards Institute (BSI)
• American National Standards Institute (ANSI)
• Institute of Electrical and Electronic Engineers (IEEE)
• Electronic Industries Association (EIA)
• Telecommunication Industries Association (TIA)

CULTURAL HERITAGE MANAGEMENT PLAN

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1 CULTURAL HERITAGE MANAGEMENT PLAN

1.1 SCOPE

This plan describes the management of archaeological and cultural features that are on or close to the route of the SCP project through Azerbaijan. The SCP corridor is 442km long within Azerbaijan, extending from the terminal at Sangachal to the Azerbaijan/Georgian border.

The cultural heritage of an area may be profoundly affected by a large-scale construction project, if it is not handled sensitively. With careful management, however, it is possible to complete the project with minimal impact on the cultural resources and, in addition, provide a substantial increase in the quantity of archaeological evidence available for a region.

This Cultural Heritage Management Plan and its supporting information has been developed as part of the ESIA process and in line with the Azerbaijan law and the environmental standards of international lending agencies. Specifically, the Plan complies with the International Finance Corporation (IFC) Operational Note OPN 11.03 (1986) entitled 'Cultural Property'. It is the policy of SCP Co. to advance the objectives of cultural heritage protection in all of its projects and to comply with all specific applicable national and international heritage requirements.

1.2 REGULATORY FRAMEWORK

Archaeological monuments are under state protection in Azerbaijan. The monuments of Azerbaijan are divided into three classes according to their importance:

- Monuments of worldwide importance: 64 architectural and archaeological monuments are currently listed
- Monuments of national importance: Includes 583 architectural monuments and 3109 archaeological monuments
- Monuments of local importance: These comprise 3318 architectural monuments, 195 monuments of garden-and-park culture and landscape architecture, and approximately 2000 archaeological monuments

A number of national reserves have been established by the Order of the Cabinet of Ministers of the Azerbaijan Republic. Currently, 14 historical-and-architectural, historical-and-archaeological, historical-and-cultural, and historical-and-ethnographical reserves exist. Portable artefacts are also protected and are the property of the State.

The relevant legislation of the Azerbaijan Republic for the protection of cultural heritage is the Law on "*Protection and Utilisation of the Cultural and Historical Monuments*". This states

:

"Article 18, Archaeological Studies on the Territories of New Constructions.

The governmental and non-governmental enterprises/ companies/ organisations carrying out a construction and economic activity shall apply to the adequate governmental bodies and the Azerbaijan Academy of Science at the stage of feasibility studies. In the case of the presence of an archaeological monument on the territory concerned, the enterprise/company/organisation

carrying out construction works shall make a contract with the Academy of Science and provide for the investigation of the archaeological monument at its own expense. It is prohibited to carry out the construction and economic activity without the adequate scientific measures.”

The legislative arrangement has recently been altered to ensure that the Ministry of Culture is responsible for issuing permits for the excavation of archaeological and heritage sites. Decisions on the granting of this permission are made following advice from the Academy of Sciences.

1.3 ARCHAEOLOGICAL STRATEGY FOR THE SCP PROJECT IN AZERBAIJAN

The archaeological strategy for the SCP project in Azerbaijan is shown below:

Phase 1 Baseline Surveys including desktop studies, walk through surveys and examination of aerial photographs leading to the development of a Cultural Heritage Management Plan

Phase 2 Intrusive work-trial pits and preliminary investigation

Phase 3 Full investigation of threatened sites

Phase 4 Activities during construction, watching brief and excavation of newly discovered sites

Phase 5 Post construction work, analysis of finds, archiving and reporting, dissemination of the results of the work by various means

Due to the construction of the BTC pipeline prior to the SCP, but parallel to it, the scale of work in phase 2 will be reduced, as much of it will be undertaken for the BTC project. This will mean that there should be much improved archaeological information to predict areas of archaeological significance.

This document represents the Cultural Heritage Management Plan. It describes how each element of the strategy has been, or will be, implemented during the course of the project. This is a live document and will be updated as the project progresses.

1.4 ARCHAEOLOGICAL STRATEGY PHASE 1: BASELINE SURVEYS

Table 1-1 Participation in Baseline Surveys

PARTICIPATION IN BASELINE SURVEYS	
Purpose:	Preliminary, non-intrusive, identification and recording of known or potential archaeological sites within the SCP pipeline corridor. Ranking of sites in terms of importance
Who:	Institute of Archaeology and Ethnography (IoAE) (various) Environmental Representative on topographic survey (Nigel Buchanan) SCP Project archaeologist (Dave Maynard) Aerial photographs (Rog Palmer)
When:	Completed, assuming no further re-routes (August 2000 – July 2001)

Table 1-1 Participation in Baseline Surveys

PARTICIPATION IN BASELINE SURVEYS	
Where:	Pipeline corridor in Azerbaijan
How:	Archaeological participation in all baseline surveys GPS recording and annotation onto maps of all potential sites Including an archaeological specialist on the topographic survey Meetings and discussions between SCP Co. and IoAE Field survey of key sites by Project archaeologist and IoAE
Deliverables:	All potential sites listed, described, and locations recorded using GPS and entered onto the GIS system Photographic record of all potential sites Minor route modifications to avoid sites Agreed list of key sites requiring additional pre-construction work List of key Cultural Heritage concerns in ITT for construction contract

Representatives of the Institute of Archaeology and Ethnography (IoAE) have participated in all baseline surveys conducted along the SCP corridor.

These surveys have identified approximately 70 potential sites on, or close to the proposed pipeline route. These sites range in character from extensive deposits of stratified material covering many periods to simple spreads of pottery. The extent and nature of many of the sites is not yet known. The identification of a site is at present based upon the recognition of cultural material on the surface or other indications. There is also the potential for other sites, as yet unknown, to be found during work along the pipeline route.

The baseline survey work has followed a phased approach following the gradual selection and improvement of the pipeline routing and design as summarised in Table 1-2.

Table 1-2 Baseline surveys

SURVEY DATES	SURVEY COVERAGE
August 2000	Survey of existing Western Route Export Pipeline
August 2000	Survey of existing Azerigaz pipeline
January-February 2001	Survey of re-route sections
March-April 2001	Archaeological input to topographical survey of proposed SCP pipeline corridor
July 2001	Archaeological surveys of key sites with SCP Co. project archaeologist
January 2002	Examination of aerial photographs

The initial surveys conducted in August 2000 involved a representative of the IoAE working as part of a wider environmental team on a survey of the length of the proposed pipeline corridors (as known at the time). The archaeological objective of these relatively rapid surveys was to identify and record all potential or known sites within the corridor.

A similar exercise was conducted in January 2001 along re-routed sections, where no coverage was available from the August surveys. This work reflects the requirement to maintain a comprehensive coverage of data as the project design evolves.

The next stage in baseline work involved a more comprehensive assessment of each of the potential sites, and an initial decision on the most appropriate management of the site. In March 2001 a representative of the IoAE accompanied the topographical survey team along the proposed pipeline corridor. The overall aim of the topographic survey was to fine-tune the route of the pipeline within the defined corridor. The archaeological objective was to look at each of the known or potential sites identified during earlier work, and to select the most appropriate management option for that site. Options included:

- No additional work; pipeline construction to continue as normal
- Archaeological watching brief during construction
- Re-route of pipeline to avoid the site
- Intrusive work prior to construction

The preferred option was to re-route the pipeline to avoid potential sites wherever feasible, thereby avoiding any impacts upon features from construction or excavation activities. In some cases this was not possible given other engineering, routing or environmental constraints, or the perceived surface extent of the site.

This work has been followed by the development of the Cultural Heritage Management Plan for the Project as shown in Table 1-3

Table 1-3 Development of Cultural Heritage Management Plan

DEVELOPMENT OF CULTURAL HERITAGE MANAGEMENT PLAN	
Purpose:	To describe how Cultural Heritage issues will be managed during the design and construction of the SCP s Project
Who:	SCP ESIA Manager (Phil Middleton) SCP Project archaeologist (Dave Maynard)
When:	Finalised for issue with ITT for construction (end October 2001) Live document – to be regularly updated.
Where:	Produced in Baku and UK
How:	Initial draft prepared by Dave Maynard, based on WREP AMP Comments provided by Project ESIA team Amended and updated by Phil Middleton. Rev 01 issued for further comment
Deliverables:	AMP as supporting document for construction ITT

The potential sites have been assessed and ranked in terms of potential significance, using the methodology described above. This has resulted in a list of areas that will be subject to more detailed, pre-construction, archaeological assessment as part of Phase 2 of the Archaeological Strategy for the SCP project. These sites have been identified in the ‘Environmental Construction Constraints and Concerns – Azerbaijan’, a document issued with the construction ITT and are listed in the section below.

The intensive study of a fairly wide corridor across Azerbaijan has confirmed the records of known sites and identified many new areas. The recognition of the intensive occupation of the

area through which SCP will pass as one where there has been intensive settlement for the past several thousand years will require further study in order to record the evidence to be found on the pipeline route.

1.5 ARCHAEOLOGICAL STRATEGY PHASE 2: TRIAL TRENCH INVESTIGATION OF POTENTIAL SITES

The provisional list of areas where trial investigations on the SCP route are needed was identified in Phase 1. Further locations will be added to this list as areas of rerouted pipeline are surveyed and the understanding of the archaeology along the route progresses. Other areas of potential archaeology may be examined at a later stage.

The locations identified for work with the SCP project are:

Gobustan (KP9-11) Sites 4, 5, 6
Kazi-Magomed (KP54) Sites 21, 22
Yevlakh (KP221) Sites 52, 53, 54
Neymatabad (KP236) Site 56
Mingechaur (KP248) Site 57
Nadirkand (KP276) Site 59
Dalimamedli (KP280) Site 60
Zayamchai (KP355) Sites 111, 112, 113
Girag Salakhli (KP405) Site 138

The aim of the trial trenching operation is to define the nature and extent of the archaeology in those locations. Following this, an appropriate mitigation measure will be prepared; this may include a change of the pipeline route, the excavation of affected features or no further work being needed at this location.

For each of the areas identified, a method statement will be prepared showing the following:

- The location and description of the site
- Details of pipeline construction requirements
- Extent and duration of the proposed archaeological works
- Ownership details of the land
- Access arrangements to the site
- Health and Safety requirements specific to the site
- Contact details for the SCP staff
- Contact details for other pipelines and services specific to the site

1.6 ARCHAEOLOGICAL STRATEGY PHASE 3: INVESTIGATION OF SITES

Once the areas of significant archaeology have been defined and the appropriate mitigation strategy defined, the full excavation of the features will commence. The work will be limited to the area where features will be impacted by construction and may extend to the limits of the pipeline right-of-way.

A method statement will be prepared for these sites as that outlined for the trial trench work. As this work will involve the actual disturbance of archaeological deposits (rather than potential

disturbance in the case of trial trenching) a permit for the conduct of archaeological excavations will be required from the Ministry of Culture.

1.7 ARCHAEOLOGICAL STRATEGY PHASE 4 PIPELINE CONSTRUCTION ACTIVITIES

A suitably qualified field archaeologist shall accompany each construction team. The function of this archaeologist is

- Provide advice to survey and right of way teams in the area of known archaeological sites
- Record archaeological features discovered during pipeline construction activities
- Provide advice to the construction superintendent on the significance and implications of new archaeological discoveries on the pipeline route

The following guidance shall be followed in the event of new archaeological discoveries.

1.8 ARCHAEOLOGICAL DISCOVERIES OF MINOR SIGNIFICANCE

This type of archaeological discovery would be of fairly small size, such as an isolated feature or findspot. It is anticipated that the Construction Archaeologist should be able to adequately record the feature by himself. The discovery should provide no delay or hindrance to the construction process.

The discovery will be reported by the Construction Archaeologist to the Construction Superintendent at the earliest convenient opportunity, and then to the Institute of Archaeology and Ethnography, Baku and SCP Environment Department, probably on a monthly basis.

1.9 ARCHAEOLOGICAL DISCOVERIES OF LOCAL SIGNIFICANCE

This type of archaeological discovery would be of small to medium size, such as a group of features or single burials. The Construction Archaeologist would be unable to record the discoveries by himself. Assistance would be required in the form of other archaeologists or labour to assist in the excavation and recording of the discovery. The discovery, and the recording process, may cause a limited disruption to construction activity, although mainline activities should continue. Arrangements may need to be made to demarcate the archaeological deposits from construction vehicles to prevent damage.

The discovery will be reported by the Construction Archaeologist to the Construction Superintendent immediately, who will then inform the SCP Environment Department, who will pass on the information to the Institute of Archaeology and Ethnography. Appropriate arrangements will have been made prior to this time for a small team of archaeological technicians, who may be despatched to assist in the recording of the features.

1.10 ARCHAEOLOGICAL DISCOVERIES OF MAJOR SIGNIFICANCE

This type of archaeological discovery would have fairly major significance such as a settlement site or group of burials. The archaeological features would cover the working width of the pipeline easement such that construction vehicles and equipment would not be able to pass down the right of way without causing damage to the archaeological deposits. The excavation and recording of these deposits may take a considerable period of time and cause some disruption to construction activities, which may need to find an alternative right of way in the vicinity of the site.

The discovery will be reported by the Construction Archaeologist to the Construction Superintendent immediately, who will then inform the SCP Environment Department, who will pass on the information to the Institute of Archaeology and Ethnography. Appropriate arrangements will have been made prior to this time for a small team of archaeological technicians, who may be despatched to assist in the recording of the features.

1.11 ARCHAEOLOGICAL STRATEGY PHASE 5 POST CONSTRUCTION ACTIVITIES

Following the completion of major earthmoving activities, a short report shall be prepared by the Institute of Archaeology and Ethnography for SCP Environmental Department. The report shall outline the results of the archaeological monitoring of construction. The report will contain proposals for the processing and analysis of archaeological material found on the pipeline. The proposals shall indicate, the need and extent to which publication of results of the archaeological studies is required. This publication may include all the phases of the archaeological study of the pipeline route.

Table 1-4 Identified Archaeological Sites Close to the Pipeline (route 9)

SITE	NAME	KP	DATE	TYPE	COMMENTS
1	Sangachal	1	Medieval	Pottery scatter	Features identified during survey of Sangachal terminal, there are a number of different sites identified here in the various surveys, all consisting of pottery scatters
2	Karadag	1			
3	Sangachal	3	Medieval	Brick scatter	
4	Jeirankechmaz 1	8	Medieval	Pottery scatter	Within Gobustan Reserve
5	Jingirdag	10	Medieval	Pottery scatter	Within Gobustan Reserve
6	Azraildag	10	Medieval		Within Gobustan Reserve
10	Koch Nohur 3	14			
12	Djingir 1	16	Medieval	Pottery and brick scatter	
13	Djingir 2	16	Medieval	Pottery scatter	
14	Turagay	24	Medieval	Pottery scatter	
15	Kazi Magomed 1	49	Medieval	Pottery scatter	
16	Turagay	49	Medieval	Pottery scatter	
17	Kazi Magomed 2	50	Medieval	Pottery scatter	
18	Kazi Magomed 3	51	Antique, Medieval	Pottery scatter	
21	Kazi Magomed 4	53	Medieval	Pottery scatter	Site 21 lies in an area of many Azerigaz facilities.
22	Kazi Magomed 5	54	Medieval	Pottery scatter	Site 22 lies in an area of many Azerigaz facilities.
26		71	Medieval	Pottery scatter	
35	Kerrar	87	Medieval	Pottery scatter	Pottery scatter around which the pipeline has been re-routed
47	Ali Bayramli	159	Medieval	Pottery scatter	
50	Laki	210	Medieval	Pottery scatter	
52	Lacky	220	Medieval	Pottery scatter, graveyard	The route appears to lie in an area of former river channel leading to an ox-bow lake
53	Yevlakh 1	220	Medieval	Pottery scatter	Possibly in former river channel

Table 1-4 Identified Archaeological Sites Close to the Pipeline (route 9)

SITE	NAME	KP	DATE	TYPE	COMMENTS
54	Yevlakh 2	221	Medieval	Pottery scatter	
56	Neymatabad	235-237	Medieval	Pottery scatter	Intensive spread of pottery over the pipeline route extends around 500m along the pipeline
57	Mingechevir	247-250	Medieval	Pottery scatter	Pottery spread, few in number but extends up to 1Km along the WREP
58	Goran	257	Medieval	Brick and pottery scatter	Bricks lying in ploughed field east of Goranchai, nothing is visible in the vicinity of the river crossing, there are former quarry workings or river erosion products in the area to the west of the river
59	Nadirkand	276	Medieval	Settlement mound	Settlement (tepe) mound through which the WREP passes. The pipeline passes through a cultivated field to the south west of the tepe.
60	Dalmamedli 1	280	Medieval	Pottery scatter	Pipeline re-routed to the west, but the pottery scatter continues
62	Sarab	285	Medieval	Pottery scatter	
65	Guneshli	287	Medieval	Pottery scatter	
67	Fahrly	289	Medieval	Pottery scatter	
68		289	Medieval	Pottery scatter	
70		290	Medieval	Pottery scatter	
71		291	Medieval	Pottery scatter	
72	Korchay	291	Medieval	Pottery scatter	
73	Agasybeyli	292	Medieval	Pottery scatter	
74		293	Medieval	Pottery scatter	
76	Ali Bayramli	295	Antique, Medieval	Pottery scatter	
77		295	Medieval	Pottery scatter	
78	Ganchai 1	295	Medieval	Pottery scatter	
81	Hodjaly 1	300	Medieval	Pottery scatter	
82	Hodjaly 2	301	Medieval	Pottery scatter	

Table 1-4 Identified Archaeological Sites Close to the Pipeline (route 9)

SITE	NAME	KP	DATE	TYPE	COMMENTS
83	Yenikend 1	301	Medieval	Pottery scatter	
84	Yenikend 2	302	Medieval	Pottery scatter	
85	Hodjaly 5	302	Medieval	Pottery scatter	
86	Hodjaly 6	303	Medieval	Pottery scatter	
88	Samukh 2	305	Medieval	Pottery scatter	
96	Qarasu	320	Medieval	Pottery scatter	
97	Shamkir Memorial	328	Medieval	Pottery scatter	
101	Shamkir Memorial 3	335	Medieval	Pottery scatter	
103	Shamkir 4	347	Medieval	Pottery scatter	
104	Shamkir 1	348	Medieval	Pottery scatter	
105	Shamkir 3	348	Medieval	Pottery scatter	
106	Shamkir 2	350	Medieval	Pottery scatter	
108	Shamkir 5	350	Medieval	Pottery scatter	
110	Zayem 1	354	Medieval	Pottery scatter	
111	Zayem 2	355	Neolithic to Medieval	Settlement mound	Extensive Neolithic to Medieval settlement deposits up to 1.5m deep visible. A reroute of the pipeline to the south west avoids main features
113	Zayamchai 1	356	Bronze Age	Pottery scatter	Bronze Age settlement, lies ?20m north of pipeline
114	Zayamchay Vadnal	356	Bridge remains	Bridge remains	100m distant from pipeline crossing of Zayamchai
116		357	Medieval	Pottery scatter	
118	Diyarly	358	Medieval	Pottery scatter	
119	Asagi Ayibli 1	358	Medieval	Pottery scatter	
121	Asagi Ayibli 2	360	Medieval	Pottery scatter	
122	Asagi Ayibli 3	361	Medieval	Pottery scatter	
123	Asagi Ayibli 4	362	Medieval	Pottery scatter	
124	Asagi Ayibli 5	362	Medieval	Pottery scatter	
133		390	Medieval	Pottery scatter	

Table 1-4 Identified Archaeological Sites Close to the Pipeline (route 9)

SITE	NAME	KP	DATE	TYPE	COMMENTS
134	Girag Kasamanly	399	Medieval	Pottery scatter	
135	Girag Kasamanly 2	400	Medieval	Pottery scatter	
138	Girag Salakhli	405	Antique, Medieval	Cemetery, settlement mound	
139	Girag Kasamanly 2	407			
150		422	Medieval	Pottery scatter	Recent dump of material, includes asbestos, no features visible in river bank
156	Beyouk Kesik 4	437	Medieval	Pottery scatter	

AERIAL INTERPRETATION REPORT

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1 ARCHAEOLOGY FROM AERIAL PHOTOGRAPHS

1.1 SUMMARY

A series of aerial photographs of the SCP route were examined for archaeological features. The photographic coverage was a corridor approximately 4km wide along the route from the Caspian to the Azerbaijan - Georgian border. Just under 1500 features were observed of all origins, with 67 features thought to be of archaeological origin. A large number of other features were recorded; these represent evidence of the past use of the area by nomadic groups. This study represents the first known analysis of large parts of the Azerbaijan landscape by aerial archaeologists using high-quality sets of data. The information obtained gives greater information on the environment of known archaeological sites and has shown the range of information that can be obtained for landuse of all periods through Azerbaijan.

1.2 METHOD OF PHOTO-EXAMINATION

Vertical photographs, taken in June 2001 at a contact scale of 1:15,000, were provided as scanned digital images on a series of CDs. These had been compressed using ER Mapper to reduce them to files of about 11-15 MB and on-screen examination was made using ER Viewer. Scan quality was excellent and allowed a considerable degree of zooming-in to examine detail.

The photographs had been taken for stereoscopic viewing so adjacent frames overlapped by 60%. This meant that the complete route could be examined on screen by viewing alternate frames. Since the route of the pipeline was not necessarily central to the photographs, examination was made of the complete frame. A subsequent assessment was then conducted to identify sites close to the pipeline. The pipeline route current at the time of the survey was Route 9.

Before work commenced on the photographs, several known archaeological sites were examined on prints and scanned images. Not all were visible and it remained uncertain how useful that particular set of photographs might be for archaeological investigation. Their summer date and lack of shadows do not make them ideal for recording slight earthwork features or minor colour changes and use of the digital images precluded stereoscopic examination that may have helped identify certain types of feature.

Photo-examination was made using an initial magnification of about 4x, with enlargement as appropriate to examine features identified. This scale of enlargement was sufficient to find obvious, and probably recent, features, but it became apparent that many of the more interesting possible archaeological features were noticed because the view had been zoomed to look at something else. It is possible, therefore, that some features were not identified. The alternative – to examine the photos at the level required – would require several months of work.

Photo-examination was carried out by two archaeologists experienced in the interpretation of aerial photographs simultaneously viewing the screen. The two-person approach allowed discussion of problem sites as necessary and provided an efficient way of tabulating results and manipulating the images.

There were two immediate problems due to use of digital images:

1. Stereoscopic examination was not possible
2. Photographs had been set with approximate North to the top. This meant that shadows fell away from the viewer and so caused problems with the correct interpretation of topography. [Vertical photos are best viewed with shadows falling towards the viewer. This helps the brain correctly read 'up' and 'down'.]

The aerial photographs were not ortho-rectified at the time of the analysis. Therefore it has not been possible to include the accurate SCP route on the photographs shown in this report. However, the alignment of the pipeline in relation to the identified features was judged based on comparison with the available route mapping. Ortho-rectified aerial photos for the route in Azerbaijan will be available in May 2002.

Photo examination began at the Azerbaijan-Georgia border and progressed to the East. An initial list (Table 1) was compiled of features identified. This used CD number, line number and photo number as the main source, and screen co-ordinates. In all but two cases (Lines 53 and 54) the origin was the Northwest corner of each frame and co-ordinates give distances from the West and then the North. Conversion of these to centimetres using a factor of 11000/23 gives a value of pixels per centimetre that enables sites to be located on the photographic prints.

1.3 RESULTS

Some 1460 features are listed in Table 1, many of which are likely to be 'recent' in date. Features thought to be archaeological, or possibly archaeological, are identified using an 'A'. Among the 'recent' features is a high number that are thought likely to remain from shepherds' camping and gathering sites. These were particularly dense south of the road between Ujar and Sighirli and, in places, showed superimposition that suggests that 'recent' could span a considerable time.

Table 1 was refined and shortened to produce a list of 223 sites that fulfilled the following criteria:

- Archaeological sites anywhere on the photographs. 67 were identified that were thought to be archaeological, or possibly archaeological.
- Cemeteries anywhere on the photographs. 38 cemeteries or probable cemeteries were identified.
- Features lying within approximately 200m of Route 9. 128 are listed and include some archaeological sites and cemeteries.

The 223 sites were given Pulkovo co-ordinates of their estimated position on the reduced 1:10000 maps, and site numbers using an easting value followed by a unique identifying number (eg 8517/1). Sites were also referenced to a 1:10000 map number and the nearest kilometre point. This shortened list is Table 2.

Reference to route maps in the tables is divided between two sets. Map numbers 347 to 377 refer to the Revision FC1 (25-01-01), other sheets are Revision D2 (19-10-01) that shows a more recent pipeline route and was received after photo interpretation had begun. No checks were made to verify whether sites tabulated as 'not on map' are within the maps of Revision D2.

Table 1 includes some known inconsistencies. Some features were noted when they were first identified but as photo examination progressed their nature became apparent and not all examples were tabulated. An example is the so-called 'keyboard' or 'piano keys' whose function was unknown when they were first noticed but which, it was later seen, appeared to derive from construction of roads. In some areas, and often associated with the shepherds'

structures, were ponds. Some appeared to be artificially enclosed, others more natural. Some, but by no means all of these, are listed in Table 1.

Figures used in this report have been rotated 180° to help read form and topography. Photographic north (see flight traces) is now at the bottom of each figure.

1.3.1 Archaeological

In the United Kingdom (UK), 'archaeological sites' may have dates between the distant past and 1945. The most recent cut-off date for Azerbaijan archaeological sites is not known but those listed as such in the Tables are thought to have origins well before the medieval period. If a more recent date is acceptable for archaeological monuments, then many more of the sites identified are likely to qualify as such, although confirmation of that can only come from field investigation.

The abbreviated descriptions in the Tables tend to identify shapes of features rather than their function although it is likely that most indicate the presence of former occupation sites. Use of 'enclosure' and 'feature' in the Tables may require clarification. 'Enclosure' is used to identify features that were constructed to enclose, and examples include walled enclosure, embanked enclosure, or rectangular enclosure. 'Features' may often have the same shape as 'enclosures' but are usually smaller and were constructed for other purposes. Examples include sub-rectangular feature, circular feature. In most cases structures are defined by walls or banks that sometimes had an accompanying ditch. Walls and banks were often eroded or reduced in height. Ditch-defined enclosures were identified in only one locality, un-named but south of KP 118 (Pulkovo 8777 area).

Surface discoloration can indicate archaeological sites in this part of the world (Donoghue *et al* 2002; Philip *et al* 2002) but were not noted during on-screen examination of the photographs. Colour change plus height, as would be apparent from stereoscopic examination of prints, may identify possible sites, but all would require surface confirmation.

A small number of known archaeological sites, or features adjacent to them, were independently identified on aerial photographs. Most features in the tables were recognised only on the photographs and are unknown from ground investigation. The distribution shows concentrations of sites on the uncultivated higher ground at the east and west of the SCP route. This is an expected result as the central part of the route crosses low-lying arable land over which this particular set of photographs was unresponsive to any sub-surface features (archaeological or natural). Cultivation in that area may have destroyed evidence of former land use.

Only three suggested archaeological sites lie within 200m of the SCP route. They are illustrated and briefly described as follows:

Site 8543/1 comprises a group of at least three adjoining walled or embanked enclosures on locally high ground. The site was identified during the ground survey and is coincident with Archaeology Site 135 (see Volume 2 Environmental Mapping).

Figure 1 Archaeological site 8543/1.



Walled or embanked enclosures on high ground. Archaeology Site 135. Source photograph: 6126.

Site 8575/1 was identified as an isolated mound with parts of a possible enclosing wall and an irregular internal surface. On the basis of the air photo evidence it was suggested to be a settlement. The site was identified during the ground survey and it coincides with known Archaeology Site 112 (see Volume 2, Environmental Route Maps).

Figure 2 Archaeological site 8575/1.



An isolated mound that appears to have parts of an enclosing wall. Archaeology Site 112. Source photograph: 6075.

Site 8585/2 is a rectangular walled or embanked enclosure with internal features. It is likely to be a settlement site and its eroded appearance suggests it to be of some antiquity.

Figure 3 Archaeological site 8585/2. A rectangular embanked or walled enclosure with internal features that may indicate that the site was a settlement. Source photograph: 6056.



Comments on other archaeological sites identified are in Section 1.3.4 below.

1.3.2 Cemeteries

Cemeteries were fairly easy to identify on the aerial photographs. Most were within enclosed areas and all showed a mixture of small graves and larger tombs. They are also marked on the 1:10000 maps, and that helped confirm their identification on the photographs. It was not possible from the photographs to determine which cemeteries were in use, which disused, but several of them had space for expansion within their boundaries.

Seven cemeteries are within 200m of the pipeline. One, 8587/1, has the WREP route immediately to its north and the SCP is mapped about 50m north of the WREP route. Some 500m east of 8587/1 is another cemetery, 8586/2. The SCP is shown 50m to its south. The other five cemeteries are between 80m and 200m from the SCP.

1.3.3 Features within 200m of the pipeline

Features located within 200m of the pipeline are indicated in the tables and include the above categories of site and others of less certain types and dates. Many are described simply as 'sub-rectangular features' but show variations in size, form and grouping that may be of relevance to understanding them. They are thought likely to remain from migratory shepherds' camps and individual structures are likely to be short-lived and seasonal. Superimposition of features shows that locations were revisited but the photographs give no indication of the time-span that these features represent. Examination of the photographs suggested each feature to comprise parallel long sides that may be slightly embanked and within which there is darker soil that could be slight hollowing and/or occupation debris. Ground visits in February 2002 confirmed this interpretation and noted that 'sub-rectangular features' are probably the remains of reed and mud structures. Although the structures themselves may be insubstantial, their ruined form, on non-arable land, may be capable of long-term survival and raises the question of the duration of use that occurred at some of these sites. The pipeline is routed through some of these structures and may provide opportunities for samples of these features to be examined by excavation.

Examples of the types and groupings of these sites are provided by the following small selection of illustrations.

Figure 4 Site 8813/2 and 3.



The left-right line on Figure 4 is the WREP route. In this area, the SCP will be some 70m to its north (bottom) and cuts through a densely-packed area of features of various forms. This group (8813/2) comprises mostly sub-rectangular features but includes some of rectangular form and a number of small circular or near-circular enclosures. Group 8813/3, at the top of the figure, includes a line of sub-rectangular features, all with 'entrances' on the south side, and some of which abut larger trapezoid enclosures that may be for stock. Source photograph: 6230.

Figure 5



Figure illustrates the apparent clustering of sub-rectangular features around modern buildings or sites of buildings. The photograph also shows some of the groupings and forms of design of these features. At the upper right centre of the photograph is a pond. This group of features is in easting 8813 and the central buildings are some 600m south of the pipeline. Source photograph: 6230.

Figure 6 Site 8619/3.



Figure 6 includes several listed sites of which 8619/3 is near the left-centre of the frame and provides an example of eroded rectangular features. This site is very close to the pipeline route. Just left of the upper centre is 8619/12 which shows the pairing of large with small rectangular features that can also be seen elsewhere. Source photograph: 6412.

Figure 7



Sites 8777/2 and 3. The group of features on the right of Figure 7 includes 'scoops' (so-called because their raised edges almost surround the interior) and somewhat eroded rectangular features. Some superimposition of features can be seen in this group and the modern track overlays or abuts others. The smaller group on the left of the photograph also includes both types of feature. Details of both sites are surveyed on the 1:10,000 map, showing they were present and visible at that date. Source photograph: 6289.

Figure 8 Part of Site 8815/1.



This further illustrates the range of shapes and groupings of the sub-rectangular features and their associated enclosures. It also shows some of the stages of decay that occur after abandonment of the temporary structures. Of interest near the top of this figure is the walled or embanked rectangular enclosure with its cultivated land within. The walls, it may be suggested, are to exclude stock. This enclosure and its approach track are shown on the 1:10,000 as are many of the sub-rectangular features. Source photograph: 6230.

Figure 9 Sites 8816/1-3.



The arc of sub-rectangular features and variants on the right of Figure 9 (8816/1) surrounds an area of lighter ground, possibly indicating wear from stock. Left of that site are two enclosures or features each within a slight circular enclosure. A smaller circular enclosure, with no internal structure, is immediately below the more centrally placed circle (8816/2). On the left of the figure is one end of an arc of wide-spaced features (see Fig 1.10, 8816/4). Source photograph: 6228.

Figure 10 Sites 8816/1-5, 8817/1.



Figure 10 shows a broader context to sites in the previous figure (seen here at the upper right). The line of wide-spaced sub-rectangular features (8816/4) extends from the vicinity of 8816/3 (upper right centre) and appears to end by a cluster and line of smaller variants on the left of the photograph. This line of features has been cut by the WREP pipeline, and the SCP will lay parallel to this and about 100m north. Site 8817/1 is a double walled square enclosure (or three sides of an enclosure) with sub-rectangular features at its open end. This has been listed as 'archaeological' but the freshness of the walls suggests it may be somewhat recent in origin. The more degraded feature of similar size to the right of 8817/1 may be the remains of an earlier and similar enclosure. Source photograph: 6228.

Other types of site close to the pipeline include:

Figure 11 Site 8566/1.



An area of conjoined long rectangular features showing as possible scoops with raised or embanked edges. Each has an open end facing a modern track and they are likely to be recent in date. Areas of light colour may indicate worn ground or levelled features. Source photograph: 6114.

Figure 12 Site 8863/1.



One of several rows of 'spots' identified during photo examination. No explanation can be given for these features. Source photograph: 6189.

Figure 13 Site 8869/5.



Part of a long straight row of 'spots' that appears to lay parallel to a linear feature – although the latter may be a vehicle track. The cause or purpose of the spots is unknown. Source photograph: 6177.

1.3.4 A selection of other archaeological features identified on the photographs

Examination of the complete area photographed has identified a total of 67 archaeological or possible archaeological sites, the majority of which are at distances greater than 200m from the pipeline route. These sites provide a wider range of examples that give context that may help interpretation of those on the route. The increased numbers of sites also suggest there to be some local types – something that would not have been apparent with a narrower search corridor.

In very general terms, the enclosed sites identified are of three main types:

- Walled enclosures, of rectilinear or curvilinear plan, which are sometimes conjoined. Some may be mis-identifications of ponds – which can also be walled. They occur more often in the western parts of the route
- Ditch-defined enclosures, sometimes with an accompanying bank. Rectilinear and curvilinear forms occur as does at least one hybrid example. Some superimposition occurs, suggesting reuse of a favoured location. These features make a local group towards the east of the route and, within the area photographed, have a densely-packed distribution centred on easting 8777. Their date, or date range, is unknown but many of them would not be out of place in Neolithic Apulia (Bradford 1957; and recent unpublished aerial survey by Braasch and Musson) and are similar to Bronze Age and Iron Age enclosures in Britain (eg Palmer 1984, Figure 3)
- Small circular features that are either mounds or open rings and may indicate burial sites. Some single examples have been identified, others form small groups, and there are two large concentrations, both on adjacent local outcrops cut by easting 8641

Traces of cultivation have also been observed. On the higher western ground these tend to be terraces and include many examples that are likely to be recent or in current use. The densest terraces occur in the western part of Azerbaijan and are north of the pipeline route.

Towards the east of the route are small areas of ridged cultivation that are reminiscent of ridge and furrow of the English midlands. The slightly curved strips suggest that they may have been ploughed using animal traction and a simple heavy plough (Bowen 1960, 8). Some parcels of strips are walled, others are apparently unfenced. Tracks may cut across ridges, but in at least one case (8775/1) ridges overlay a linear feature that is likely to have been a track. Much of the ridged cultivation occurs in the area of ditched enclosures but their chronological relationships are not always clear.

Types of feature identified are illustrated by the following examples in which the relevant features are central to each figure unless otherwise noted. The figures span the pipeline from west to east and include a number of sites with X-prefixes. These did not fall within the area of the 1:10000 maps provided and could not be assigned accurate eastings references. Their neighbours in Table 1 will indicate an approximate location and greater precision will be obtained by use of the photo numbers and co-ordinates.

Figure 14 Site 8525/1. Walled curvilinear enclosure on locally high ground. Possible occupation site. Source photograph: 6024.

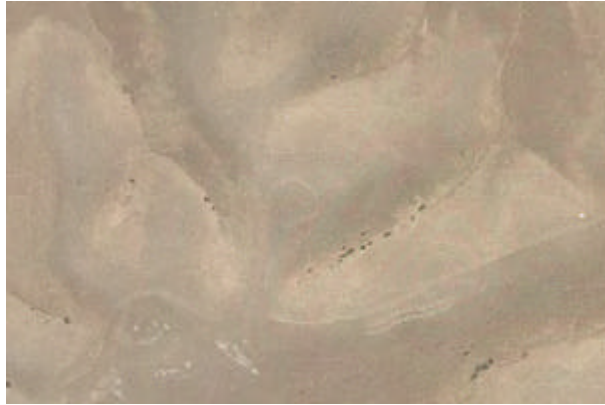


Figure 15 Site 8528/1. Five or more small circles on high ground between two watercourses. Possible occupation or burial sites. Source photograph: 6026.



Figure 16 Site X2. A walled curvilinear enclosure with internal divisions which probably indicates a settlement site. Source photograph: 6028.



Figure 17 Site 8530/2.



Walled curvilinear enclosure, possibly a pond rather than occupation? Source photograph: 6030.

Figure 18 Site 8533/6.



Two (possibly more) small circles adjacent to a disturbed area that may indicate quarrying. Source photograph: 6032.

Figure 19 Site 8535/1.



A row of at least three small circles. Their eroded appearance may suggest them to be archaeological but other similar sites in the vicinity (eg 8535/2, 8536/1) appear more recently made. Possibly burial sites, but very uncertain. Source photograph: 6032.

Figure 20 Site 8540/4.



An oval mound of bare soil with surface irregularities. This is similar in appearance to known occupation sites but the presence of a second such mound in the upper right corner suggests they may be associated with modern farming. Source photograph: 6130.

Figure 21 Site X3.



A mound surmounted by a circular rampart within which is uneven ground. This is likely to be a settlement site. Source photograph: 6108.

Figure 22 Site 8560/1.



A group of circular features on high ground between watercourses. Possibly occupation sites. The rectangular features to their right are similar to others associated with shepherds' camps (see Figs 1.5, 1.6). Figure 23 overlaps the lower part of this photograph. Source photograph: 6091.

Figure 23 Site 8560/2.



An area of slight rectangular features, possibly indicating a settlement site. Figure 22 overlaps the upper part of this photograph. Source photograph: 6091.

Figure 24 Site X4.



A walled enclosure on high ground in a fairly mountainous area. Source photograph: 5569.

Figure 25 Site 8618/4.



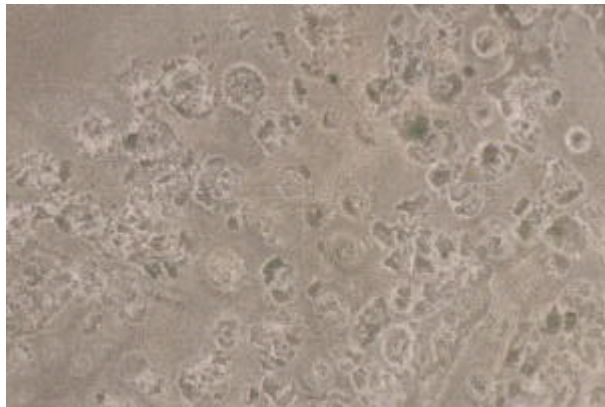
Two D-shaped conjoined enclosures at the foot of an escarpment overlooking a watercourse. Possibly an occupation site, more probably recent. Source photograph: 6412.

Figure 26 Site 8641/1.



Local outcrop with many circular and other features that may indicate burials or may result from localised erosion. A part-enlargement is below as Figure 27. Some 1.5km to the north is a similar, but larger, outcrop (site 8640/2). Source photograph: 6384.

Fig 1-27 Site 8641/1.



An enlarged area of Figure 26. Source photograph: 6384.

Figure 28 Site 8735/1.



An embanked or walled enclosure with internal structures. Located at the confluence of two extinct rivers. Source photograph: 6272.

Figure 29 Site 8775/2.



A ditched curvilinear (oval) enclosure with traces of an internal bank. Two linears cross over the enclosure and the unidentified dark spots also seem to post-date it. In the lower right corner of the figure is some ridged cultivation that possibly indicates the most recent activity in this figure. Source photograph: 6288.

Figure 30 Site X5.



A double-ditched curvilinear (oval) enclosure with possible internal and external features. A modern hut has been placed between the two ditches suggesting that they are visible on the ground. Several tracks cross the enclosure. Source photograph: 6288.

Figure 31 Site 8777/5.



A ditched curvilinear enclosure with superimposed cultivation. Source photograph: 6289.

Figure 32 Site 8778/1.

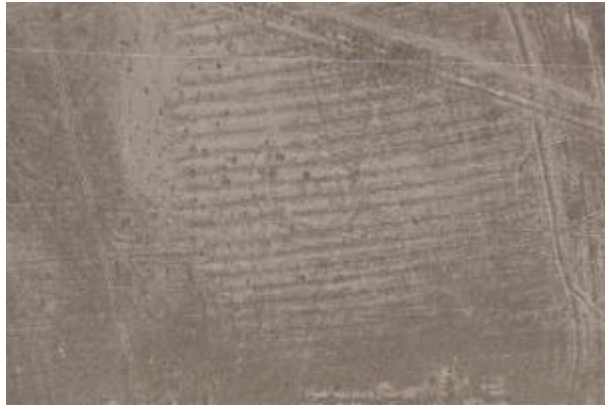


Figure 32 may illustrate three phases of activity. Ridged cultivation and a ditched curvilinear enclosure are superimposed in a manner which makes it difficult to identify which was earlier. Above both of these is a curvilinear wall or bank that was constructed within, but not concentric to, the ditched enclosure. Source photograph: 6289.

Figure 33 Site 8778/4.



Central to the figure is a ditched sub-rectangular enclosure and to its lower left an oval enclosure with concentric double-ditches. Ridged cultivation appears to overlay both. Source photograph: 6289.

Figure 34 Site X8.



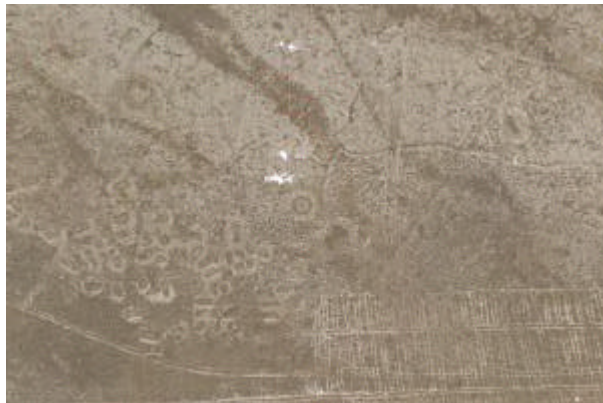
Two superimposed multivallate enclosures that overlay a single ditched enclosure. Ridged cultivation on the right side of the figure may be overlain by the most recent enclosure. Source photograph: 6289.

Figure 35 Site X13.



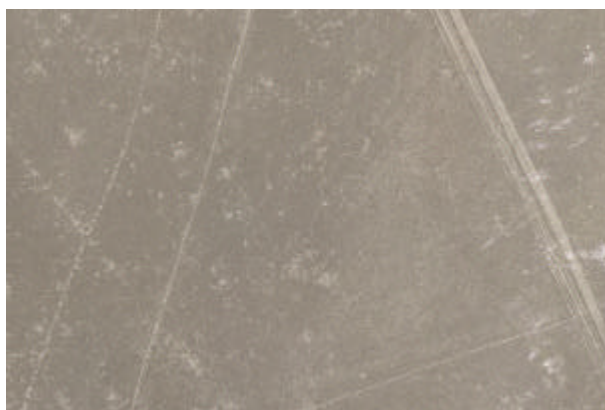
Central to the figure is a ditched oval enclosure that is probably overlain by ridged cultivation. The rectangular enclosure (X10) on the left of the figure has a less clear relationship to the cultivation, but appears to overlay the dark-toned linear features (?ditches) that cross within it. X10 may also overlay the curving linear ditch that crosses the figure. Source photograph: 6289.

Figure 36 Site 8799/2.



In the centre of Figure 36 is a small circular feature comprising an external bank, a possible ditch and a central mound or platform within which there is a pit. This may indicate a burial monument. To the left are several phases of sub-rectangular features remaining from shepherds' camps. Source photograph: 6240.

Figure 37 Site 8818/1.



Seven, possibly more, slight walled enclosures in a range of sizes. Similar enclosing walls have been noted in areas frequented by shepherds (see Figure 9), but there are none of their usual structures in this vicinity. Source photograph: 6228.

1.4 References

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1.5 Appendix 1: Results of field visits to selected areas of aerial photographic features

During February 2002, David Maynard visited a number of areas identified during the aerial survey analysis. These sites were chosen at random while travelling along the pipeline route, rather than for their interest as aerial photographic sites. The visits were without the benefit of copies of the photographs, so only the most obvious features could be seen; subsequent viewing of the air photographs showed how much had been missed in these visits.

8799/1-5

There are numbers of embankments or hollows that are shown to some extent on the 1:10000 mapping. The only dating evidence is a spread of sandstone building blocks and some modern rubbish at 8798780, 4460421, the 1:10000 map shows a building at this location.

A circular earthwork is at 8798792, 4460561. This is 6m diameter externally, slight bank to the outside, hollow area 1-1.5m wide, 0.3m deep, steep sided with flat bottom. The centre is 1.5m diameter and may be higher than the surrounding ground, but not much. It is flat topped rather than a mound.

An oval version of the above at 8798762, 4460573, this is 10m by 7m externally.

There are shepherds' huts spread about, but in the short, square, version, say 6m by 6m. Other features seem to be large depressions shown by irregular banks, possibly holding pens for livestock.

8640/2

The setting is steep sided hillocks that appear to have a denuded origin. The ground surface is liberally covered with small boulders or large stones. There are small mounds and circular elements that can be seen on the aerial photographs.

The mounds are c. 5m diameter and 1m high. The circular elements appear to be a fairly level circular part with a small mound again maybe 4-5m externally for each unit. There is no evidence of modern activity or rubbish.

These small hills could be burial mounds or kurgans, although there are large numbers of them and some of the features appear to have a natural origin. There is another larger area of similar mounds to the south east, site 8640/1 and two further examples can be seen in the area on a black and white set of aerial photographs held by BP.

8874

An area of former dwellings not identified in the air photographic survey was visited to the east of the Djeyranchachmas River at 8874200, 4459500. A supply system to bring water from the Djeyranchachmas into a set of concrete storage tanks was accompanied by concrete sheep watering troughs and a pond to collect surplus water. More than 6 scooped sunken-floored shepherds' huts were scattered around. A series of large rectangular buildings was shown by the remains of foundations. There had possibly been an episode of removing sandstone blocks from the buildings for use elsewhere. A large quarry to the south east, possibly acted as an alternative economic base for the settlement.

All these features could be matched with evidence seen on the aerial photograph of the site, and compare well with other examples seen in this part of the pipeline route.

8869

This is part of the site shown in figure 1.13. The typical features were again visible at this site around 8869000, 4460600. There are standing walled enclosures of sandstone blocks, that are probably in use at the present time. One of the scooped structures was furnished with sidewalls of sandstone, the only example of this to have been seen. The settlement was equipped with a water supply and storage system similar to the example by the Djeyranchachmas. The air photographs show many similar looking structures in the valley to the east, together with a small cemetery.

8871 North side of Djeyranchachmas

The air photographs show the location of individual rocks and boulders, together with evidence of some rough stone walling, in addition to the topographic setting of the site. A printed version of the photograph would be very useful in locating and recording individual rock carvings

1.6 TABLES

Results from examination of aerial photographs were tabulated as work proceeded. Table 1 includes sites of all types that were identified during that work. Table 2 is a sub-set of Table 1 and lists three types of site only: those thought to be archaeological, cemeteries, and any site within 200m of the pipeline route.

Columns show the following information:

- CD, Line, and Frame numbers of the non geo-referenced photographs
- Coord x and y and Scrn x and y show print and screen co-ordinates respectively. Print co-ordinates were calculated by multiplying the on-screen pixels by 11000/23 to give a measurement in centimetre that enables sites to be located on the photographic prints
- Comment is a brief description of the type of feature identified (see 1.3.1 above)
- Arch, Cem and <200m identify sites thought to be archaeological, cemeteries and sites within 200m of the pipeline. The latter includes some archaeological sites and cemeteries
- Site No is derived from the Pulkovo 1km Easting followed by a unique number. Fifteen archaeological sites that are outside the areas of the 1:10000 maps have been given numbers prefixed by X
- Polkovo E and N are co-ordinates, taken using a roamer, from the reduced 1:10000 maps. Use of geo-referenced photographs may slightly alter these. Not all sites in Table 1 have Pulkovo co-ordinates
- Map is the 1:10,000 map number. Reference to maps in the tables is divided between two sets. Map numbers 347 to 377 refer to the Revision FC1 (25-01-01), other sheets are Revision D2 (19-10-01) that shows a more recent pipeline route and was received after photo interpretation had begun. No checks were made to verify whether sites tabulated as 'not on map' are within the maps of Revision D2
- KP shows the KP number for sites within 200m of the pipeline route.

Add Table 1 and 2

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1 INTRODUCTION

1.1 SCOPE OF REPORT

The purpose of this report is to provide a description of groundwater conditions along the proposed pipeline route in Azerbaijan,

The report considers specifically the hydrogeological characteristics of the proposed pipeline corridor (using Route 09 as the baseline case), and is based on existing reports, expert opinion and recent geotechnical investigations.

1.2 SOURCES OF INFORMATION

The following sources of information have been used when compiling this report:

- Excursions to the field in April and October 2001, focussing on the area of the Karayazi wetland and the Ganja-Kazakh Piedmont Plain
- Results of analysis of sediment samples collected during field trips, performed by Caspian Environmental Labs of Baku
- Discussions with Azerbaijani specialists, in particular, Dr F Aliyev, Dr A Alekperov, Dr I Tagiev (State Committee for Geology, Ministry of Environment and Natural Resources), Dr R Israfilov (Institute for Geology) and Dr N Katz
- Results of Shah Deniz midstream geotechnical investigations (Gibb 2001)
- Relevant portions of the Environmental Impact Assessment for the Western Route Export Pipeline
- Reports compiled for BP by Dr F Aliyev (2001) and Dr Tagiev and Dr Alekperov (2001)
- Published geological (Nalivkin et al. 1976) and hydrogeological (Aliyev et al. 1992) maps
- Records of exploration boreholes (pumping test results, geological logs), maps and sections provided by the State Committee for Geology
- Published scientific literature (see Section 4, References), and international guidance documents available via the Internet
- Findings of other RSK employees, communicated in written form to the author

2 HYDROGEOLOGICAL CONDITIONS ALONG THE PIPELINE ROUTE

2.1 CLIMATE, TOPOGRAPHY AND HYDROLOGY

The main climatic, topographic and hydrological factors relevant to the hydrogeology of the study area are summarised below, from the reports by Kashkay and Aliyev (*undated*) and Ali-Zadeh et al(*undated*).

As the proposed pipeline corridor traverses Azerbaijan from the semi-desert areas in the east to the more temperate west the following changes are noted:

- Climate becomes somewhat cooler and potential evapotranspiration declines. Typical potential evapotranspiration rates are generally high along the whole route at some 600-800mm/annum
- Average annual precipitation increases from 150mm in the east to some 400mm at the Karayazi wetland area
- River flow seasonality becomes more pronounced, with peak flows in May, related to snowmelt in the Lesser Caucasus
- Soils and waters become less saline

A major source of river flow generation and groundwater recharge is precipitation falling as rain or snow in the Lesser Caucasus, with annual precipitation rates of some 800mm/annum. According to Musaev and Panakhov (1971), some 45-51% of the discharge of these rivers derived from groundwater, some 35-38% snowmelt and some 14-18% rainfall.

In the area containing the major fresh groundwater reserves (west of Yevlakh), the following right-bank tributaries of the Kura are crossed, draining from the Lesser Caucasus (from E to W):

- Indjachay
- Goranchay (mean discharge $2.4\text{m}^3/\text{s}$)
- Kurekchay
- Karasuchay (mean discharge $4.2\text{m}^3/\text{s}$)
- Ganjachay (mean discharge $4.61\text{m}^3/\text{s}$)
- Shamkirchay (mean discharge $8.56\text{m}^3/\text{s}$)
- Dzhegamchay (Zayamchay) (mean discharge $5.66\text{m}^3/\text{s}$)
- Tovuzchay (Tauzchay) (mean discharge $0.91\text{m}^3/\text{s}$)
- Hasansuchay

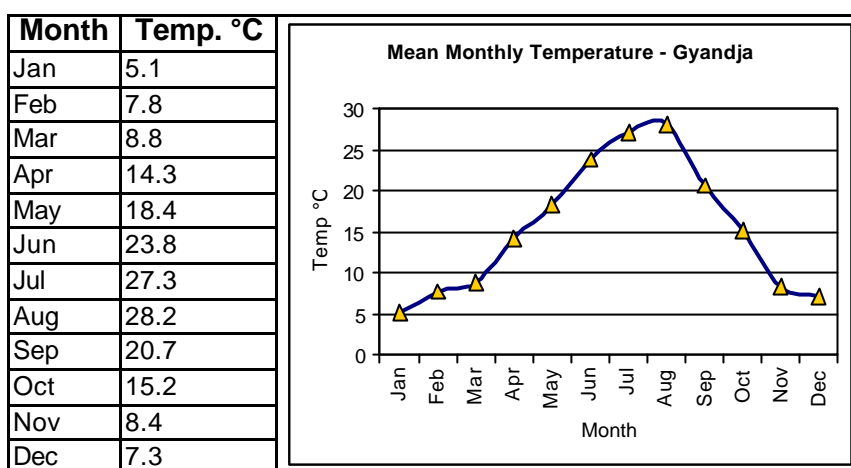
The flow in the above rivers is highly seasonal. For example, the maximum flow in the Shamkirchay is estimated as $127\text{m}^3/\text{s}$, the minimum as $0.95\text{m}^3/\text{s}$. Low flows are typical in December-February with peak flows between April and June.

The rivers typically have a relatively high pH of around 8 and an electrical conductivity in excess of $600\mu\text{S}/\text{cm}$. According to Musaev and Panakhov (1971), the waters are mostly of Ca-HCO_3 type.

These rivers are associated with thick alluvial fan outwash deposits, which contain a high proportion of pebbly/gravelly material and which contain significant fresh groundwater resources.

Table 2-1 shows monthly average near-surface temperatures from a meteorological station in Ganja. Assuming that subsurface/groundwater temperatures reflect annual average air temperature, a subsurface temperature in Ganja of some 15-16°C might be expected.

Table 2-1 Average near-surface monthly temperatures, Ganja, for the year 1999



2.2 OVERVIEW OF GEOLOGY

In the following description, a brief overview of the setting of the Caucasus area is given, based on descriptions by Nalivkin (1960), followed by a more detailed description of strata in the Ganja-Kazakh area (the focus of most hydrogeological interest), based on descriptions by Musaev and Panakhov (1971). The following specific Azerbaijani terms should be noted:

- Maikop Suite - a series dominated by alternating sands and clays originating from the late Palaeogene (Oligocene) to early Neogene (Miocene)
- Sarmat - a time corresponding to Late Miocene
- Akchagil Suite - a dominantly argillaceous series, comprising clays with sands, silts, conglomerates and volcanogenic strata, of Pliocene age
- Apsheron Suite - similar to Akchagil sediments, but more dominated by arenaceous (sandy) facies. Of late Pliocene age

2.2.1 Mesozoic

The geological and hydrogeological context of the proposed pipeline route is defined by the Alpine-Caucasus orogenic (mountain building) event. The mountains of the Caucasus are largely characterised by metasediments and metavolcanics of Palaeogene and Mesozoic ages.

The Jurassic rocks of the Lesser Caucasus in the Ganja-Kazakh area occur in the Mrovdag and Shakhdag Ranges and comprise porphyrites, tuffaceous sandstones, quartzic plagioporphyries, limestones, dolomites, conglomerates and clays/argillites. The Cretaceous of the area comprises a basal conglomerate, limestones (sometimes marly or sandy), sandstones, argillaceous shales, volcanogenic formations (porphyrites, tuffaceous conglomerates and sandstones).

2.2.2 Palaeogene

The Lower Palaeogene is characterised by flysch deposits and marine shales with some limestones and volcanics. In the Upper Palaeogene in the Lesser Caucasus, molasse-type deposits comprising mudstones, sandstones and conglomerates, with thick volcanic sequences, become dominant (Nalivkin 1960).

In the Ganja-Kazakh area, Palaeocene deposits occur extensively in the Ganjachay-Indjachay interfluvial area and comprise marly limestones, marls, marly clays, sandy marls and sandstones. Eocene deposits are well developed in the foothills of the Lesser Caucasus and comprise marls and marly clays with layers of sandstone and, in some places, volcanogenic deposits. Beneath the Ganja-Kazakh Piedmont Plain, Palaeocene and Eocene deposits are encountered in boreholes, at depths of some 300-350m depth near Akstafa, and at 1050-1210m depth at the River Kurekchay (Musaev and Panakhov 1971).

Oligocene deposits (the lower part of the Maikop Suite) are widely distributed in the Ganja-Kazakh area and comprise sandy/clayey deposits of some 2000m thickness (Musaev and Panakhov 1971).

2.2.3 Neogene

In the Neogene, the latest phases of orogenic activity reached maximum intensity and a transition from dominantly marine to dominantly continental environment occurred. On the Kura Plain, for example, Neogene sediments of terrigenous "molasse" type, resulting from the erosional denudation of the Caucasus, reach 6000-7000m thickness (Nalivkin 1960).

In the Ganja-Kazakh area, the Lower Miocene (the upper part of the Maikop Suite) is expressed as alternating clays and sandstones with layered sands and marls. Thickness varies from 500 to 1500m. In many locations, the full Lower Miocene sequence has been removed by subsequent erosion. Middle and Upper Miocene deposits are only found locally in the foothills of the Lesser Caucasus and are believed to have been eliminated beneath the Ganja-Kazakh Piedmont Plain by subsequent erosion during the prevailing continental regime of Sarmat-Akchagil time (Musaev and Panakhov 1971).

In the Ganja-Kazakh area, the Pliocene Akchagil deposits are dominated by clayey sediments. Commencing with a basal conglomerate, they transgressively overlie older strata. Towards the Lesser Caucasus, the clayey marine facies of the Akchagil becomes progressively more interbedded with a continental facies (clays, sands, sandstones, conglomerates, marl, volcanogenic ash), sometimes to the extent that the marine facies disappears (Musaev and Panakhov 1971).

Similarly, the Pliocene Apsheron deposits are also represented by marine (clays with layers of sand/sandstone) and continental (more arenaceous and conglomeratic) facies in the Ganja-Kazakh area. The Apsheron is transitional from marine to continental, both in time (becoming more continental with time) and geographically (becoming more continental towards the foothills of the Lesser Caucasus, where the Apsheron comprises thick conglomerate sequences). Beneath the Quaternary deposits of the Ganja-Kazakh Piedmont Plain, only the Lower Apsheron is marine. The overlying continental analogue of the Apsheron is transitional into the continental, alluvial and proluvial deposits of the Quaternary (Musaev and Panakhov 1971).

2.2.4 Quaternary

During the Quaternary, the Caucasus (especially the Greater Caucasus) experienced valley and mountain glaciation, resulting in moraines and fluvioglacial deposits. Thick alluvial/proluvial plains developed at the foot of the mountains, forming (for example) the inclined Ganja-Kazakh Piedmont Plain (Nalivkin 1960).

Most of the important groundwater reserves are contained within the Quaternary, and the detailed structure of these deposits will be dealt with in the following sections.

2.3 OVERVIEW OF HYDROGEOLOGY

Despite the importance of groundwater in Azerbaijan, only limited hydrogeological information is readily available for the proposed pipeline route, although a number of hydrogeological cross-sections and maps are held by the State Committee for Geology. Few hydrogeological analyses for Azerbaijan have been published in the accessible international literature. This contrasts strikingly with the wealth of publications on the petroleum geology of Azerbaijan and the hydrogeology of neighbouring Caucasus Republics, including aquifer modelling and the relationships of groundwater levels and spring discharges to precipitation receipts and seismic activity.

The essential elements of the hydrogeological conditions along the proposed pipeline corridor are summarised below, from the hydrogeological map of Aliyev et al. (1992), discussions with the State Committee for Geology and the reports of Tagiev and Alekperov (2001) and Banks (2001):

The proposed pipeline corridor largely lies within a fault-bounded intermontane trough between the Lesser Caucasus and the Greater Caucasus. The Lesser Caucasus south of the Ganja-Kazakh area is composed of Jurassic and Cretaceous “bedrock”, comprising sandstones, tuffs, limestones, shales, breccias, porphyries etc., and contains some fresh groundwater resources. These are not of immediate relevance to the proposed pipeline.

The intermontane trough between the Lesser and Greater Caucasus is filled by a succession of Neogene and Quaternary sediments. The sediments in the immediate subsurface are of three main types:

- Outwash/alluvial fan sedimentation generated by erosion of the Lesser and Greater Caucasus mountain chains, comprising thick layers of rather poorly sorted sands, gravels and cobbles, with finer-grained silty/clayey interlayers. This type of sedimentation becomes more dominant towards the west and in the proximity of the mountains. These sediments are often called *proluvial* in Soviet terminology
- Marine sedimentation, becoming more dominant towards the east
- Modern, Kura-river alluvial deposits

In the western end of the intermontane trough (near the Georgian border) and along the foothills of the Greater and Lesser Caucasus, the proluvial/alluvial sediments would be expected to be generally more dominated by coarser-grained horizons, with a greater degree of interconnection between potential aquifer horizons. Towards the centre of the trough and away from the Caucasus foothills, coarse-grained sediments would be expected to become less dominant and aquifer horizons would be expected to have a lesser degree of connectivity. The map of Aliyev et al. (1992) confirms that alluvial fan sediments in the foothills of the

Lesser Caucasus are 90% comprised of pebble-sized clasts. In the upper Kura valley, this proportion is somewhat lower at 75-90%, and in the lower Kura valley <25% (Figure 2-2).

Figure 2-1 Hydrogeological map for the western Azerbaijan

INSERT A3 MAP

Figure 2-2 Proportion of pebbles in Quaternary aquifer horizons

INSERT A3 MAP

The distribution of coarse-grained sediments in the alluvial fan deposits is likely to be governed by the complex interplay of several factors:

- The development and lateral migration of rivers flowing out of the Caucasus ranges
- Episodes of fault motion and orogenic uplift increasing hydraulic gradients and producing higher energy erosional environments
- Climatic fluctuations (eg melting of ice caps following Quaternary glacial periods) would also produce high-energy environments for erosion and transport of coarse-grained material. In fact, the extremely poor sorting of the proluvial sediments and the large range of clast types suggest that the sediments may be *fluvioglacial* (ie derived from reworking of glacial deposits) rather than purely fluvial (K Richardson, BP, *pers. comm.* 16/10/01)

As a result, any attempt to systematise the sediments into laterally extensive, separate, strata-bound aquifer horizons is very problematic. Tagiev and Alekperov (2001) indicate this and therefore divide the sediments into aquifer complexes. The Quaternary aquifer sediments of the intermontane trough can be divided (Aliyev et. al. 1992) into:

- Upper Continental Quaternary Aquifer Complex $K(Q_{II-IV})$ of Upper and Middle Quaternary age
- Lower Continental Aquifer Complex $K(N_2^3-Q_{I,IV})$ of Upper Pliocene and largely lower Quaternary age

These may in turn be underlain by Neogene sediments of the Apsheron (continental) and Akchagil (continental and marine) complexes. These Neogene sediments also outcrop at the surface, especially in the core of the intermontane trough between the Greater and Lesser Caucasus, forming linear ranges of hills, for example, around Lake Mingechaur and on the northern bank of the Kura west of Lake Mingechaur.

In the western end of the intermontane trough (near the Georgian border) and along the foothills of the Greater and Lesser Caucasus, recharge would be expected to occur largely from infiltration of water in rivers flowing off the Caucasus ranges onto the Quaternary alluvial fan sediments. In these regions, downward head gradients would be expected to be predominant. The ultimate source of recharge is probably thus precipitation and snow melt-water on the Caucasus ranges and foothills. Irrigation water and direct infiltration of precipitation to the proluvial sediments will also be sources of recharge.

In the central and eastern part of the intermontane trough, upward head gradients are likely to be predominant (with artesian heads in deeper aquifer horizons). Direct recharge from precipitation in these areas is likely to be of little importance to the water balance of the aquifer complexes, owing to these upwards head gradients and to high evapotranspiration.

One would expect a greater thickness of unsaturated zone in the foothills of the Caucasus and a lesser thickness below the plains in the centre of the trough.

Groundwater flow in the intermontane sedimentary aquifer complexes is generally from the Caucasus foothills towards the Kura and from the west to the east. This is shown by the contours on Figure 2-1.

Groundwater quality is freshest in the coarse sediments of the recharge areas at the foothills of the Caucasus. It becomes more progressively more saline towards the lowlands and towards the east. Its hydrochemical type changes from HCO_3^- to $SO_4^{=}$ or even to Cl^- (Musaev

and Panakhov 1971). This is shown on Figures 2-1, 2-3 and 2-4b. This salinisation process is probably related to two main factors:

- Progressive salinisation along flow pathways owing to water-sediment interaction (gypsum dissolution, interaction with residual salts in marine sediments)
- Lower rainfall and higher evaporation in the central plains. Evapotranspiration of water during recharge and from shallow groundwaters increases contents of dissolved solids

Fresh groundwaters are dominantly of bicarbonate, bicarbonate-sulphate or bicarbonate-chloride type. Brackish waters in the central part of the intermontane trough (Shirvan Plain) may be of bicarbonate, sulphate or chloride-dominated. Saline waters in the eastern part of the country are typically chloride type.

2.4 HYDROGEOLOGY OF PIPELINE SECTIONS, BASED ON EXISTING DATA

2.4.1 Sangachal-Kazi Magomed Section

Morphologically, this section comprises (Gibb 2001):

- KP0-6: a coastal plain, with shallow wadi courses, until a scarp feature at KP6
- KP7-13: raised plateau feature comprising clays and silts underlain by shallowly dipping mudstones
- KP13-23.5: a flat piedmont plain at the base of the Touragai mud volcano
- KP23.5-28.5: steep rugged topography of the Gotur mud volcano ridge
- KP28.5-41: flat alluvial plain with saline silt and clay soils
- KP41-50.5: low hilly area with dominantly silty and clayey soils, ending with a low scarp at Kazi-Magomed

In this section of the route, exposed lithologies comprise Quaternary sediments of continental, mud-volcanic and "diluvial"/marine facies, overlapping Tertiary sedimentary rocks of the Apsheron and Akchagil formations (Aliyev 2001).

The sub-soils in this section are generally of low permeability (silts, clays), while borehole and trial pit logs from the Shah Deniz geotechnical investigations give no indication of significant laterally continuous aquifer horizons. The section is characterised by varied elevation, ravine and gully systems and the occurrence of mud volcanoes. Some borehole logs (BH-A1b, BH-A4) provide evidence of volcanic mudflow-derived horizons.

According to Aliyev (2001), the route does not traverse any significant groundwater reserves in this section, and such limited groundwater reserves as do occur are highly mineralised. Average annual precipitation is approximately 100 - 250mm/annum. Yearly precipitation is usually considerably less than potential evapotranspiration, the latter being extremely high because of strong solar radiation receipts, high temperatures, low atmospheric humidity (average 12.4 - 14.6%) and high wind speeds in the region. Very little recharge of groundwater resources, therefore, is thought to be taking place under present climatic regimes.

Limited reserves of low-mineralisation groundwater may occur and are typically found in association with the narrow alluvial deposits of rivers (eg the Pirsagat River). Occasionally

hand-dug wells or springs based on small pockets of fresh groundwater may be used by nomadic or local peoples (although generally, in the arid east of Azerbaijan, water is often tankered in and sold by the bucket - Wolfson and Daniell 1995). Other scarce fresh groundwater sources are mainly related to outcrops of limestone which are occasionally confined by low permeability clay layers. Such resources are clustered mainly in an arc to the north-east of the Pirsagat river, which includes the Dagni nomad camp. These are not thought to conflict with the proposed pipeline corridor.

In summary, groundwater vulnerability is regarded as low in this region.

2.4.2 Kazi Magomed -Yevlakh section (Shirvan Plain)

This section of the proposed pipeline route crosses the flat, semi-arid Shirvan Plain, underlain dominantly by Pliocene-Quaternary proluvial, "diluvial" deposits and alluvial deposits of the Kura river system (Aliyev 2001). In general, sediments tend to be dominated by fine grain sizes, as evidenced by geotechnical borehole and trial-pit logs. Coarse-grained sediments are typically associated with river outwash systems, such as that of the Alazan-Agrichay.

Between KP146-150, the route runs north of the West Karasu Bog. From KP156 westwards, the Plain becomes more barren and saline and halophilic plants become evident. This area was, however, extensively farmed in the Soviet era. The Plain is dissected by many irrigation channels of 2 to 5m depth, which are especially dense between KP153-158, KP191-200 and KP203-206. The Geokchay and Turianchay canals cross the route at KP171 and KP193, which subsequently revert to natural meandering river systems. The soils become more fertile once again and are being farmed towards the River Kura, whose floodplain, with abandoned channels and oxbow lakes, occurs between KP 216-226 (Gibb 2001).

Aliyev (2001, undated) argues that the vulnerability of groundwater resources in this section to potential pollution by oil products is low, simply because extensive fresh groundwater resources are not perceived to exist. Along the proposed pipeline route, groundwater mineralisation is typically in the range 5-100g/l. The water table is generally within 3m of the ground surface over 90% of the area of the Shirvan Plain, partially owing to protracted infiltration of irrigation water from canal systems. On the proposed pipeline route, only in the regions of Kurdamir and Shakyar-Kobu is the groundwater level expected to be deeper, approximately 5-10m bgl (Aliyev 2001).

According to Aliyev (2001), horizontal groundwater head gradients on the Shirvan Plain are low (0.03 to 0.0007) and decrease in the direction of the Kura River. The thickness of significantly transmissive strata also decreases towards the Kura and is believed to be of the order of 10-20m in the proposed pipeline corridor. Hydraulic conductivities are believed to be 0.1 to 3m day⁻¹ in the water-bearing strata.

Below only around 5% of the area of the Shirvan Plain can groundwater resources be classified as "fresh" (<1g/l mineralisation, Aliyev 2001) and these lie topographically above the level of the proposed pipeline corridor and are not vulnerable to contamination.

Specifically, the route across the Shirvan Plain can be divided into two hydrogeological sections, according to Aliyev (2001):

1. Kazi-Magomed to Karasu/Padar/Sigirly railway stations which are underlain by alluvial-diluvial and proluvial-diluvial deposits of clays, silts and silty sands. Groundwater levels are typically at 2-3m depth and the groundwater mineralisation is 40-85g/l, being dominated by sodium chloride, with high sulphate concentrations.

2. Sigirly to Kura crossing and Yevlakh where silts, silty sands and sands predominate. Here the landscape is characterised by irrigated farming. In some sections, the water table is very close to the surface and conditions are swampy and saline, especially between Udzhari and the Kura River. On the River Kura floodplain itself, sandy strata occur, often below clayey surficial strata (Gibb 2001).

According to Aliyev (2001), three artesian aquifer complexes are recognised below the shallow, "quasi-unconfined" aquifer complex of the Shirvan Plain. Water in these is typically highly mineralised (5-10g/l). In these, generally upward vertical head gradients prevail, providing protection from contamination.

In general, therefore, there is not perceived to be any risk to significant groundwater resources in this zone of the proposed pipeline route, owing to (a) the poor aquifer characteristics of the sediments and (b) the saline nature of the groundwaters. However, there may be the possibility of small areas of fresh groundwater being present along the courses of major rivers (eg the Kura alluvium) and adjacent to freshwater irrigation canals. Also, there is the possibility that small pockets of fresh groundwater or seepage areas may exist which are too small to have been flagged up by the State Committee for Geology. These may, however, be very important as watering places for local herdsmen (e.g. a seepage area, near the main road, some 3-4 km west of the Goranchay River crossing at N40°38'46.7" E46°45'35.0").

In general, the vulnerability of groundwater reserves in this area is regarded as low.

2.4.3 Yevlakh

In the western part of Yevlakh, unconfined and confined groundwaters occur in the alluvial deposits of the Kura River (whose alluvial plain extends to around KP244.5, according to Gibb 2001) and in marine deposits. Shallow groundwaters are encountered at depths of only 1-2m below ground level (bgl), typically in sands and loamy sands with hydraulic conductivities of 0.1 to 3m day⁻¹, and are usually highly mineralised (10-15g/l mineralisation of sodium chloride/sulphate type). Confined aquifers of sands and loamy sands are encountered at 50-200m bgl, and contain brackish waters (1.2-1.5g/l) that are widely used for a variety of purposes including potable supply. The confined aquifers are typically isolated from the surface by at least 10m of clay (Aliyev 2001).

2.4.4 Yevlakh-Poylu Section (Ganja - Kazakh Piedmont Plain)

The section, on the southern side of the Kura, between Yevlakh/Geranboi and the Kura river crossing at Poylu, traverses a small part of the *Karabakh Plain* (between Yevlakh and Mingechaur Station) and the Ganja-Kazakh Piedmont Plain. The latter region is essentially underlain by alluvial fan (*proluvial*) deposits with a high proportion of coarse-grained permeable sediment, containing fresh groundwater resources. Recharge to these is believed to be derived from precipitation (41%) and by infiltrating river waters (32%), although irrigation waters (22%) and inflow from mountain zones (5%) are also significant (Tagiev and Alekperov, 2001).

On the Ganja-Kazakh Piedmont Plain, the aquifer horizons here are conventionally divided (Tagiev and Alekperov 2001) into one upper, partially unconfined aquifer complex (Russian *gruntovaya voda*) and four confined aquifer complexes (Russian *napornii vodonosnii gorizont*), largely on the basis of stratigraphic proximity of aquifer horizons with similar water chemistry. These subdivisions are largely symbolic and arbitrary as the real structure of

the aquifer is complex with many alternating coarse and fine layers that vary laterally. Ultimately, the sedimentary succession must be viewed as a single unit. Recharge occurs in the foothills of the Lesser Caucasus, where deposits are coarse and aquifer levels are to a greater or lesser degree interconnected. Further north, towards the Kura, aquifers become more confined and separate in nature and deeper confined aquifers may even develop artesian heads. Indeed, uncontrolled artesian overflowing boreholes in such aquifers are used for irrigation.

2.4.4.1 Upper, unconfined aquifer

The uppermost, largely unconfined aquifer complex (according to the conventional subdivision) is the most potentially vulnerable to pollution incidents (Tagiev and Alekperov 2001). It comprises gravels, cobbles and pebbles, with sandy, silty interlayers, in its proximal facies in the foothills of the Lesser Caucasus, becoming finer grained towards the River Kura. Figure 2-4a shows typical depths to the shallow water table. It will be noted that depths to groundwater are greatest (often >25 m) in the interfluves between the rivers draining from the NE slope of the Lesser Caucasus, especially:

- Each side of the Ganjachay
- Between the Kurekchay and Goranchay
- The interfluves between the Shamkirchay and Akstafachay Rivers

The shallowest depths to groundwater (<5 m) occur:

- Immediately north of Geranboi, possibly partly owing to infiltration from the Upper Karabakh Canal
- In the valleys of the rivers draining the NE slope of the Lesser Caucasus, especially the Kurekchay, Tovuzchay, Hasansuchay and Akstafachay
- In the Kura valley where, in places, the water table intersects the surface, swamping the land

Groundwater level hydrographs (Annex 2) suggest that water level fluctuations are low in magnitude. Where seasonal trends can be identified (wells 57/4 and 81/2, Annex 2), groundwater level maxima are seen around April-May.

Recent groundwater level data independently collected from geotechnical boreholes (Gibb 2001) broadly supports the groundwater level interpretation given in Figure 2-4a. Groundwater flow is generally from the SW to NE (ie, toward the Kura, Figure 2-1), except in the east where groundwater flow tends to be towards the east, owing to obstruction of flow by the low-permeability Bozdag hills.

The upper aquifer complex sediments are exposed in gravel pits and erosional ravines containing the major rivers flowing from the NE slopes of the Lesser Caucasus. The coarsest deposits comprise sub-angular to moderately well-rounded cobbles and pebbles set in a matrix of silt, fine sand and medium sand (in some cases up to coarse sand). Deposits as a whole are generally poorly sorted and this may lead to a somewhat lower hydraulic conductivity than would otherwise be expected from deposits of this clast size. A thin layer (1-2m thick) of brown clayey silty material (fine sand according to the State Committee for Geology) typically overlies coarser transmissive aquifer deposits in interfluvial areas, but is breached in river valleys. Silty/fine sand interbeds are noted within the aquifer succession. Exploration boreholes drilled in connection with the Shah Deniz midstream geotechnical program suggest that in interfluvial areas, good thick coarse sand, gravel or pebble sequences are not especially common in the upper c. 20m of the succession. In the valleys of rivers such

as the Koshkarchay, Karasuchay, Shamkirchay, Dzegamchay and Tovuzchay, sand/gravel units are found in the immediate subsurface, implying greater connectivity, vulnerability and transmissivity in the main river valleys. The hydraulic conductivity of aquifer facies typically ranges from 0.1 to 13.4m day⁻¹ and the transmissivity from 3 to 1600 m²/d (see Table 2-2). The highest values of transmissivity are observed in the central part of the alluvial fans of the Dzegamchay and Shamkirchay rivers (Tagiev and Alekperov 2001). Records of test pumping of exploration boreholes No. 47 to 64 (provided from the archives of the State Committee for Geology) suggest typical values of hydraulic conductivity of around 10m day⁻¹. However, it should be noted that A. Alekperov and F. Aliyev (State Committee of Geology, Azerbaijan Ministry of Environment, pers. comm. minutes of meeting, 3/9/01) cite hydraulic conductivities of 20-100m day⁻¹ (average 20-40m day⁻¹) as being typical of coarse proluvial aquifer sediments in this area.

Figure 2-4b shows the total mineralisation of groundwaters of the upper aquifer unit. As regards water quality, fresh (<1g/l mineralisation) groundwater is present in the upper aquifer horizon beneath almost the entire area. Areas of brackish water occur just north of Akstafa and some distance NE and NW of Ganja. To the north and east of Geranboi, salinity increases rapidly. As regards contamination, the quality of groundwaters in the aquifer complex is generally good. Limited nitrogen contamination is stated to occur near livestock farms and other contamination near the Ganja aluminium factory (Tagiev and Alekperov 2001).

2.4.4.2 Confined aquifers

Deeper confined aquifer complexes in this area generally have favourable hydraulic characteristics for groundwater abstraction and contain good-quality water over the majority of the area. These units are not believed to be especially vulnerable to oil contamination from the proposed pipeline owing to their depth and the presence of aquitard horizons separating them from the upper, unconfined aquifer complex.

While dominantly remaining fresh and Ca-HCO₃ dominated, there is some tendency with increasing depth and increasing distance along flow pathways, to acquire Na-SO₄⁻ or even Na-Cl character. Some of the deeper artesian boreholes yield saline Na-Cl waters with a salinity of several thousand mg/l. Some of these boreholes also contain dissolved H₂S at concentrations exceeding 20 mg/l and significant concentrations of dissolved methane (Musaev and Panakhov 1971).

2.4.4.3 Abstractions

There are reported to be more than 2000 abstraction wells in the Ganja-Kazakh Piedmont Plain, with typical depths of 100-150m. They generally abstract from the first confined and, to a lesser extent, the unconfined aquifers (and, less commonly, the second confined aquifer). In the south-eastern part of the Plain, they also abstract from the fourth confined aquifer. In recent years, the total rate of production of subsurface waters for the entire Piedmont Plain was between 820,000 and 1,130,000 m³/d (9,500 to 13,100 l/s). In the early 1980s the annual production exceeded 1,600,000 m³/d (18,500 l/s). Besides production wells, groundwaters are also abstracted by springs, karizes (qanats) and horizontal drains that are constructed in stream valleys. The abstracted waters are mainly used for irrigation purposes by farms and private persons, although groundwater also provides drinking water supply to Ganja, Tovuz and Shamkir towns and the majority of rural settlements (Tagiev and Alekperov 2001, see Table 2-3). Locally approved reserves of exploited groundwater exist in this complex (Figure 2-3), namely:

- Alluvial fan of the Ganjachay river, for water supply to Ganja

- In the valley of the Akstafachay river, for water supply to the settlements of Kazakh and Akstafa regions
- In the valley of the Dzegamchay alluvial fan, for water supply to settlements of Tovuz Region
- The Dzegamchay-Djagirchay interfluve, for water supply to settlements of Shamkir Region
- The fan of the Ganjachay river, for water supply to settlements of Samukh and Khanlar regions
- The fan of the Kurekchay river, for water supply to settlements of Geranboi region

In the Ganja-Kazakh Piedmont Plain, more than 300 karizes were known in the unconfined aquifer by Musaev and Panakhov (1971), with a total flow of >6000 l/s. These typically yield fresh water of mineralisation < 1g/l and of Ca-HCO₃⁻ type (occasionally Ca-SO₄⁼).

Figure 2-3 Hydrogeological map of confined aquifers of Azerbaijan

INSERT A3 MAP

Figure 2-4a Depth to groundwater (g/l) in the 1st aquifer horizon (unconfined aquifer) of the Gyandja-Kazakh Piedmont Plain and Karayazi Plain

INSERT A3 MAP

Figure 2-4b Mineralisation of groundwater in 1st aquifer horizon (unconfined aquifer of the Gyandja-Kazakh piedmont plain and Karayazi plain)

INSERT A3 MAP

2.4.4.4 Yevlakh - Geran Station

As far as local details are concerned, between Yevlakh and Geran Railway Station, shallow and confined aquifer horizons are ubiquitous, although the latter are too deep to be of practical importance. Shallow groundwaters occur at depths of 0.4-12m bgl, however, typically in silts, silty sands and sands, with hydraulic conductivities in the range 0.1 to 0.7m day⁻¹. Mineralisation is high, ranging from 3 to 25g/l. Flow is towards the east, owing to the Bozdag Hills obstructing northwards flow to the Kura (Aliyev 2001).

Goranchay - Ganjachay

Further west, towards the Ganjachay, confined and shallow aquifers become valuable sources of water, occurring in gravels/pebbles and sands, with hydraulic conductivities of 3 - 20m day⁻¹. The depth to shallow groundwater ranges up to 25-30m (see Figure 2-4a), while the mineralisation increases downgradient from fresh up to 10g/l. In the proposed pipeline corridor, however, waters are generally fresh and used for potable supply, e.g. from "subartesian" aquifers near the villages of Safikud, Dalimamedly and Geranboi. In this region, aquitard strata between unconfined and "confined" strata do not possess as low hydraulic conductivity as elsewhere, potentially rendering the aquifer sequence vulnerable to contamination (Aliyev 2001).

2.4.4.5 West of Ganja

Still further west, along the route north of Ganja, between Ganjachay and Shamkirchay, a surficial layer of silty sands some 2 to 5m thick occurs, with a depth to groundwater of up to 5-10m bgl in the foothills of the Bozdag range. Here mineralisation may be as high as 1-3g/l (Aliyev 2001).

Continuing west, fresh groundwater in shallow and confined aquifer horizons is ubiquitous. Shallow groundwater often occurs in alternating sands and silt strata, although aquifers of pebble and gravel are associated with the main river valleys: Ganjachay, Goshgarchay, Shamkirchay, Dzegamchay, Tovuzchay, Akstafachay and Kura (Aliyev 2001).

Table 2-2 Characteristics the shallow "quasi-unconfined" and the upper two confined aquifer complexes of the Ganja-Kazakh Piedmont Plain (after Tagiev and Alekperov 2001)

	Unit	Aquifer Complex		
		Shallow, "quasi-unconfined"	1 st Confined	2 nd Confined
Depth to top of complex	m bgl	-	9.0-138.00	38.5-218.0
Water level	m	54.2-0.3	(-)77-(+)15.5	(-)70-(+)10.6
Absolute level of piezometric surface	m OD	-	441.4-33.8	400.0-40.0
Hydraulic gradient		Akstafachay-Hasansu interfluv	0.03 to 0.007	0.03-0.003
		Hasansu-Tovuzchay interfluv	0.05 to 0.007	
		Tovuzchay-Dzegamchay interfluv	0.01 to 0.011	
		Dzegamchay-Ganjachay	0.03 to 0.008	

Table 2-2 Characteristics the shallow "quasi-unconfined" and the upper two confined aquifer complexes of the Ganja-Kazakh Piedmont Plain (after Tagiev and Alekperov 2001)

	Unit	Aquifer Complex			
		Shallow, "quasi-unconfined"		1 st Confined	2 nd Confined
		Remaining part of the plain	0.1 to 0.004		
Yields of (exploration) wells	l/s	0.1-33.3		0.2-39.7	0.05-28.3
Specific yields of wells	l/s.m.	0.02-10.8		0.02-3.38	0.03-2.7
Thickness of aquifer	m	4.0-138.0		4.0-134.0	6.5-129.5
Hydraulic conductivity	m/d	0.1-13.4		0.25-50.6	0.7-21.4
Transmissivity	m ² /d	3-1600		14-1675	8-990

Table 2-3 Production of groundwater by administrative regions from the aquifers of the Ganja-Kazakh Piedmont Plain (after Tagiev and Alekperov 2001)

Administrative Regions	Abstraction of groundwater, various years 10 ³ x m ³ /d	Usage of subsurface waters, %		
		For public and drinking purposes	For production and technical purposes	For irrigation
Akstafa Region	20 - 48	14	3	83
Kazakh Region	24 - 59	43	17	40
Tovuz Region	70 - 75	17	12	40
Shamkir Region	190 - 290	10	12	78
Samukh Region	206 - 255	10	8	82
Geranboi Region	238 - 312	3	4	93
Yevlakh Region	20 - 41	25	19	56
Ganja City	48 - 52	57	30	13

2.4.5 Poylu - Georgian Border (Karayazi aquifer complex)

The topography of the north bank of the Kura in this area appears to be related to underlying geology and comprises successive ridges of hills trending ESE-WNW. These ridges correspond with successively older terraces of the River Kura.

2.4.5.1 Kura alluvial floodplain

Firstly, the current Kura alluvial flood plain appears, in the Poylu area, to comprise moderately-to-well-rounded pebbles and cobbles in a matrix of silt to medium sand. In places this is overlain by 10-20 cm of silty material, assumed to represent the current flood plain deposits. The current River Kura alluvial deposits must this be assumed to represent a good aquifer unit. Groundwaters are fresh and shallow (Figure 2-4a).

2.4.5.2 Quaternary alluvial-proluvial aquifer complex

To the north-east of the modern Kura flood plain, there is a flat area/"terrace" stretching from Salakhli, through Karayazi to Sadikhli and Boyuk Kasik, and hosting the Karayazi wetland. It is this feature which the proposed corridor traverses for much of its length between Poylu and

the Georgian border. The geological map designates it as "Modern" alluvial deposits of the Kura River.

This area appears to be underlain by a complex of sedimentary deposits (gravel/pebbles/cobbles in a silt/sand matrix, with interlayers of silty/clayey material) of alluvial and probably (at depth) also proluvial derivation. In many places, a surficial layer of silt or clay is observed.

The complex contains fresh groundwater. According to Aliyev (2001), the depth to water table in the unconfined aquifer ranges from near zero up to 37m in the hills of the NE. Figures 2-4a and 2-5a illustrate depth to groundwater in the Karayazi Plain, although it will be noted that there are considerable inconsistencies between the two maps in places. This is likely to be because the map in Figure 2-5a utilises, at least in part, data from very deep boreholes whose water level may not represent the unconfined water table. Both maps do, however, indicate that the water table in the upper unconfined part of the aquifer is shallow (<5 m) over large areas, and is, in places, shallow enough to support wetland areas of ecological value. Fieldwork undertaken in December 1996 at the Karayazi wetland indicated that pool water was clear (turbidity 2.36 NTU), alkaline (pH 7.82) and not highly mineralised (electrical conductivity: $665\mu\text{S}\cdot\text{cm}^{-1}$).

When groundwater level contours are reduced to metres above sea level, it appears that the general direction of groundwater flow in the unconfined aquifer is parallel with the Kura, from WNW to ESE. In the western part of the Karayazi plain, a hydraulic gradient of some 0.002 appears to be typical.

Deeper (>100 m) parts of the Karayazi aquifer complex are often characterised by artesian heads.

Shallow (3 to 8 m) dug wells in the unconfined aquifer are commonly used by villagers for irrigation and (in Sadikhli) drinking water supply.

There also exist public supply abstraction boreholes at Soyukbulakh. One of these is located at (085-22-783/045-76-264) just south of the railway, and is 120m deep, and operates under artesian pressure. A second public supply borehole of similar depth is reported to be sited in the military compound north of the railway, immediately adjacent to the proposed route at KP 429.5.

Deeper boreholes in the lower part of the complex also support public water supply abstractions: two artesian boreholes of depth 360-380m at (085-16-546E/045-84-384N) supply several thousand villagers at Muganli and Boyuk Kasik with drinking water. These deep boreholes, presumably tapping confined aquifers, are likely to be well-protected in the event of a spill from an oil pipeline (both the WREP and the proposed pipeline route run within a few hundred m of the boreholes).

To the north-east of the railway the land rises in a series of "quasi-scarps" which are likely to correspond, in part, to successively older terraces of the Kura. These are composed of alluvial and proluvial deposits. For example, those immediately north of Boyuk Kasik and Soyukbulakh are observed to comprise large thicknesses of moderately well-rounded pebbles and cobbles in a silt to medium sand matrix, with some silty/fine sand interbeds, and occasional thin beds of cemented pebbles and cobbles. Around Salakhli, a significantly higher proportion of finer-grained sediment appears to be present, especially in the lower "terraces". In the area to the north of the railway, between Kechveli and Poylu water quality becomes slightly brackish (1-3g/l).

Figure 2-5a Depth to groundwater (m) in the Quaternary aquifer complex of Karayazi plain

INSERT A3 FIGURE

**Figure 2-5b Mineralisation of groundwater (g/l) in the Quaternary aquifer complex of the
Karayazi plain**

INSERT A3 FIGURE

2.4.5.3 Neogene sediments

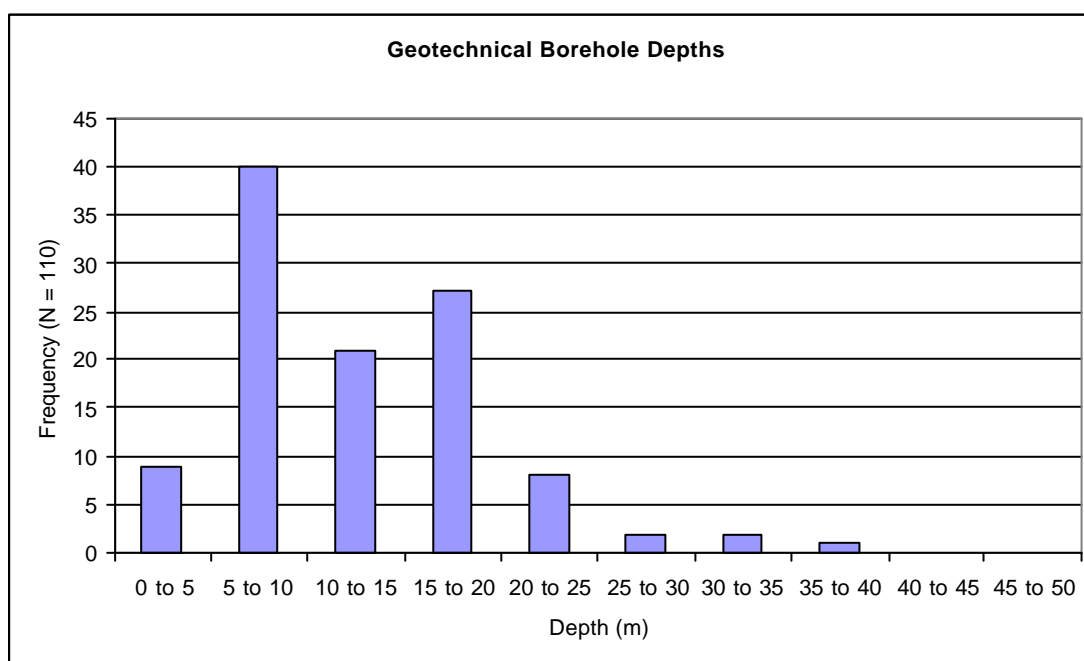
Further to the NE, geological maps indicate that Neogene sediments outcrop. Access restrictions to these areas, owing to presence of military ordnance, did not permit examination of these sediments. These are believed to be dominantly fine-grained. It is noted that the various maps (those of Aliyev et al. (1992) and Nalivkin et al. (1976)) do not wholly agree on the areas of outcrop of the Neogene sediments, or on their hydrogeological significance. The current proposed pipeline corridor (as at Route 09), however, avoids these areas of controversy.

2.4.6 Determinations of aquifer characteristics from geotechnical site investigations

Results from the Shah Deniz midstream geotechnical investigations (Gibb 2001) have been examined, based on a digital preliminary version of all trial pit and borehole logs (provided by K. Richardson, geotechnical consultant to BP, 16/10/01). These comprise:

- c. 112 trial pits, typically to c. 3m depth
- c. 110 investigation borehole logs. The boreholes are generally rather shallow, being less than 40m and, in most cases, less than 20m deep (Figure 2-6)

Figure 2-6 Distribution of depths of investigation boreholes forming the Shah Deniz midstream geotechnical investigations



In general, the geotechnical results support the information gleaned from existing sources in section 2.4 above, with generally fine-grained sands and silts east of Yevlakh (with the exception of coarser-grained alluvial materials in the Kura valley), and coarser sands and gravels becoming more prevalent west of the Goranchay River. It is, however, noteworthy that the investigation boreholes encounter good gravelly/sandy massive aquifer units rather seldom in interfluvial areas west of Yevlakh. It may be that the "unconfined" aquifer complex,

discussed by local hydrogeologists (Section 2.4.4), over much of this interfluvial area comprises, in its upper part, alternating sands, silts and clays rather than a massive gravelly aquifer unit. It may alternatively be that any thick aquifer sequence commences beneath the base of the rather shallow geotechnical boreholes (in which case such an aquifer would be well protected, and may possibly even be partially confined).

In certain locations, however, exploration borehole logs indicate that sands and gravels stretch almost from the surface to the full depth of the borehole. Such boreholes are typically located in major river valleys (eg the Koshkarchay, Shamkirchay, Dzegamchay, Tovuzchay and Hasansuchay). Here, it is believed that coarse, transmissive deposits form the "core" of alluvial fans, and *may* provide a recharge pathway to deeper aquifer horizons.

Section 2.5.1 discusses the uppermost portion of the borehole and trial pits logs (down to 4m depth). Sections 2.5.3 to 2.5.5 use the samples collected from trial pits and entire borehole sections to statistically assess the distribution of hydraulic parameters west of the River Goranchay.

2.4.7 Distribution of sub-soil permeability (to 4m depth) along the pipeline route

Borehole and trial pit logs from the Shah Deniz midstream geotechnical investigations have been examined. The assessment is based on the zone from 1 to 4m depth, as this is believed to be the zone most relevant to possible leakages from a buried pipeline (at 1 to 2m depth). The classification used is based on the following scale:

- 1 = very low permeability (clay)
- 2 = low permeability (silt and fine sand)
- 3 = medium permeability (medium to coarse sand)
- 4 = high permeability (gravels/cobbles)
- 5 = very high permeability (fissure flow)

There is clearly a degree of subjectivity in the classification for the following reasons:

- Based on logs, it is difficult to ascertain the degree of sorting (which will have a large effect on permeability)
- Trial pit logs do not reach to 4m, therefore the assessment is made of only a partial profile. Classifications based on borehole data are thus more representative than those based on trial pits
- The relevant section of the logs may contain different lithologies. In most cases, it was decided to err on the side of caution. For example, if the 3m section (1-4m) contains 1.5m silt and 1.5m gravel, the location would receive a rating "4". If, however, the gravel was only a thin bed within silts, a compromise designation of "3" may be chosen

Results are plotted in Figures 2-7a,b to 2-8a,b.

Figure 2-7a,b Classification of subsoil permeability at 1 to 4m depth in Shah Deniz geotechnical boreholes.

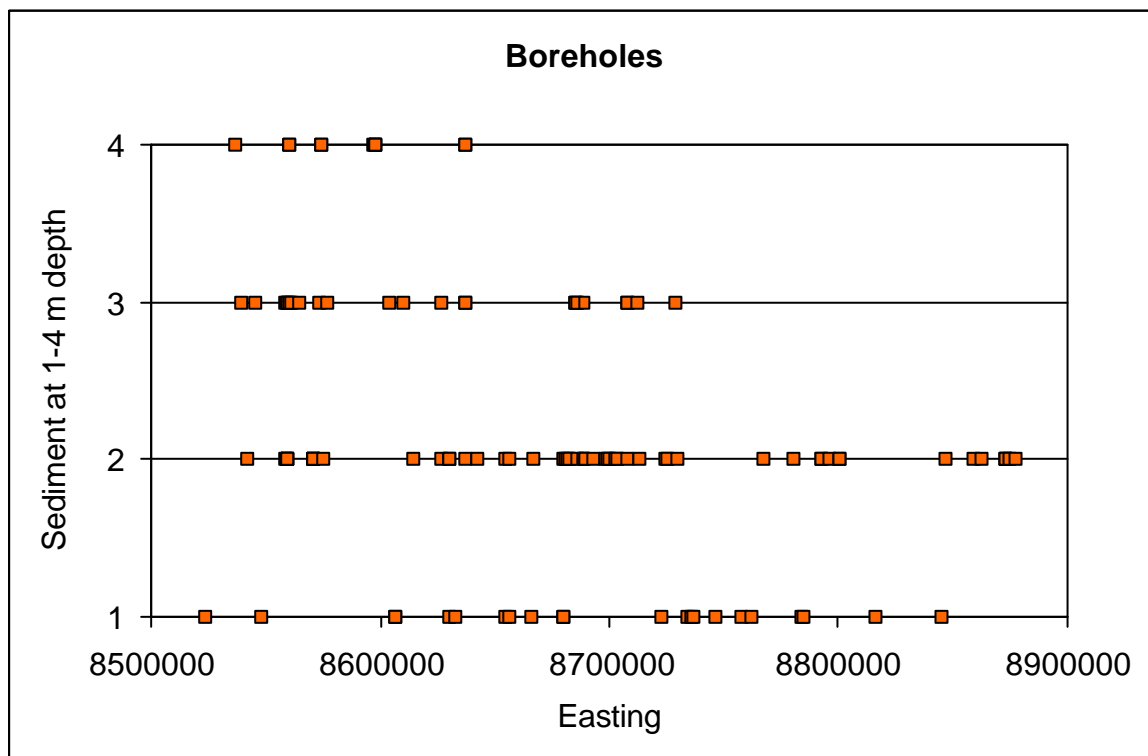
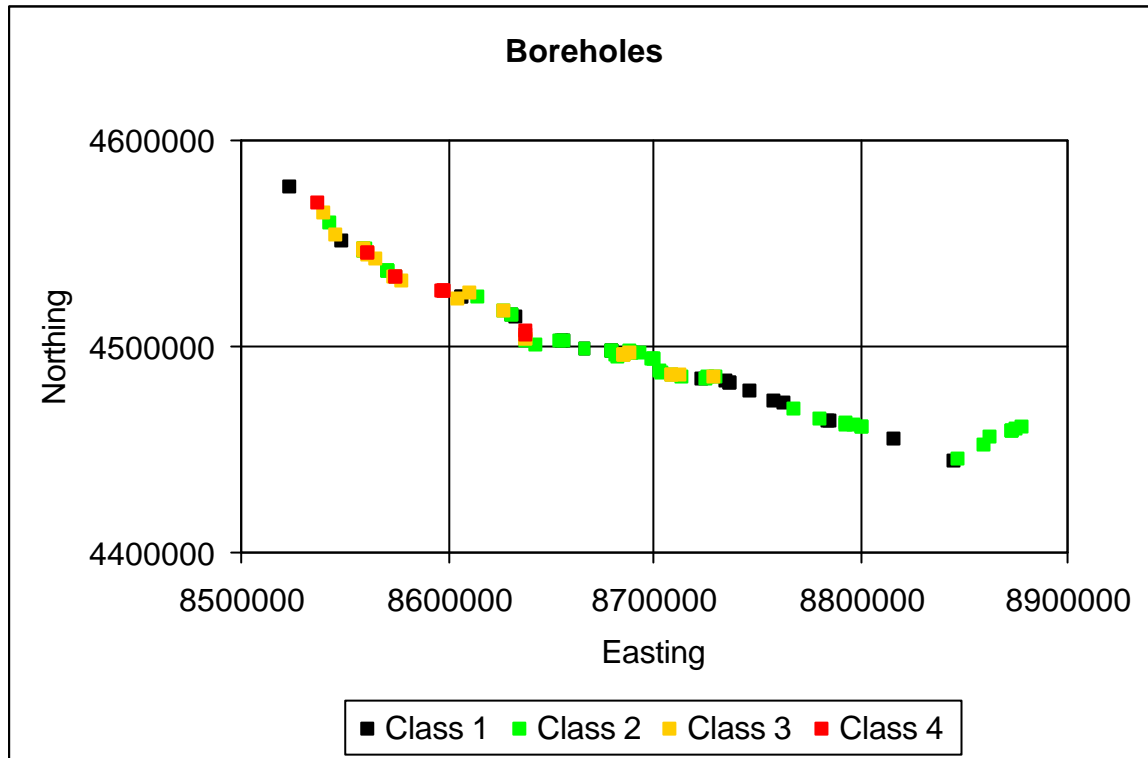
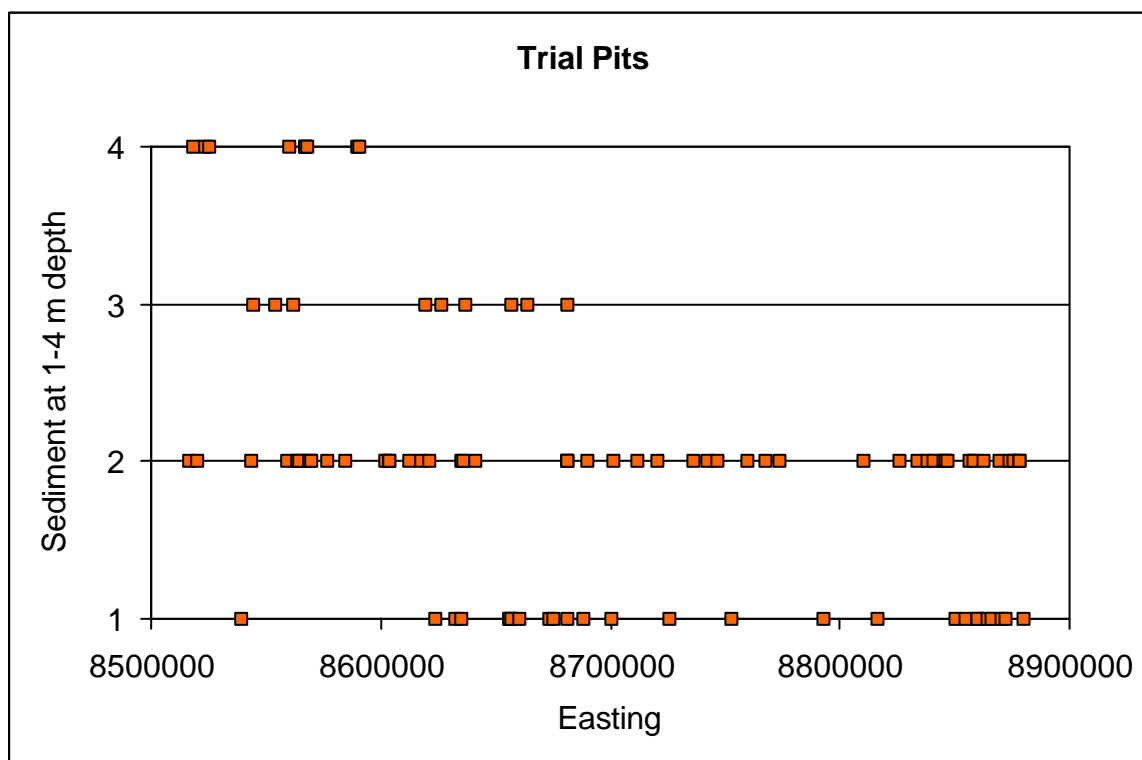
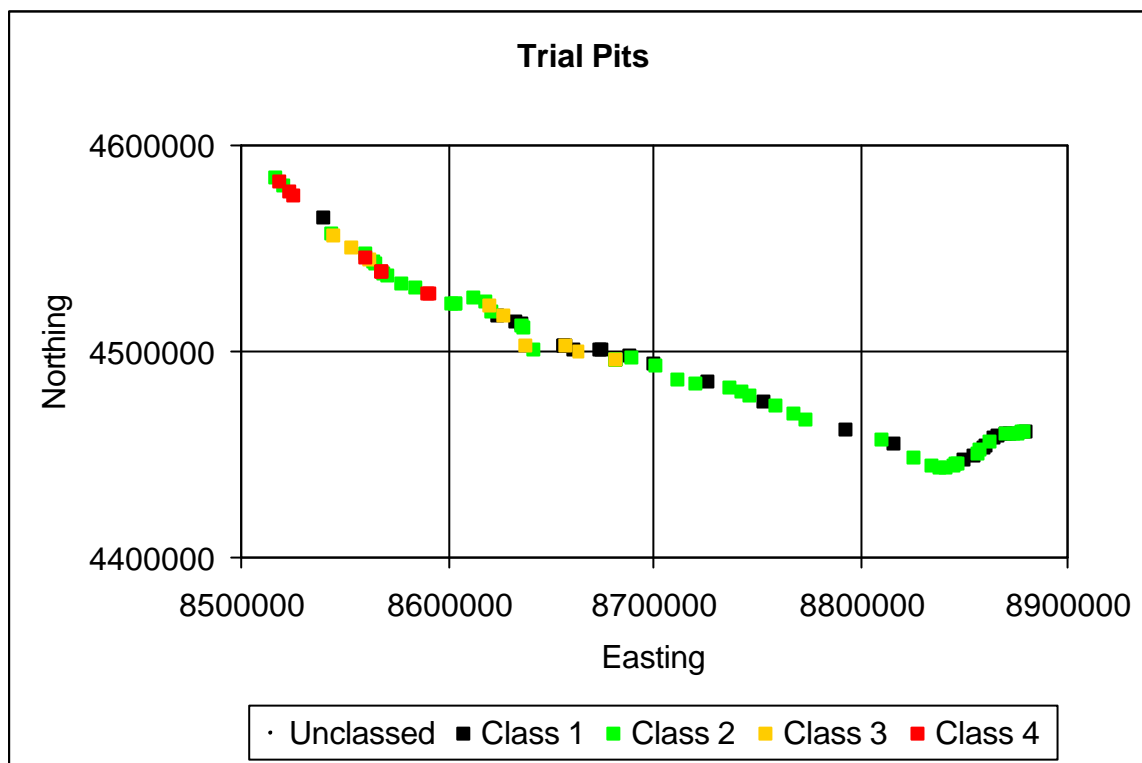


Figure 2-8a,b Classification of subsoil permeability at 1 to 4m depth in Shah Deniz geotechnical trial pits

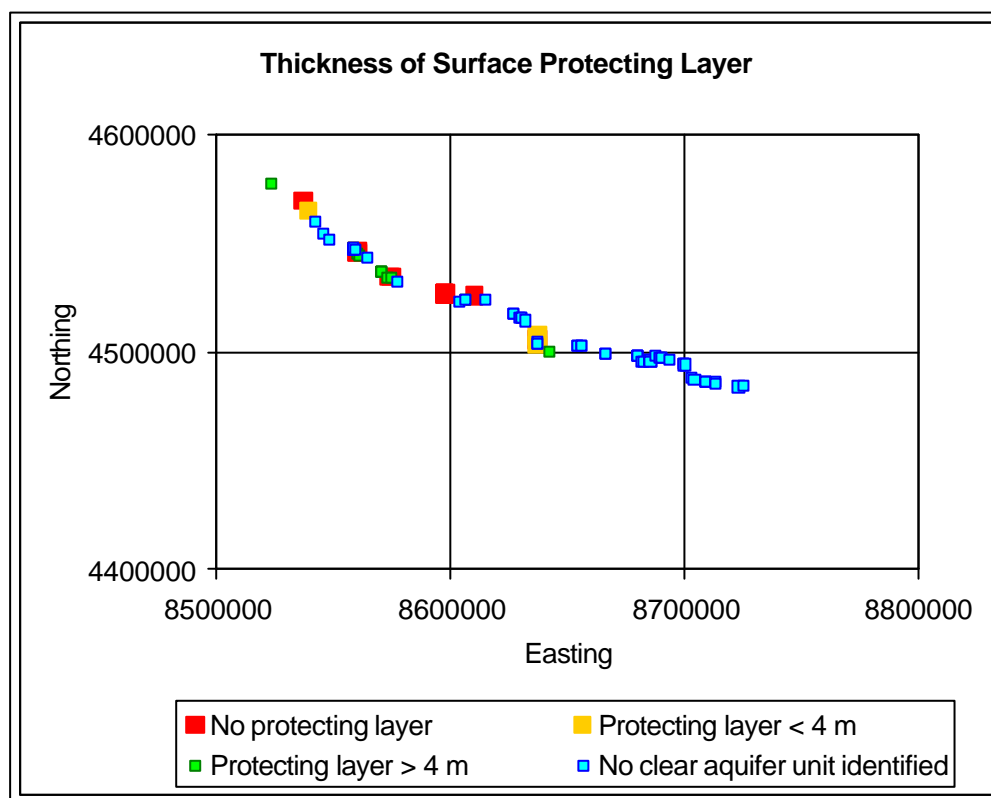


It is clear from Figures 2-7 and 2-8 that the subsoil to the east of the Kura crossing near Yevlakh is largely comprised of fine-grained silts and clays with subordinate sands. West of

Yevlakh, and especially west of Shamkir, the subsoil becomes more frequently sandy/gravelly/cobbly (Gibb 2001), offering less protection to the groundwater environment in the event of a leakage or spill. It will be noted, however, that, in the Ganja-Kazakh Piedmont Plain and the Karayazi section, there are locations where a superficial layer of silty or clayey material several metres thick appears to afford a degree of protection. It is, however, not consistently present. Thus, borehole logs west of the River Kura crossing have been examined to identify the thickness of any silty/clayey protecting layer overlying a major sand/gravel aquifer (Figure 2-9). Boreholes have been ranked in 4 ways:

- 1 = no protective layer. Sand/gravel aquifer exposed at surface
- 2 = protective layer <4m thick above sand/gravel aquifer
- 3 = protective layer >4m thick above sand/gravel aquifer
- 4 = no clear aquifer unit identified in borehole (this could mean that the aquifer unit does not commence until below the borehole base, or that the aquifer here comprises relatively thin interlayers of finer and coarser material, rather than a single unit).

Figure 2-9 Nature of any superficial protective layer overlying sandy/gravelly aquifer material in geotechnical exploration boreholes west of the River Kura.



It is notable that, east of Ganja, it was typically not possible to identify a clear massive sand/gravel aquifer unit within the depth of the borehole. West of Ganja, an "unconfined" sand/gravel aquifer unit becomes more readily identifiable (especially in major river valleys), either with or without any protective superficial layer. However, even here, in a significant number of localities, a clearly identifiable aquifer unit was not identified within the depth of the borehole.

2.4.8 Gypsum and organic carbon content

Gypsum spots, streaks or, occasionally, crystals are present in the soils along the route, with determined gypsum contents in samples ranging from 0.07 to 4 %, with some high values of up to around 9% (Gibb 2001).

Content of organic material was determined on a very limited number of samples along the proposed pipeline route by Gibb (2001), and summarised in Table 2-4. It is assumed (though not specifically stated by Gibb) that these samples are generally clays and silts, rather than gravels.

Table 2-4 Organic content of sediment samples taken along proposed pipeline route by Gibb (2001), expressed as % organic matter.

Chainage KP	Range %	Median %	Location
129	0.62	(0.62)	BVA5
153	0.43	(0.43)	BVA6
90-216	0.43-0.90	0.48	
216-226	0.28-0.62	0.45	
226-244.5	0.22-0.32	0.27	
281-322.5	0.14	(0.14)	

2.4.9 Grain size distribution

Grain size analyses from samples from the boreholes and trial pits of the Shah Deniz midstream geotechnical investigations (Gibb 2001) have been examined (digital preliminary version of trial pit and borehole log data, provided by K. Richardson, geotechnical consultant to BP, 16/10/01). The Beyer method, cited in Langguth and Voigt (1980) and Misund and Banks (1993) has been used to estimate hydraulic conductivity (K), porosity and effective porosity from grain size distributions.

The grain size analyses suggest that such gravelly deposits as are encountered in boreholes and trial pits in the Yevlakh/Akstafa and Karayazi areas are generally rather poorly sorted, with d_{60}/d_{10} ratios in the range 10 to >100. Occasionally, better-sorted coarse-grained gravels occur, with d_{60}/d_{10} ratios in the range 210 and very high calculated values of hydraulic conductivity, especially within the valleys of the Rivers Tovuzchay and Shamkirchay,

Figures 2-10 and 2-11 show grain size analyses for samples of gravels and silts/clays with rather typical estimated values of hydraulic conductivity (with the exception of BH-A61/B4, which comprises very coarse gravels in the Tovuzchay valley, yielding an extremely high value of conductivity).

Figure 2-10 Grain size distribution curves for five selected samples of gravel: (i) Borehole BH-A70, sample B2 (4-5m depth), Karayazi, nr. Kechveli, estimated $K = 70\text{m day}^{-1}$, (ii) Borehole BH-A61, sample B4 (6.5-8m depth), River Tovuzchay, estimated $K > 1000\text{m day}^{-1}$, (iii) Borehole BH-A56, sample B1 (0-0.75m depth), near River Dzegamchay, estimated $K = 190\text{m day}^{-1}$, (iv) Trial pit TP-A67, sample B1 (0.2-1m depth), near Hasansuchay, estimated $K = 290\text{m day}^{-1}$, (v) Trial pit TP-A59, sample B3 (1.1-3.1m depth), between Dzegamchay and Tovuzchay, estimated $K = 390\text{m day}^{-1}$.

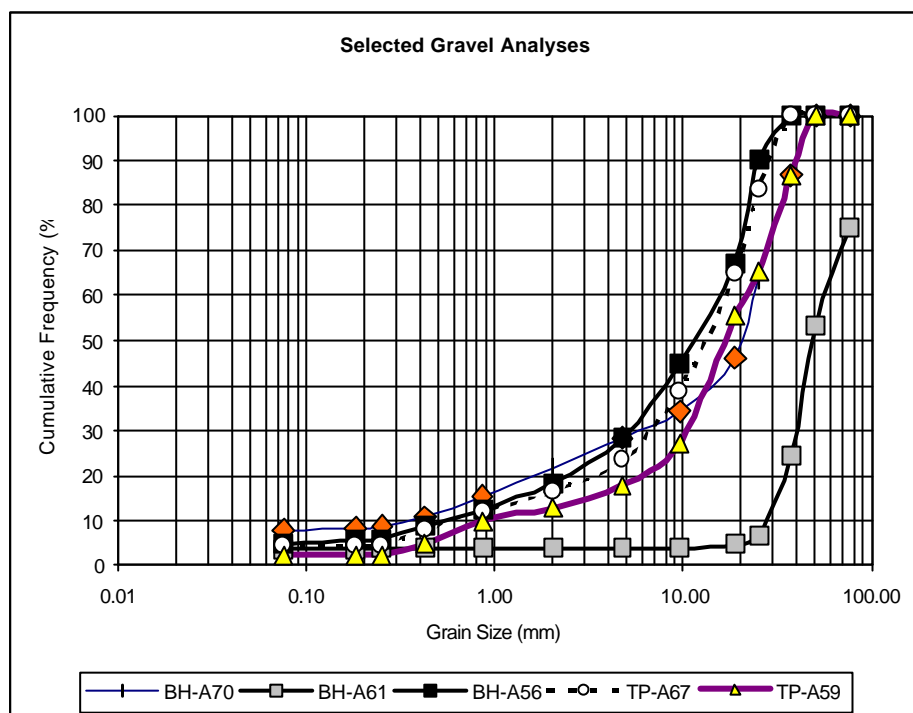
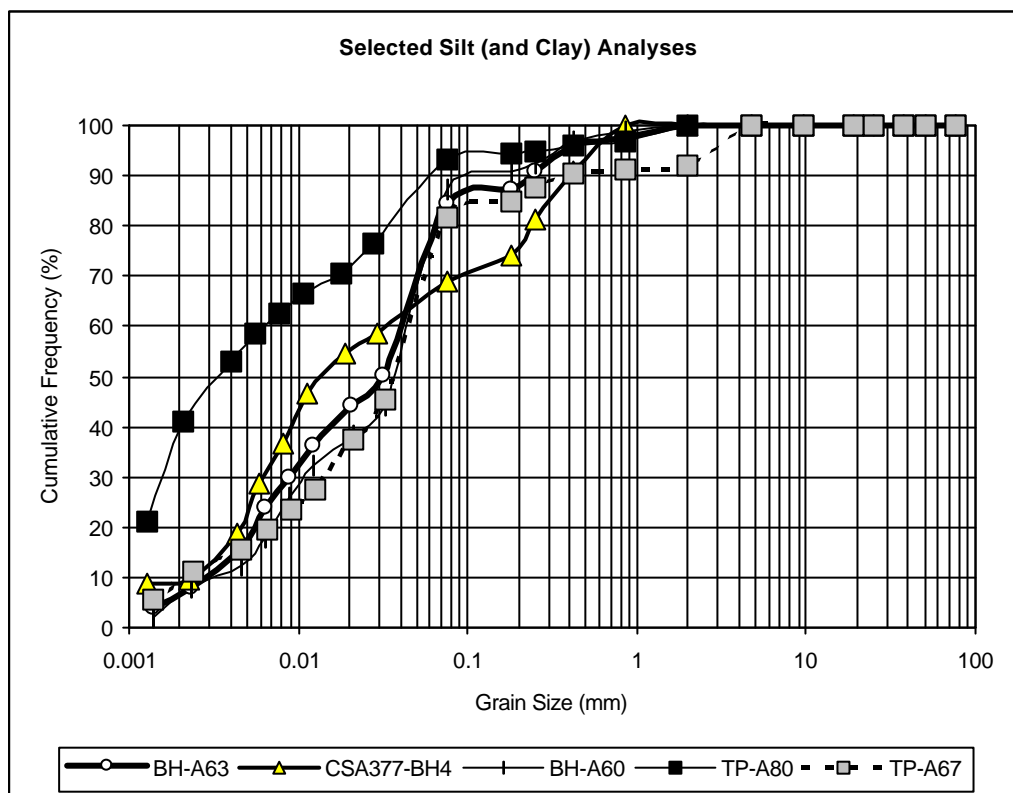


Figure 2-11 Grain size distribution curves for five selected samples of silt/clay: (i) Borehole BH-A63, sample UD3 (silt, 4-4.5m depth), SW of River Hasansuchay, estimated $K = 5 \times 10^{-8}$ m/s, (ii) Borehole CSA377-BH4, sample B1-2 (silt, 2.5-3m depth), NW of River Tovuzchay, estimated $K = 4 \times 10^{-8}$ m/s, (iii) Borehole BH-A60, sample UD1 (silt, 2.5-3m depth), near River Tovuzchay, estimated $K = 7 \times 10^{-8}$ m/s, (iv) Trial pit TP-A80, sample B1 (clay, 0.15-1.05m depth), near Boyuk Kasik, Karayazi, near Georgian border, estimated $K = 8 \times 10^{-9}$ m/s, (v) Trial pit TP-A67, sample B2 (silt, 1.3-2.2m depth), near Hasansuchay, estimated $K = 3 \times 10^{-8}$ m/s.



2.4.10 Saturated hydraulic conductivity

The estimation of hydraulic conductivity is essentially based on the following algorithm:

$$K = C \cdot d_{10}^2$$

where C is a coefficient depending on the degree of sorting (d_{60}/d_{10}), and d_{10} and d_{60} are the 10th and 60th percentiles of the cumulative grain size distribution curve. The following diagrams (figures 2-12a-c and 2-13) illustrate the distribution of calculated hydraulic conductivities in samples west of borehole BH-A36 and trial pit TP-42a (ie west of River Goranchay).

Figure 2-12a Distribution of hydraulic conductivity (estimated from grain size distributions for samples where $d_{10} > \text{detection limit}$) of samples from boreholes west of the River Goranchay)

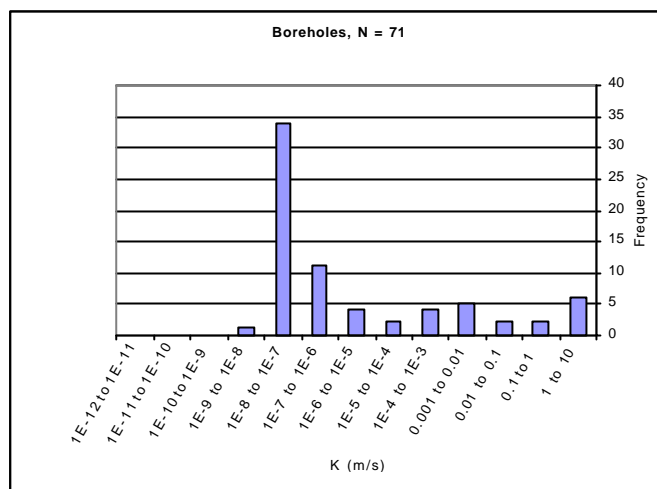


Figure 2-12b Distribution of hydraulic conductivity (estimated from grain size distributions for samples where $d_{10} > \text{detection limit}$) of samples from trial pits west of the River Goranchay)

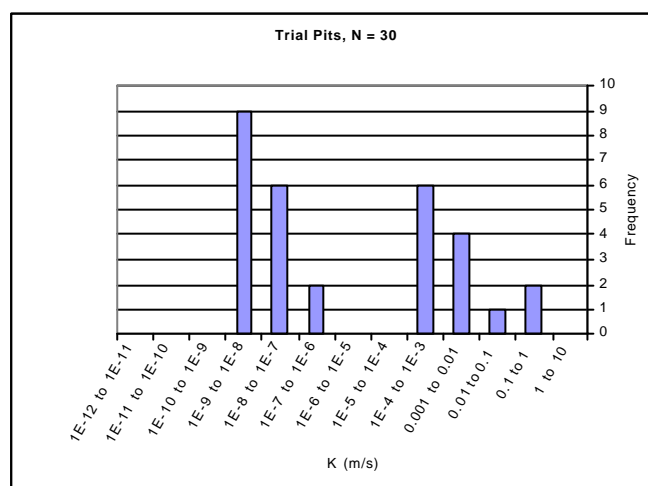


Figure 2-12c Distribution of hydraulic conductivity (estimated from grain size distributions for samples where $d_{10} >$ detection limit) of samples from trial pits and boreholes west of the River Goranchay).

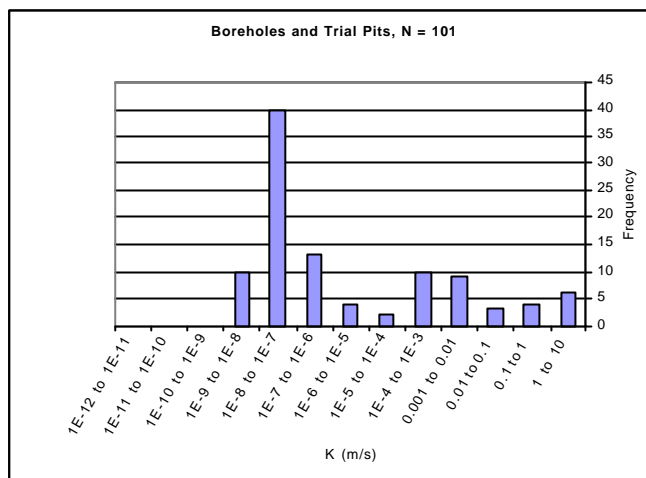
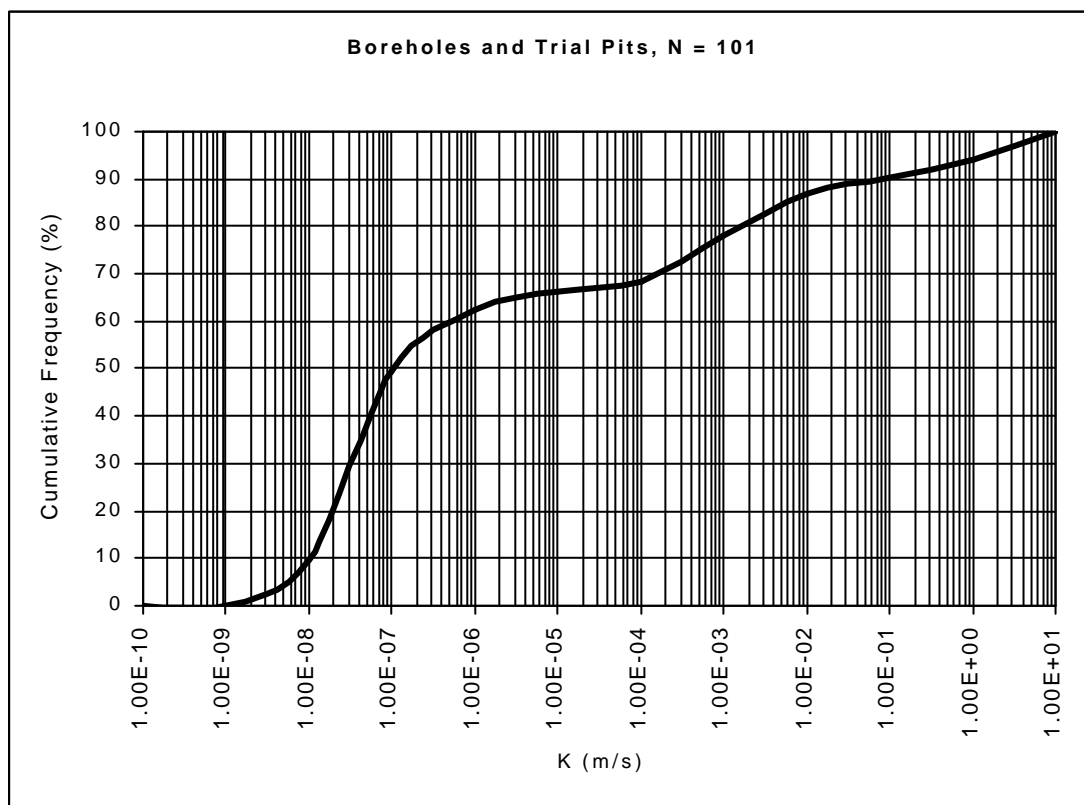


Figure 2-13 Distribution of hydraulic conductivity (estimated from grain size distributions for samples where $d_{10} >$ detection limit) of samples from trial pits and boreholes west of the River Goranchay



The diagrams suggest a bimodal distribution of hydraulic conductivities, with modal values:

Silt: mode = $3 \text{ to } 4 \times 10^{-8} \text{ m/s}$ ($3 \times 10^{-3} \text{ m day}^{-1}$)

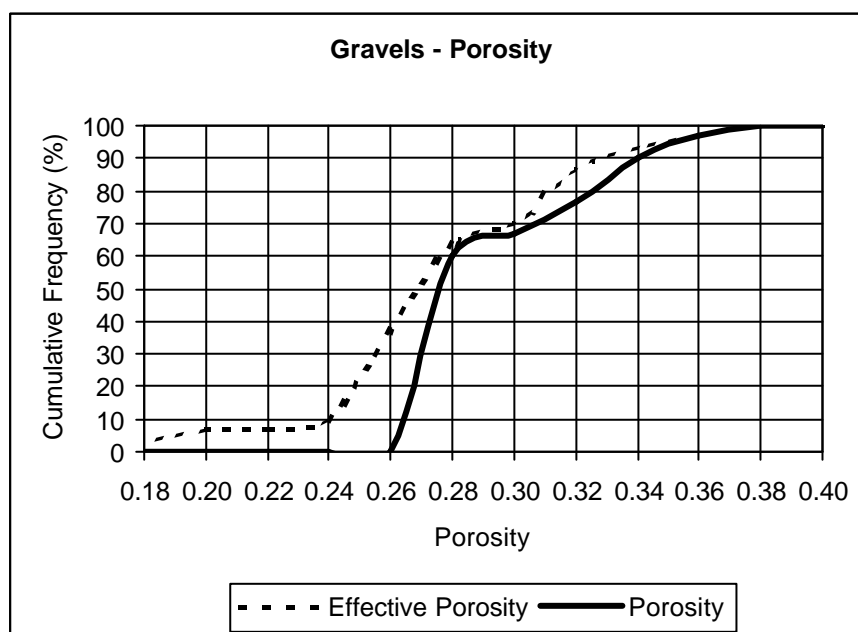
Gravel and sandy gravel: mode = c. $1 \text{ to } 2 \times 10^{-3} \text{ m/s}$ ($86 - 170 \text{ m day}^{-1}$), median = $5 \times 10^{-3} \text{ m/s}$ (430 m day^{-1})

This situation is almost certainly not a true representation of the distribution of conductivities in the ground. Fine-grained samples were determined for particle size by wet sieving and hydrometer, coarse sediments by wet sieving. There are a substantial number of clayey samples with a d_{10} grain size $<0.001\text{mm}$ (the lowest category determined by hydrometer measurements), for which it has not been possible to quantitatively estimate hydraulic conductivity. There are also a number of coarser samples where the d_{10} value lies below the smallest sieve size of 0.075mm . Thus, the apparent bimodal distribution, may simply be an artefact of clayey and finer sandy deposits not having d_{10} quantified by the available analytical techniques. Additionally, the very highest gravel hydraulic conductivities are likely to be significantly overestimated, as the Beyer method is not appropriate to such large grain sizes.

2.4.11 Porosity

Porosity and (hydraulically) effective porosity can also be estimated by Beyer's nomograms (Langguth and Voigt 1980, Misund and Banks 1993), although these are only likely to be valid for rather sandy/gravelly sediments. Taking only the gravel strata in samples west of borehole BH-A36 and trial pit TP-42a (ie west of River Goranchay), the distribution of these parameters is shown in figure 2-14.

Figure 2-14 Distribution of porosity and effective porosity (estimated from grain size distributions) of gravel samples from trial pits and boreholes west of the River Goranchay (N=30).



It will be seen that the median gravel porosity is estimated as some 28%, with a median effective porosity of 27%.

2.5 AQUIFER PROPERTIES DETERMINED BY ADDITIONAL ANALYSES (OCT. 2001)

2.5.1 Introduction

In October 2001, fifteen samples of sediment (numbered Az10 to Az24) were collected from the area between Geranboi and the Georgian border at Boyuk Kasik. The samples were collected from the erosional bank cliff of river channels (eg Tauzchay, Shamkirchay, Hasansuchay etc.) or from gravel pits. The samples are typically either of gravels/cobbles or of silty strata, and are typically also collected within three vertical metres of the ground surface. The sample descriptions are given in Annex 1. The quantity of sample collected was typically some 6-7l (c. 15kg) in a sealed bucket, using a stainless steel trowel. The samples were submitted to Caspian Environmental Laboratories (CEL) of Baku, where they were subject to the following analyses:

- Grain size analysis using a combination of dry sieving, wet sieving and pipette determination. This resulted in grain size classes ranging from >4mm to <3.6µm. The method is described in CEL (2001a)
- Determination of carbonate content (by weight loss on hydrochloric acid digestion) and organic matter content (by additional weight loss on ignition at 600°C). The method is described in CEL (2001b)
- Sediment-water partition coefficients for benzene were determined at three aqueous concentrations of benzene (100, 500 and 1000µg/l) using a batch method.

Samples Az17 and Az19 were field duplicates.

2.5.2 Grain size distributions

Raw data for the grain size analyses may be found in Annex 1. Figures 2-15a, b, c illustrate graphically the results as diagrams showing cumulative percentage passing each individual sieve size.

Figure 2-15a Cumulative grain size distribution curves (percentage finer than a given dimension) for gravel/cobble samples Az11, 12, 13 and 14, analysed at CEL.

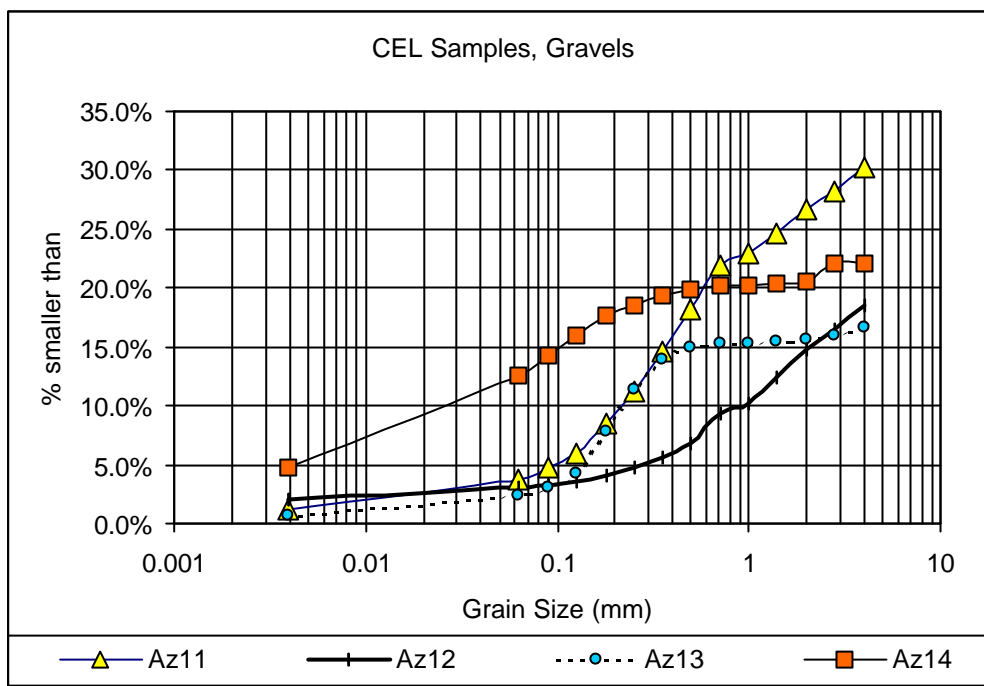


Figure 2-15b Cumulative grain size distribution curves (percentage finer than a given dimension) for gravel/cobble samples Az15, 16, 20, 21 and 23, analysed at CEL

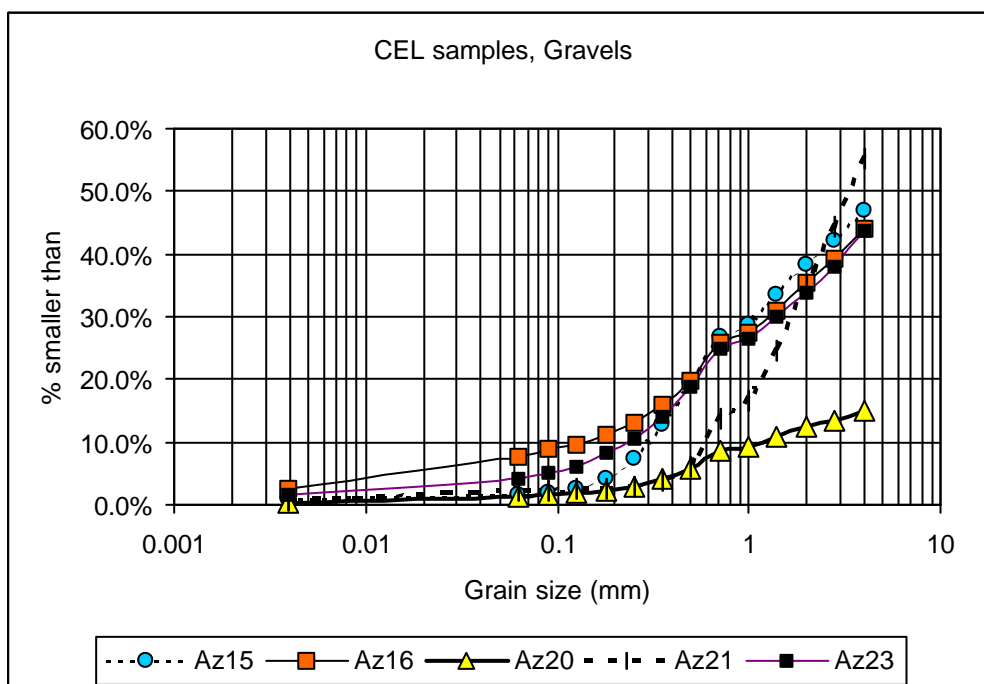
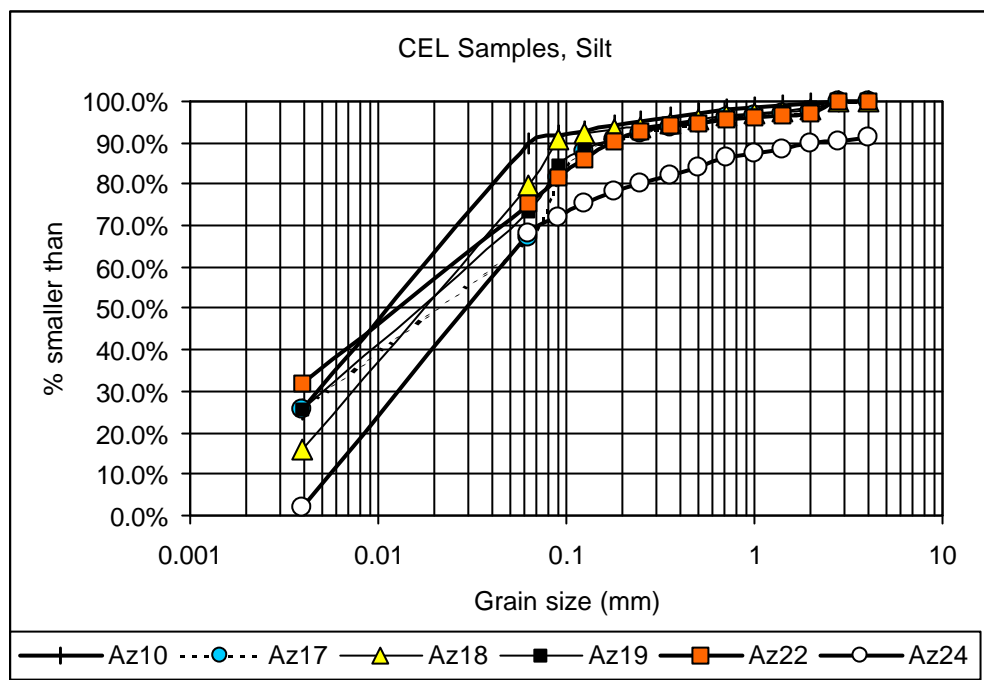


Figure 2-15c Cumulative grain size distribution curves (percentage finer than a given dimension) for silt samples Az10, 17, 18, 19, 22 and 24, analysed at CEL. Az17 and Az19 are field duplicates



2.5.3 Determinations of organic matter and carbonate content

Raw data from these determinations are shown in Annex 1. Table 2-5 summarises the statistical distribution of organic and carbonate content in the silt samples (Az10, 17, 18, 19, 22 and 24) and gravel/cobble samples (Az11, 12, 13, 14, 15, 16, 20, 21 and 23).

Table 25 Arithmetic mean (average), median, maximum and minimum values for organic matter (OM) and carbonate contents in silt (N=6) and gravel/cobble (N=9) samples, analysed at Caspian Environmental Laboratory. Organic carbon (OC) is estimated by $OC=0.5 \cdot OM$.

Silts	OM	OC	Carbonate
Average	4.5%	2.3%	22.9%
Median	4.3%	2.2%	22.9%
Max	6.1%	3.1%	28.0%
Min	2.8%	1.4%	18.4%
Gravels	OM	OC	Carbonate
Average	1.1%	0.6%	5.9%
Median	0.9%	0.4%	5.6%
Max	2.3%	1.1%	11.1%
Min	0.4%	0.2%	2.2%

It will be noted that the determinations of organic matter do not tally well with those performed by Gibb (2001) and documented in Table 2-4. It may be that the CEL samples were sampled in a more open environment than the Gibb (2001) samples (which were taken from trial pits/boreholes) and so may have had more opportunity to be contaminated by surficial humic soils. The discrepancy may also be ascribed to analytical error. While the

grain size curves and carbonate contents are very similar for the field duplicate samples Az17 and Az19, the organic matter determinations deviate significantly (Annex 1).

2.5.4 Sediment-water benzene partition coefficient

Sediment-water partition coefficients for benzene were determined at three aqueous concentrations of benzene (100, 500 and 1000 µg/l) using a batch method. A sediment-water mass ratio of approximately 2:1 was used. The benzene solution-sediment mixture was agitated in sealed vessels for 14 hours, following which the sediment was allowed to settle for 1 hour before the aqueous phase was filtered. The filtrate was analysed by GC-FID. Process blanks were included to determine benzene losses and recovery, and the data in Table 2-6 have been corrected accordingly.

Table 2-6 Soil/water partition coefficients for benzene (ml/g) for four different sediment samples

Sample	Type	Benzene conc. µg/l	K _d ml/g	Average K _d ml/g	Soil characteristics
Az13	Gravel/cobbles	100	0.52	0.36	83.5% >4mm 2.0% organic matter
		500	0.20		
		1000	0.35		
Az18	Silt	100	1.13	1.16	80% <63µm 0% >4mm 2.8% organic matter
		500	1.71		
		1000	0.63		
Az20	Gravel/cobbles	100	0.27	0.25	85% >4mm 0.4% organic matter
		500	0.15		
		1000	0.33		
Az21	Gravel/cobbles	100	0.61	0.63	44.8% > 4mm 1.4% organic matter
		500	0.53		
		1000	0.76		

Note that the US Environmental Protection Agency cite K_d values of 0.14 to 0.83 ml/g for soils containing 0.1-1% organic carbon. Golder (2000) recommend a value of 0.57 ml/g for sediments with 1% organic carbon. Given that it is generally accepted that K_{oc} lies in the range of several tens of ml/g, the determined values in table 6, suggest that organic carbon contents of around 0.4 - 1.1% are realistic for gravels, and 2.0% for silt. These tally with the organic carbon determinations provided by CEL (section 2.6.3).

3 CONCLUSIONS

3.1 PIPELINE ROUTE

3.1.1 Hydrogeological classification of the pipeline route

The proposed pipeline route has been assessed according to two measures:

1. Soil/subsoil permeability from depth 1m to depth 4m, according to the following scale, using data from the Shah Deniz midstream geotechnical investigations (Gibb 2001):
 - Class 1 = very low permeability (clay)
 - Class 2 = low permeability (silt and fine sand)
 - Class 3 = medium permeability (medium to coarse sand)
 - Class 4 = high permeability (gravels/cobbles)
 - Class 5 = very high permeability (fissure flow)
2. Groundwater vulnerability, based on type and importance of aquifer, using the following scale :
 - Class 1 = Non-aquifer
 - Class 2 = Confined aquifer - local importance
 - Class 3 = Confined aquifer - regional importance
 - Class 4 = Unconfined aquifer - local importance
 - Class 5 = Unconfined aquifer - regional importance

In terms of subsoil permeability, it should be noted that there is a degree of subjectivity in the classification for the following reasons:

- Trial pit logs do not reach to 4m; therefore the assessment is made of only a partial profile. Classifications based on borehole data are thus more representative than those based on trial pits
- The relevant section of the logs may contain different lithologies. In most cases, we have chosen to err on the side of caution. For example, if the 3m section (1-4m) contains 1.5m silt and 1.5m gravel, the location would receive a rating "4". If, however, the gravel was only a thin bed within silts, a compromise designation of "3" may be chosen
- The trial pits and boreholes are not evenly distributed along the borehole route, and do not reach a density of one per kilometre. Thus, a significant amount of interpolation between investigation points has been necessary. For example, between KP 414 and KP 426 there is no available geological information
- The route of geotechnical investigation deviates significantly from the latest pipeline route (Route 09) between KP 365 and KP 390

As regards groundwater vulnerability, it should be noted that the applied classification is not ideally suited to the situation along the proposed pipeline route for several reasons:

- It takes no explicit account of water quality (ie whether water is potable or not)
- Along parts of the proposed pipeline route, there may exist a vertical sequence comprising an unconfined aquifer complex and several confined aquifer complexes

- It does not recognise that a deep unconfined aquifer may be overlain by a substantial protective (though not confining) layer of silt and clay, whereas a confined aquifer may be very shallow and confined by only a relatively thin layer of clay

In general, groundwater can be regarded as vulnerable to contamination from pipeline construction or operation where the subsoil permeability is high, and where there exists an unconfined aquifer of local or regional importance.

3.1.2 East of Yevlakh

From KP0 (Sangachal) to the Kura at KP216, there is likely to be little conflict between potential contamination from the pipeline and potable groundwater interests. This is because the subsurface sediments are generally fine-grained, groundwater recharge is very low and groundwaters are saline and not suitable for exploitation as potable water resources. Regional head gradients are also likely to be dominantly upwards. Aliyev (2001) and the published hydrogeological map (Aliyev et al. 1992) support this viewpoint.

Between Sangachal and Kazi Magomed, terrain varies in elevation and is, in places, steep. Sediments are dominantly argillaceous and groundwaters saline. The main exception is in the alluvial deposits of the River Pirsagat, where limited fresh groundwater resources are stated to occur (Aliyev 2001).

On the Shirvan Plain, head gradients are low (0.03 to 0.0007) and decrease in the direction of the Kura River. The thickness of significantly transmissive strata also decreases towards the Kura and is believed to be of the order of 10-20m in the proposed pipeline corridor. Hydraulic conductivities are believed to be 0.1 to 3m day⁻¹ in the water-bearing strata. On the proposed pipeline route across the Shirvan Plain, groundwater mineralisation is typically in the range 5-100g/l. The water table is generally within 3m of the ground surface over 90% of the area of the Shirvan Plain, partially owing to protracted infiltration of irrigation water from canal systems. On the proposed pipeline route, only in the regions of Kurdamir and Shakyar-Kobu is the groundwater level expected to be deeper, approximately 5-10m bgl (Aliyev 2001).

Three caveats to the general designation of low groundwater vulnerability in this section should be noted, however:

1. There may exist small (unmapped) pockets or lenses of fresh groundwater along the route. These, if they exist, are likely to be extremely important to local herdsman, nomads and even villagers in this arid region because fresh groundwater reserves are so scarce.
2. Where permeable strata exist, groundwater resources are likely to be brackish or saline, and thus of little use as a drinking water resource. They may, however, have a potential use as irrigation water (under some circumstances) or as a water resource for industrial use. Such uses of water are obviously less sensitive to contamination than potable usage. However, even such low sensitivity usages will be susceptible to gross contamination by hydrocarbons.
3. Even where usable groundwater resources do not exist, permeable strata in the subsurface may be efficient at transporting spilled or leaked contaminants to surface water receptors such as streams or irrigation canals, where the presence of contamination could have an adverse impact.

In the immediate vicinity of the Kura, high permeability alluvial sediments occur, which are assumed to have potential value as aquifers (KP217-225). Such deposits are also likely to be efficient at transporting spilled or leaked contaminants via the subsurface to the River Kura.

3.1.3 Yevlakh and west

West of the Kura, through Yevlakh and in the western outskirts of Yevlakh, confined aquifers exist which are exploited for reserves of fresh groundwater. This confined groundwater is not believed to be vulnerable to contamination from construction or operation of the proposed pipeline, as it is confined typically by at least 10m of clay. In this area, shallow "unconfined" groundwater is encountered at depths of only 1-2m bgl, typically in sands and loamy sands with hydraulic conductivities of 0.1 to 3m day⁻¹. It is usually highly mineralised (10 - 15g/l) and generally unsuited to potable supply, but may conceivably have applications for industrial usage. The subsurface may also permit spilled hydrocarbons to migrate to surface water recipients, or permit vapours to migrate into dwellings. In general, the sensitivity of groundwater to contamination is regarded as low, however.

Further west, especially west of the River Goranchay, on the Ganja-Kazakh Piedmont Plain, unconfined groundwater becomes progressively fresher and regarded as an exploitable resource. Its vulnerability to contamination thus increases. The aquifer complex here comprises proluvial and alluvial deposits of sands, gravels and cobbles, alternating with silty/clayey interlayers. The complex generally becoming finer grained away from the Lesser Caucasus towards the River Kura. The aquifer horizons here are conventionally divided into one upper, partially unconfined aquifer complex (Russian *gruntovaya voda*) and four confined aquifer complexes (Russian *napornii vodonosnii gorizont*), largely on the basis of stratigraphic proximity of aquifer horizons with similar water chemistry. These subdivisions are largely symbolic and arbitrary as the real structure of the aquifer is complex with many alternating coarse and fine layers that vary laterally. Ultimately, the sedimentary succession must be viewed as a single unit.

On the Piedmont Plain, depths to groundwater are low (<5m) in the Geranboi/Goranchay area and in the valleys of the main rivers. Depths to water table can exceed 25m in interfluvial areas. Groundwater is generally fresh (<1g/l mineralisation) except in the area immediately north and north-east of Geranboi. The hydraulic conductivity of the sediments comprising the upper aquifer complex is stated by Tagiev and Alekperov (2001) to be in the range 0.1-13.4m day⁻¹, although discussions with the State Committee for Geology suggest that values of 20-100m day⁻¹ may be more typical for the gravelly/cobbly strata.

In the immediate subsurface of interfluvial areas of the Ganja-Kazakh Piedmont Plain, there are often layers of silt or clay which will hinder (although not necessarily prevent) the downward migration of hydrocarbons to the water table. Several confined aquifer horizons, with fresh groundwater reserves, also exist beneath most of the area. These are generally not regarded as being vulnerable to potential contamination from pipeline-related activities.

Throughout the Ganja-Kazakh Piedmont Plain, both unconfined and confined aquifers are exploited by wells, boreholes, springs and karizes for potable, irrigation and industrial uses. In recent years, the total rate of production of subsurface waters for the entire Piedmont Plain was between 820,000 and 1,130,000 m³/d (9,500 to 13,100 l/s). Musaev and Panakhov (1971) reported more than 300 karizes in the unconfined aquifer of the Piedmont Plain, with a total flow of >6,000 l/s.

In the valleys of the major rivers (Tovuzchay etc.) draining the north-eastern slope of the Lesser Caucasus, vulnerability of groundwater is regarded as extremely high, for the following reasons:

- The immediate subsurface is generally sandy/gravelly/cobbly, with a high degree of interconnectivity

- The water table is relatively shallow
- The gravels of the immediate subsurface may have been "winnowed" of fine material by fluvial reworking; these deposits may thus be especially permeable

A spill in such valleys may have particularly severe implications because contaminants may migrate rapidly vertically downwards to groundwater resources, down-valley through fluvial sediments or laterally to the surface watercourse through fluvial sediments.

For similar reasons (shallow water table, gravelly/cobbly subsurface strata, highly permeable aquifer strata), large portions of the Karayazi Plain section of the proposed pipeline route are regarded as rather sensitive as regards groundwater contamination. In this area, inhabitants are known to use shallow groundwater for drinking water supply. Shallow groundwater also supports wetland interests of considerable ecological value.

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ANNEX 1 Results of analyses of sediment samples collected in October 2001 and performed by Caspian Environmental Laboratories.

Annex 1, Table 1 Sample locations for samples analysed at CEL

Sample	Pulkova E	Pulkova N	Elevation m asl	Location	Description
Az10	085-86-394	045-27-672	319	Smallish river near Dallar	Sample of bed (c. 1 m thick) of occasionally sandy, pale brown, unbedded silt/clay in 4 m high erosional river bank, c. 20 m south of main road
Az11	085-86-394	045-27-672	319	Smallish river near Dallar	Sample of bed of gravel/pebbles in medium-coarse sandy matrix (with relatively low silt/clay content) in 4 m high erosional river bank, c. 20 m south of main road
Az12	085-93-541	045-20-099	365	River Shamkirchay	Sample of gravel/pebble/cobble strata in rather poorly sorted medium-coarse sandy matrix, with some individual coarse sand layers. From the base of c. 8 m high erosional cliff comprising similar sediments, in west bank of Shamkirchay River c. 100 m south of main road bridge.
Az13	085-16-916	045-85-772	292	Gravel pit north of Boyuk Kasik	Sample of subangular to subrounded gravel/pebbles/cobbles in poorly sorted matrix of fine-medium sand in quarry.
Az14	085-23-988	045-77-845	312	Stream channel N of Kechveli	Moderately well-rounded gravel/pebbles/cobbles in poorly sorted silty/fine sand matrix in eastern erosional cliff of dry valley.
Az15	085-29-649	045-73-956	277	River Kurudere	Subangular to subrounded gravel/pebbles/cobbles in poorly sorted matrix of fine-medium sand in erosional cliff (c. 2-3 m high) in east bank of river, c. 200 m south of road bridge.
Az16	085-42-241	045-52-156	340	River Hasansuchay	Subangular to subrounded gravel/pebbles/cobbles in very poorly sorted matrix of silt-medium sand in erosional cliff (c. 8m high) in west bank of river, c. 20-30 m south of road bridge.
Az17	085-46-378	045-48-098	364	Small stream east of Hasansuchay	Compact, homogeneous clayey light brown silt, c 1.5 m below surface in west cliff of stream, c. 20 m north of road bridge.
Az18	085-54-328	045-39-243	375	River Tauzchay	Sample of c. 2 m thick clayey silt layer at top of 12-15 m high cliffs of west bank of river, c. 20 m north of main road bridge. Sample from c. 2 m below top of cliff.
Az19	085-46-378	045-48-098	364	Field duplicate of Az17	

Annex 1, Table 1 Sample locations for samples analysed at CEL

Sample	Pulkova E	Pulkova N	Elevation m asl	Location	Description
Az20	085-54-328	045-39-243	375	River Tauzchay	Sample of subangular to subrounded gravel/pebbles/cobbles in poorly sorted silt-coarse sand matrix. From c. 3 m below top of 12-15 m high cliffs of west bank of river, c. 20 m north of main road bridge.
Az21	086-07-739	045-10-565	398	Gravel pit just west of Ganja	Subangular gravels (some pebbles) in largely sandy matrix, c. 2 m below original surface.
Az22	086-14-451	045-21-332	212	Excavation for water pipe, Ganja-Yenikend road	Brown fine sandy, clayey silt from c. 2 m below surface
Az23	086-30-388	045-07-327	261	Gravel pit east of Ganja	Pebbles/cobbles in poorly sorted dominantly medium sand matrix with silt/clay. From 5 m below surface in south face of gravel pit.
Az24	086-30-388	045-07-327	261	Gravel pit east of Ganja	Fine sandy silt from surficial silt layer. Sample from c. 1 m below surface in east face of pit.

Annex 1, Table 2. Results of grain size analysis and determinations of organic matter and carbonate content

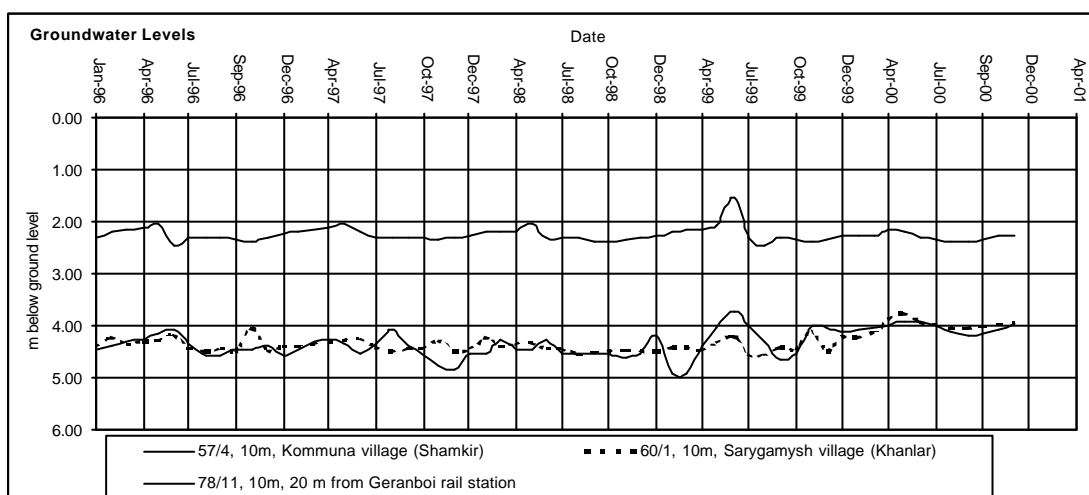
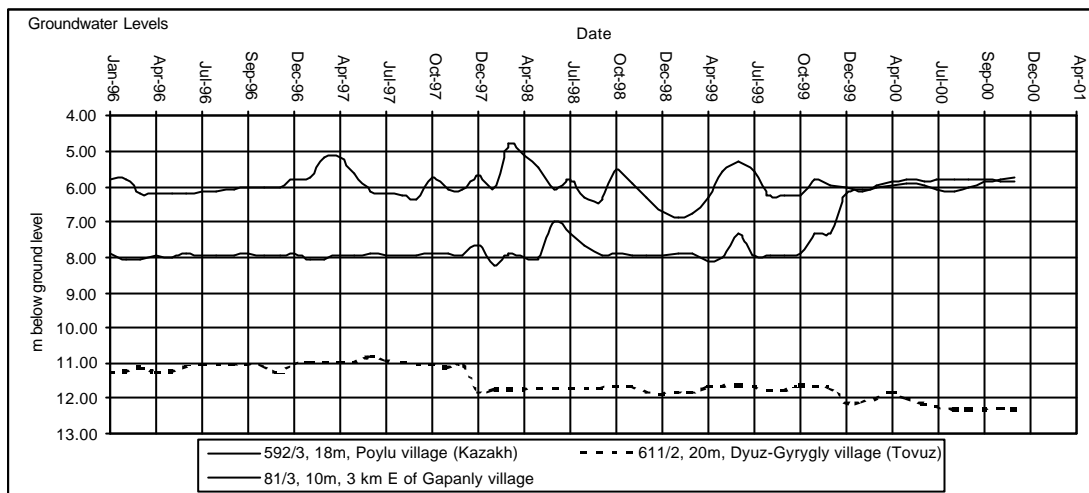
Size class	Az10	Az11	Az12	Az13	Az14	Az15	Az16	Az17	Az18
>4mm	0.0%	69.6%	81.5%	83.5%	77.8%	53.1%	56.0%	0.0%	0.0%
4 - 2.8mm	0.0%	2.0%	2.1%	0.7%	0.0%	4.7%	4.8%	0.0%	0.0%
2.8 - 2mm	0.5%	1.5%	1.7%	0.3%	1.6%	3.8%	3.7%	2.2%	2.2%
2 - 1.4mm	0.5%	2.1%	2.4%	0.2%	0.1%	4.8%	4.4%	0.7%	0.5%
1.4 - 1.0mm	0.5%	1.7%	2.2%	0.1%	0.1%	4.7%	3.7%	0.6%	0.5%
1.0mm - 710µm	0.3%	0.9%	0.8%	0.0%	0.1%	2.1%	1.6%	0.4%	0.2%
710 - 500µm	1.1%	3.9%	2.6%	0.3%	0.3%	7.1%	5.9%	1.3%	1.0%
500 - 355µm	1.0%	3.5%	1.2%	1.0%	0.5%	6.8%	4.0%	1.0%	1.0%
355 - 250µm	1.0%	3.4%	0.9%	2.6%	0.8%	5.4%	2.9%	1.3%	1.0%
250 - 180µm	1.0%	2.7%	0.6%	3.5%	1.0%	3.1%	1.7%	1.6%	0.7%
180 - 125µm	1.4%	2.6%	0.6%	3.6%	1.7%	1.9%	1.6%	3.1%	0.9%
125 - 90µm	1.0%	1.2%	0.3%	1.2%	1.6%	0.6%	0.9%	6.1%	1.2%
90 - 63µm	1.9%	1.0%	0.2%	0.7%	1.8%	0.3%	1.0%	14.5%	11.0%
3.9-63µm(Silt)	64.4%	2.5%	0.9%	1.7%	7.7%	0.5%	5.1%	41.5%	64.1%
<3.9µm(Clay)	25.5%	1.2%	2.1%	0.7%	4.8%	1.0%	2.7%	25.7%	15.8%
Carbonate %	24.5%	3.2%	3.7%	7.9%	3.4%	7.2%	8.9%	18.4%	21.3%
Organic matter %	4.0%	0.6%	0.5%	2.0%	0.7%	0.9%	2.3%	3.9%	2.8%
Size class	Az19	Az20	Az21	Az22	Az23	Az24			
>4mm	0.0%	85.0%	44.8%	0.0%	56.3%	8.7%			
4 - 2.8mm	0.0%	1.4%	10.7%	0.0%	5.6%	1.1%			
2.8 - 2mm	1.7%	1.2%	9.4%	3.0%	4.1%	0.5%			
2 - 1.4mm	1.0%	1.5%	10.5%	0.5%	3.8%	1.2%			
1.4 - 1.0mm	0.9%	1.5%	8.0%	0.5%	3.6%	1.2%			
1.0mm - 710µm	0.4%	0.7%	2.9%	0.2%	1.7%	0.6%			

Annex 1, Table 2. Results of grain size analysis and determinations of organic matter and carbonate content

710 - 500µm	1.6%	2.8%	7.6%	0.8%	6.1%	2.4%
500 - 355µm	1.1%	1.7%	2.3%	0.8%	4.7%	1.9%
355 - 250µm	1.2%	1.1%	0.8%	1.4%	3.5%	1.9%
250 - 180µm	1.5%	0.7%	0.4%	2.4%	2.3%	1.9%
180 - 125µm	2.6%	0.5%	0.2%	4.5%	2.1%	3.3%
125 - 90µm	3.5%	0.3%	0.1%	4.1%	1.0%	3.0%
90 - 63µm	11.4%	0.3%	0.1%	6.2%	0.8%	3.9%
3.9-63µm(Silt)	47.9%	0.8%	1.7%	43.4%	2.6%	66.2%
<3.9µm(Clay)	25.4%	0.4%	0.5%	32.1%	1.7%	2.1%
Carbonate %	19.9%	2.2%	5.6%	28.0%	11.1%	25.2%
Organic matter %	6.1%	0.4%	1.4%	4.6%	1.3%	5.7%

ANNEX 2: Groundwater hydrographs from the Goranboy-Kazakh piedmont plain

Well number, depth, location (region)



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1 TRAFFIC ASSESSMENT

1.1 INTRODUCTION

A traffic census has been carried out and an outline mitigation measures have been developed as part of the ESIA. The purpose of the traffic census is to establish an accurate baseline so that a project specific Transport Management Plan can be developed by the contractor constructing the pipeline. This plan will indicate measures to avoid excessive inconvenience to local traffic.

The objectives of the traffic census are to:

- Define the number of vehicle movements along the key access routes at different times of day
- Identify if there are any seasonal differences in the level of traffic on certain routes
- Provide a breakdown of total vehicles on key access routes by type
- Identify key pinch points or restrictions along these access routes (these may physical, cultural or schedule driven)
- Identify key sensitivities along these access routes (eg schools, hospitals etc)

The survey was carried out between 20th November 2001 and 8th December 2001. Supervision of the survey teams was done jointly by Adam Andreski of WSP and Frances Waters of RSK. Surveyors and an additional supervisor were provided by Baku Engineering Contractors (BEC).

1.2 METHODOLOGY

1.2.1 Route identification

Prior to undertaking the surveys it was necessary to determine appropriate survey points to ensure that the data collected was representative of the likely access routes between the main road network, the pipe dumps and the rail line. Likely access roads from the potential pipe yards and construction camps were identified along the whole of the route through Azerbaijan.

The routes selected were considered to be likely routes. Whilst the pipeline construction contractor will be responsible for the identification of the routes to be used it was considered that the survey points would identify the levels of traffic likely to be experienced and so would be appropriate for identifying the basic nature of the Transport Management Plan.

1.2.2 Baseline traffic

In order to identify the current levels of traffic on the roads likely to be directly affected by the construction and operation of the pipeline base line surveys to identify the volume and nature of existing traffic were required. Different types of vehicle using the road have different impacts in terms of noise, vibration, speed and amount of highway capacity (and space) required. In order to determine both the volume and type of vehicle using the roads manual classified vehicle counts were required.

Census points were chosen at critical sections where construction traffic would be likely to travel. These included main roads in towns, river crossings, and access roads between pipe dumps, camps and the pipeline. A total of ten traffic surveyors were employed over a two-week period at the end of November and beginning of December 2001. The forms used for the counting are contained in Appendix A.

BP's safety and overseas working regulations do not allow travelling during the hours of darkness, nor the use of non-approved accommodation. This restricted the ability to keep survey staff on site for the 12 hour period and, in general, an 8 hour survey period was completed.

In order to assess the variation in traffic flows throughout the week two survey sites (sites 6 and 61) were surveyed over a seven day period.

1.2.3 Analysis

Following this data collection the following analysis was undertaken:

- A Modifying all observations to a common base
- B Summarising data for analysis
- C Assessment of additional flows generated by the construction and operation phases
- D Analysis of total traffic flows
- E Determination of highway capacity
- F Identifying pinch-points
- G Development of management measures

Items A and B are covered in some detail in Section 1.3, whilst Section 1.4 covers the forecasting of additional traffic and the resulting total traffic flows. Items E to G are covered in Section 1.5.

1.3 ANALYSIS OF TRAFFIC DATA

The traffic flow information has been processed so that the data can be compared consistently across all sites and against well-defined capacity standards. The surveys were undertaken on average weekdays and covered an 8 hour period (0900-1700) which represents the busiest times of the day. During the period of the surveys the survey staff had to take comfort breaks on a regular basis. Hourly counts were corrected to allow for no observation of traffic during these periods. For example if 10 minutes were lost in an hour then a correction factor of 60/50 was applied.

Traffic on the roads of Azerbaijan is of a very wide mix. Whilst motorised traffic is extremely common there is still considerable reliance on the vehicles drawn by animals, walking and cycling. These various sorts of traffic have very different impacts on the local environment, the highway pavement and the road capacity. These different users are also differentially sensitive to the impacts of the heavy lorry traffic that will be generated by the construction of the pipeline.

In order to gain a sense of the nature of these problems the traffic observations have been further aggregated as identified in Table 1-1 below.

The "slow" category do not generally take up a considerable amount of the highways capacity but can reduce vehicle speeds and will be very sensitive to increases in heavy goods traffic. Light vehicles will generally move more quickly, take up more road space and could well be disadvantaged by increases in slow moving heavily laden vehicles. Heavy vehicles will be less affected by construction traffic but the existing volumes will have implications in terms of net increases in noise and vibration and impact on pavements.

Table 1-1 Vehicle classification

Vehicle type	Category
Pedestrians	Slow
Animal Flocks	Slow
Bicycles	Slow
Animal Drawn Carts	Slow
Motorcycles	Light vehicle

Table 1-1 Vehicle classification

Vehicle type	Category
Agricultural Vehicles	Light vehicle
Cars/Taxis	Light vehicle
Minibuses	Light vehicle
Buses	Heavy vehicle
Trucks	Heavy vehicle

1.3.1 Average weekday traffic flows

Each of the surveys has been analysed to provide the following information:

- Total number of vehicle movements during the survey period
- Proportion of each category of vehicle during the day
- Level and time of peak traffic flows and composition of that traffic

A table summarising the data is contained in Appendix B.

Flows on almost all roads surveyed are very low over the survey period. Minimum two-way flows of less than 100 per day are observed and the maximum flow over the 8-hour period of just over 6000 vehicles. Only two roads (the main and access roads at survey site 50) exceed 4000 vehicles during the survey period.

Vehicle compositions vary greatly between sites. However, almost universally the proportion of slow mode vehicles (pedestrians, cycles, animal drawn carts and flocks of animals) represent less than 15% of roads users on the main routes. This relates to the use of these lesser roads as thorough-fares for local agricultural and industrial activities.

The proportion of heavy vehicles on the most of the roads high with many of the main roads vary from 15-25% of vehicles falling into this category. Many of the proposed access routes also form parts of the local road network feeding villages and towns from the main route from Georgia to Baku. Many of these also have substantial proportions of goods vehicle traffic.

On a general basis therefore the main road network is characterised by low traffic flows but serves a large volume of goods vehicle traffic. The access roads have lower volumes of traffic, this generally being due to a reduction in the proportion of light vehicles. On these roads the predominance of slow moving vehicles and heavy vehicles will result in very slow travel speeds.

1.3.2 Road capacity

The nature of the road network along the route has a considerable bearing on the ability of the roads to handle volumes of traffic. In general the following observations can be made that affect the capacity of the local road system:

- A large proportion of roads are not metalled
- Lack of street lighting in most areas, limited in urban areas
- Poor signage
- Lack of road markings
- Extensive use of single track roads
- Poorly maintained road surfaces
- Lack of crash barriers and other safety infrastructure
- Direct frontage of commercial activities onto the frontages
- Fixed infrastructure (bridges, underpasses and level crossings)

All of these have an impact on the capacity of the road and only direct observation could identify the maximum volumes of traffic using the roads. However, as a rough approximation the following hourly two-way traffic flows can be used:

- For the main route, which has a reasonably well maintained road surface and is of adequate width - 1500 vehicles per hour
- For access routes unmetalled, but allowing for two-way operation of traffic – 1000 vehicles per hour
- For access roads with passing spaces at least every 100m - 500 vehicles per hour
- For access roads with passing spaces less frequently - 250 vehicles per hour

Clearly the capacity of the single direction of operation is dependent on directional split of traffic, if flows are evenly balanced then considerable conflicts will occur and the capacity will be reduced further. If the flow is in one direction only then capacity would be of the order of 600 vehicles per hour in that direction.

Analysis of the peak flows identified in the Table 1-1 shows that only four sites exceed 500 vehicles per hour at any time during the day. Site 50 is in the middle of the urban area of Gyandzha. The road has ample pedestrian facilities, a well-maintained metalled road surface and is of considerable width. This road has ample capacity and a flow of 500 vehicles per hour will not pose a problem. Similarly, site 7 is located on the main east-west highway. The pavement is fully constructed and well-maintained, has gravel hard shoulders and very limited access. A flow of 500 vehicles per hour is again well within the capacity of the road.

1.3.3 Conclusion

It may therefore be concluded that the existing levels of traffic are catered for adequately by the existing road network. Consideration must therefore be given to the level of traffic likely to be generated by the construction and operation of the pipeline. This is covered in the next section.

1.4 FORECAST TRAFFIC LOADS AND DESIGN CRITERIA

1.4.1 Construction Process

1.4.1.1 Method of transport of pipeline

The pipe itself will be transported to pipe dumps by rail. Onward movements will then be conducted using pipe trucks, which will be capable of carrying 3 sections of pipe, each some 12 metre long pipes. The pipes will be transported to the pipe dump locations during a 3 month pre-stocking period, and will then be transported to the pipeline itself as construction progresses.

1.4.1.2 Types of Vehicles

Whilst no information is available on the type of vehicles used for the transporting of the pipe sections they will be likely to be either 16.5m standard articulated vehicles or logging style trucks with a separate rear axle using the load, in this case the pipe, as the rigid structure. In either event these vehicles have a large minimum turning circle and poor acceleration/braking characteristics. Such vehicles will take up a considerable proportion of the highway capacity, are likely to experience problems on narrow roads when encountering oncoming traffic and will need to be considered carefully when choosing routes through urban areas and particularly on routes where there is significant amounts of street furniture such as street lighting.

In addition, all materials and equipment will need to be delivered to the pipeline along these same roads. Heavy digging and lifting equipment, generators etc may require vehicles with even more substantial dimensions and axle loadings.

1.4.1.3 Duration of Operations.

Initial operations are scheduled for commencement in October 2002, with construction continuing for 2 years. The contractor will develop the final plan for construction procedure, but the oil pipeline (SCP) will be laid in the first year (Oct 2002-Oct 2003), with the gas pipeline (SCP) following from Oct 2003-Oct 2004. During this period the temporary and permanent camps will need to be maintained and serviced, resulting in considerable volumes of traffic delivering food, water and construction supplies.

1.4.1.4 Traffic Generation

The following criteria have been set as the minimum assumption in the ITT documents.

Table 1-2 Traffic generation assumptions

ROAD CLASSIFICATION	NO. OF COMMERCIAL VEHICLES PER DAY IN BOTH DIRECTIONS	CUMULATIVE NO. OF STD. AXLES PER 20 YEARS (MILLION)
Main plant access road	80	0.61
Primary road	40	0.30
Secondary road	20	0.15
Service road	6	0.046

With each section of pipeline being some 12m long, and each lorry being able to carry three sections of pipeline per trip this equates to the delivery of 2.8km of pipeline per day. Over a two year period, assuming a 6 day working week this would result in 1700km of pipeline delivered. This seems to be in the right order, allowing for slack periods, the need to deliver other equipment and materials etc which will reduce the number of deliveries from the 80 proposed above. This figure will be used as worst case estimate.

1.4.2 Design criteria

The following sets out some of the key design criteria that may have impacts on the local road network and other road users.

1.4.2.1 Speed limitations

Geometric design shall be based on the following design speeds:

- Main plant access road - 80km/h
- Primary road - 50km/h
- Secondary road - 30km/h
- Service road - 25km/h

1.4.2.2 Radii

Minimum radii of edge of paving or surfacing for 90 degrees intersection shall be:

- Main plant access road - 15m
- Primary road - 10m
- Secondary road - 8m
- Service road - 6m

1.4.2.3 Horizontal and vertical clearance

At roads without raised kerbs a horizontal clearance of 1.0m shall be maintained between the edge of the shoulder and any structure projecting above shoulder level. However, for safety barriers and traffic signs the minimum horizontal clearance shall be 0.6m.

At roads with raised kerbs the minimum horizontal clearance shall be 0.6m from the face of the kerb. Horizontal clearances shall be maintained for the full required vertical clearance for the road classification.

For vertical clearances over roads refer to piping design and plant layout requirements.

1.4.2.4 Road widths

Minimum lane and shoulder widths shall be as listed below. Shoulder widths shall be added to the carriageway widths to obtain minimum roadway widths.

Table 1-3 Road widths

Classification	Carriageway Width (m)	Each Shoulder (m)
Main plant access road	8.0	2.0
Primary road	8.0	1.5
Secondary road	6.0	1.5
Service road	4.0	0.0

1.5 IMPACT ON THE ROAD NETWORK

The volumes of traffic being proposed in the ITT are unlikely to have any significant operational impacts on the existing road network. Whilst on some roads the volumes will represent more than a doubling of existing traffic flows the volumes are universally low enough that this should not be a concern. There are no locations where the additional volumes will create delays, queues and generally disadvantage other road users.

However, there are a number of problems that will result from the increased level of heavy vehicle traffic on the roads:

- Conflict with slow road users on most of the access roads where the road is too narrow to allow convenient passing
- Physical constraints in urban areas
- “Anti-social” aspects of goods vehicles near sensitive receptors
- Accidental impacts

Each of these items is discussed in detail in the remainder of this section.

1.5.1 Conflict with slow road users

Slow road users will be disadvantaged in a number of ways by the general increased level of traffic along the roads being used. The vast majority of “slow” road users are pedestrian. The most significant potential impact for pedestrians is in terms of safety. In many cases pedestrian activity is a significant proportion of the total level of traffic on the road. As such conflicts with large vehicles being used to transport the pipes and any other construction materials are very likely and any incidents will probably be of a serious nature.

In the more rural areas the potential to mitigate these impacts will be less. The highway infrastructure in Azerbaijan does not appear to include for specific provision of footways for pedestrians, nor any form of protected crossing points. Despite the volumes of pedestrian movements any provision could not be

justified. Consideration may need to be given to the speed at which the vehicles are permitted to travel on the public road network and especially in non-urban areas.

In urban areas the conflicts may be more readily managed. The routes pass through relatively few urban areas so any management will be relatively easy to undertake. Again, the key issue will be the speed at which vehicles may travel in urban areas. A maximum speed of 50km/h in any built up area will ensure that braking distances are not too great. Unless there is no other option routes should be chosen to avoid locations that attract considerable volumes of pedestrian traffic, namely:

- Hospitals
- Schools
- Shops and markets
- Major employment centres

In this schools are of particular concerns as young children have not developed the same level of traffic and road awareness and so are at a greater risk. Where urban areas cannot be avoided the operation of the deliveries should be controlled to avoid the busy periods, particularly the start and end of the school and working day.

If this is not possible from an operational perspective then consideration should be given to local safety improvements outside schools and hospitals. Any investment should be low cost and not require subsequent maintenance. Railings immediately outside the school entrance and possibly a central refuge for those crossing the road would be a maximum level of provision.

There are some areas where the movement of animal flocks are also of a reasonable level. Such movements will most likely take up the whole road and will take some time to dissipate. It is unlikely that conflict with animal flocks can be avoided and careful consideration will need to be given to the nature of any mitigation measures. The provision of crossing facilities in rural areas for occasional conflicts would not present an economic solution unless these conflicts were extremely frequent and impacted upon the construction programme. This is highly unlikely given the number of such observations. It is most likely that the only reasonable mitigation is through ensuring driver behaviour by reducing speeds in areas where conflicts occur and providing guidelines on how to deal with situations, eg:

- Stop at least 10m from the herd
- Do not sound the horn
- Switch off engine if the wait is likely to be for more than 1 minute
- Allow the flock and herder to clear the road before continuing

1.5.2 Physical constraints in urban areas

Clearly the size of the vehicles used in transporting the pipeline and other materials will be substantial, often in excess of 16.5m. In the more rural areas such vehicles are unlikely to have any problems but in urban areas, where there are constraints on all sides, junctions and street furniture this is likely to be a more substantial problem.

Observations identify that there are likely to be few restrictions in terms of vertical constraints, although a thorough audit of all underpasses will need to be undertaken in identifying routes. Problems are most likely to result at junctions where the vehicles are required to make a turn. The length of the vehicles means that there is a considerable over-run area where the vehicle turns. Some of the existing routes identified include a number of sharp right or left turns in urban areas. These should be avoided wherever possible. Where no practical alternative can be found then the junctions will need to be assessed to ensure that the vehicle is capable of making the turn without physically damaging any existing infrastructure.

In urban areas there were a number of observations of shops and stalls immediately to the side of the road. Such activities create pinch points either physically or through parking of other vehicles in close proximity. Where such locations cannot be avoided it may be necessary to assist the owner in moving the stall further from the edge of the road or providing parking facilities off the road.

On-street parking is also a very common issue that may need to be addressed in urban areas. The level of parking on roads reduces the effective operating width of the carriageway and may mean that larger vehicles cannot safely negotiate a section of the road. The solution to this problem will be dependent on the duration over which the road will be used. Over a long period (more than 2 months say) a semi-permanent solution may need to be found, identifying an alternative local site where the vehicles may park. However, this is likely to be problematic in terms of identifying the location, obtaining permission to use the land and making the ground ready for use.

If the problem is for a shorter period of time then may be sufficient to obtain the assistance of the local police. Temporary restrictions on parking along any particularly constrained part of the route would need to be enforced diligently by local police but would be a simpler solution to the problem for short periods of time.

1.5.3 “Anti-social” aspects of goods vehicles near sensitive receptors

In this regard anti-social aspects of goods vehicles are considered to be noise, vibration and emissions. Issues in this regard will be related to both time and location. It is not clear whether nighttime operations would be considered during the construction programme, but these should not be allowed in urban areas where the noise and vibration caused by heavy vehicles will affect considerable numbers of local residents. It is recommended that work at night be avoided for safety reasons. Traffic accidents related to construction and camp service vehicles would be much more likely at night.

As already identified earlier in this section, where possible routes should avoid schools, and hospitals. Where this is not the case, and in all areas where the vehicles are in close proximity to people the following general principals should be adhered to:

- Do not leave engines idling either when in queues or parked unless absolutely necessary
- Avoid unnecessary revving of engines
- Radios not to be played loudly in quiet locations

Considerable benefits can be generated through ensuring the vehicles used are in a reasonable state of repair. Clearly emissions testing is not a viable option in this regard but the operators of the vehicles should be encouraged to ensure that vehicles do not produce significant emissions because of poor maintenance and financial incentives (or penalties) should be put in place to ensure that this does not occur.

This maintenance regime should also be designed to ensure the braking systems and tyres are of a sufficient quality that the vehicles will not represent an undue safety hazard during normal operations or when a hazardous situation occurs.

1.5.4 Accidental impacts

The greatest impacts are most likely to be experienced as a result of some accidental actions. In particular consideration should be given to ensuring only routes identified for use are followed. With a considerable volume of vehicles being used, some following circuitous routes, there is the potential for vehicles to follow the wrong routes. This could lead to a wide range of issues including:

- Bridge strikes and grounding
- Boggling down on roads unprepared for the loads

- Damage to pavements
- Damage to other infrastructure
- Accidents involving injury
- Lost operating time

The most appropriate way to take this forward is through the development of a signing and routing system that is easily understood by all. Care should be taken that this not map based, because of the quality of any mapping is questionable and also because drivers will not necessarily be experienced in reading maps.

Following the contractors detailed assessment detailed access plans should be produced. These plans will involve:

- Identifying routes from pipe storage area to site
- Identifying weight/height restrictions and alternative routes
- A signing strategy for the routes
- Mechanisms for vehicle control

1.5.5 Route identification

The route identification process will need to take account of all the issues described earlier in this section. In addition audits of clearances, restrictions and limits along the route, along with pavement conditions will inform the process. Developing detailed route plans will allow the further problems to be identified as below.

1.5.6 Weight/height restrictions and alternative routes

These restrictions are the absolute drivers of any route requirements. Maximum vehicle dimensions and axle loadings will determine the main constraints and allow the optimum route to be defined. Where there are alternative routes for different vehicle types this will need to be identified for information and control purposes.

1.5.7 Signing strategy

The signing strategy will probably be the most important element of the process. All routes must be clearly signed from the main highway, and always through urban areas. The signing strategy must allow unique identification of each route, along with speed and other restrictions. All drivers should have access to a schedule of the routes and a delivery control mechanism put in place to ensure all goods and material deliveries are clearly routed.

The strategy may also include further restrictions such as restriction upon the time during which vehicles may operate and the hazard warnings.

Signs must clearly indicate that they relate to vehicles serving the pipeline construction so that they are not misunderstood by other road users.

1.5.8 Mechanisms for vehicle control

Despite the efforts to provide information the operator must guard against pipeline vehicles using inappropriate roads and other road users venturing down pipeline access roads.

For the former, where there is a danger that this will result in a serious accident or other safety risk then some form of physical restriction to access may need to be considered. For the latter additional signing along the road and potentially gating may be required to ensure drivers are aware that they have no right of access. Turning points may be required in some locations.

1.6 KEY OBSERVATIONS

Within the time available for in-country surveys it was neither possible nor practical to visit all access roads along the route. In any event, as the final decision for the routes to be used will be by the pipeline construction contractor, the value of detailed route surveys was limited. However, a number of observations can be made that have relevance to the route selection.

1.6.1 Railway crossings

The pipeline follows a similar route as the river and railway line to the Georgian border from Baku. There are many instances along the route where it will be necessary for the access routes to cross the railway line. Most of the crossings observed were by level crossing or underpass. The general issues to be considered as part of the route definition have been noted earlier in the report. However, some particular observations are worthy of note.

Some of the underpasses beneath the railways are narrow and limited dimensions. The photograph below indicates the sorts of underpasses that will be encountered.

Figure 1 Typical railway underpass



A number of observations can be made; firstly the underpass can only operate in single alternate directions. Heavy traffic flows at such locations (more than say 50 vehicles per hour two-way) will require management of the traffic to ensure safe operation, especially during winter months and during early morning and late evening when the light is poor.

Level crossing present a similar problem. An example of the sorts of crossing is shown in below. It can be seen that the crossing has little control on vehicle access which may lead to safety problems where considerable levels of traffic are generated by the pipeline.

Figure 2 Typical railway crossing without bridge



Especially in locations such as this with no vehicle control and considerable vertical deflections across the tracks there will be a danger of grounding. Such locations will need to be controlled to ensure safe operation.

APPENDIX A

TRAFFIC SURVEY FORMS

Especially in locations such as this with no vehicle control and considerable vertical deflections across the tracks there will be a danger of grounding. Such locations will need to be controlled to ensure safe operation.

WSP/RSK Azerbaijan Pipeline Traffic Survey Form 1 Base Sheet BP

Count Location İ şöi ö:şà	Location No. İii şö i şnoà	Time of start Àðà ýià-àà	Time of finish Àðà ýeiíòà	Date Ààà
------------------------------	-------------------------------	-----------------------------	------------------------------	-------------

Name of Supervisor Èi ýNóĩ şââççà	Name of Surveyor Èi ýNóĩ şââççà
Signed İ i äĩ èñü	Signed İ i äĩ èñü

Direction of traffic	Direction of traffic
----------------------	----------------------

Pedestrians İ åðĩäü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Animal Flocks Nòääçäiöüö

1	2	3	4	5	6	7	8	9	10	11	12
Total											

Bicycles Åæèñüü şü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Motorcycles İ i öööëüü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Animal Drawn Carts Öääë

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Agricultural Vehicles Næüñëiöüçvënòääiüé öðäñi iðò

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Cars/Taxis Åäöüi íääëë

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
Total											

Minibuses

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Buses Åäöiáöñü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
Total											

Trucks Åöóciääëë

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
Total											

Comments İ ðëi à-äiëý

Pedestrians İ åðĩäü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Animal Flocks Nòääçäiöüö

1	2	3	4	5	6	7	8	9	10	11	12
Total											

Bicycles Åæèñüü şü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Motorcycles İ i öööëüü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Animal Drawn Carts Öääë

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Agricultural Vehicles Næüñëiöüçvënòääiüé öðäñi iðò

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Cars/Taxis Åäöüi íääëë

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
Total											

Minibuses

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
Total											

Buses Åäöiáöñü

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
Total											

Trucks Åöóciääëë

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
Total											

WSP/RSK Azerbaijan Pipeline Traffic Survey BP

Form 2 Daily Summary Sheet

Location ID No.		Date	
Count Location		Time of start	
Direction		Time of finish	

Name of Supervisor											Name of Surveyor										
Signed											Signed										

Direction of traffic											Direction of traffic										
Hour From	9	10	11	12	13	14	15	16	Hour From	9	10	11	12	13	14	15	16				
Hour To	10	11	12	13	14	15	16	Total	Hour To	10	11	12	13	14	15	16	Total	Total for both directions			
Pedestrians																					
Animal Flocks																					
Bicycles																					
Motorcycles																					
Animal Drawn Carts																					
Agricultural Vehicles																					
Cars/Taxis																					
Minibuses																					
Buses																					
Trucks																					
Total																					

Comments

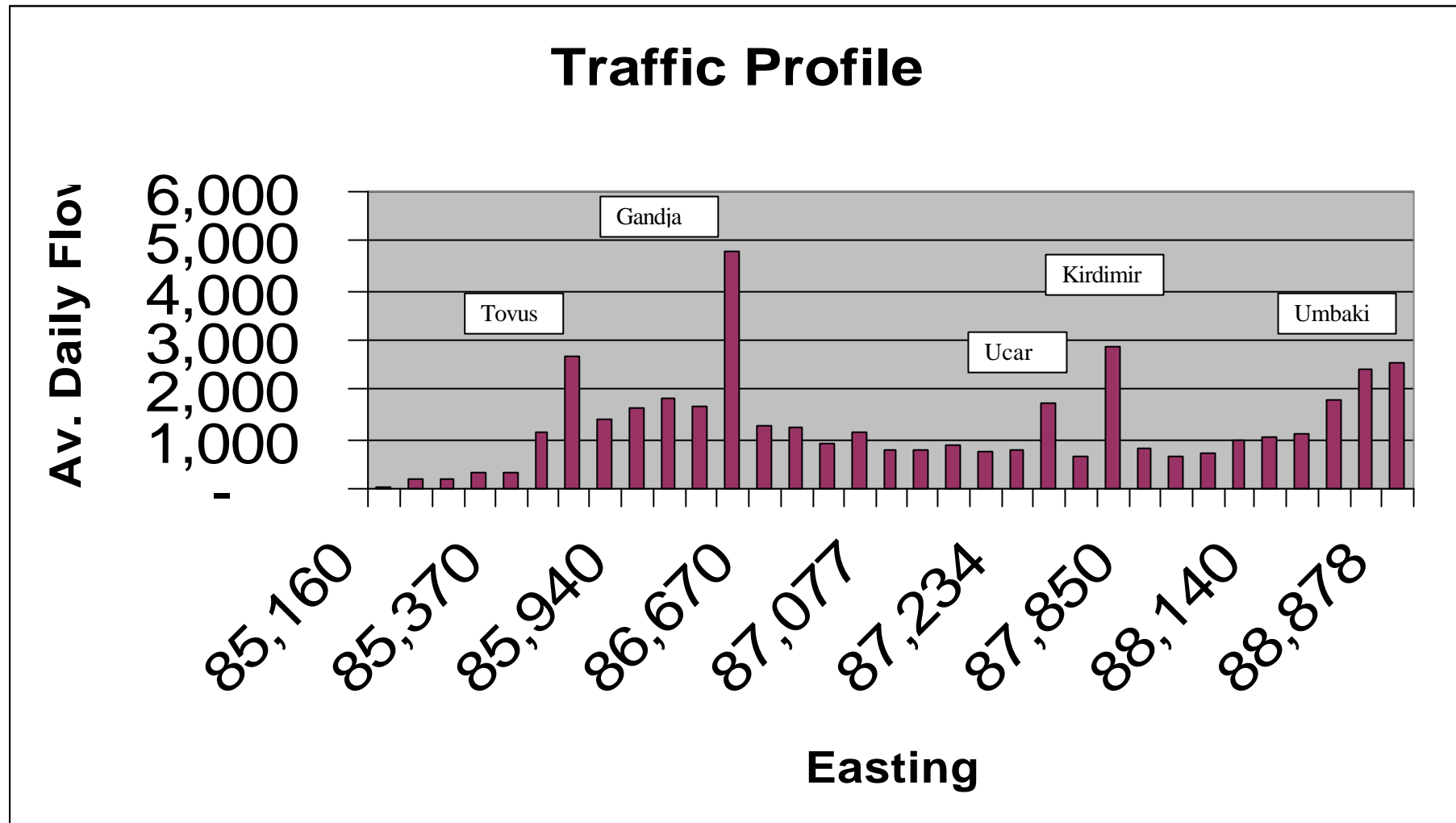
APPENDIX B

SUMMARY TRAFFIC DATA

SCP ESIA
AZERBAIJAN
DRAFT FOR DISCLOSURE

Site ID	Location	Grid reference		Road type	Average daily flow (Vehicles)	Flow composition (%)			Max flow Vehicle/hr
		Easting	Northing			Slow	Light	Heavy	
T1	Mbaki	88,878	44,630	Main	2,524	0	77	23	434
T2	Mbaki	88,805	44,585	Access	746	45	42	13	90
T3 (N-S)	Randibar East	88,477	44,428	Access	153	3	76	21	31
T3 (E-W)	Randibar East (EW)	88,477	44,428	Access	260	1	7	92	34
T4	Randibar Main (Pirsaat)	88,455	44,434	Main	2,408	1	69	29	300
T5	Kazi-Magomed Access	88,370	44,429	Access	1,064	46	50	4	114
T6	Kazi-Magomed Main	88,325	44,435	Main	1,800	1	75	24	516
T7	Kazi-Magomed Access	88,330	44,443	Access	47	32	45	23	8
T8	Mugan	88,250	44,480	Main	1,083	10	65	25	107
T8	Mugan Access	88,250	44,480	Access	216	60	34	6	30
T9	Kasasu main	88,132	44,538	Main	1,001	2	74	25	103
T9	Kazasu access	88,132	44,538	Access	186	6	86	7	21
T10	Karasu (main road)	88,140	44,550	Main	1,036	5	69	26	106
T10	Karasu (access road)	88,140	44,550	Access	241	15	76	10	28
T11	Padar	88,001	44,600	Main	703	1	69	30	76
T12	Sigirli Main Road	87,908	44,634	Main	671	14	53	33	111
T12	Sigirli Access Road	87,908	44,634	Access	74	47	47	5	15
T13	Aksu Canal Main	87,850	44,657	Main	814	5	69	26	114
T14 west of cana	Aksu west access	87,850	44,643	Access	44	63	37	0	9
T14 east of cana	Aksu east access	87,773	44,681	Access	16	88	12	0	6
T15	Kurdamir	87,773	44,681	Access	44	31	66	4	11
T16	Kurdamir roundabout	87,687	44,715	Main	2,872	12	77	10	746
T16	Kurdamir roundabout	87,687	44,715	Access to In	2,564	13	75	12	373
A22 main	Kulabend Main Road	87,313	44,882	Main	665	7	75	18	83
A22 access	Kulabend access Road	87,313	44,882	Access	108	53	45	2	24
A23 main	East Ucar Main	87,260	44,880	Main	1,725	9	84	7	216
A23 access	East Ucar Access	87,260	44,880	Access	942	16	77	7	137
A25 main	Ucar Pipe Dump Central	87,234	44,879	Main	767	2	77	21	87
A25 access	Ucar Pipe Dump Central	87,234	44,879	Access	209	16	71	13	32
A26 main	Ucar West Main	87,221	44,878	Main	730	5	75	20	86
A26 access	Ucar West Access	87,221	44,878	Access	237	65	34	1	76
A27 main	Alikend Main Road	87,122	44,897	Main	872	3	74	24	192
A27 access	Alikend Access Road	87,122	44,897	Access	91	25	64	11	24
A28 main	Turanchay East Main Rd	87,078	44,914	Main	758	1	74	25	76
A28 access	Turanchay East Access	87,078	44,914	Access	11	82	0	18	3
A29 main	Turanchay West	87,077	44,915	Main	782	1	74	26	78
A29 access	Turanchay West Access	87,077	44,915	Access	20	70	30	0	6
A30 main W	Laki Pipe Dump Main Ro	87,054	44,924	Main	933	7	71	22	98
A30 main E	Laki Pipe Dump Main Ro	87,054	44,924	Main	1,125	16	67	17	103
A30 access N	Laki Pipe Dump Access f	87,054	44,924	Access	933	7	71	22	98
A30 access S	Laki Pipe Dump Access f	87,054	44,924	Access	922	23	69	9	115
A33 access SW	Yevlakh Pipe Dump Acce	86,815	44,965	Access	96	8	73	19	13
A33 access SE	Yevlakh Pipe Dump Acce	86,815	44,965	Access	1,533	1	85	15	162
A34 main	Yevlakh West	86,805	44,985	Main	1,256	2	81	17	90
A34 access	Yevlakh West Access	86,805	44,985	Access	356	15	79	6	32
A36 access	Mironabad	86,751	45,010	Access	229	23	71	6	30
A37 access	Neymatabad Access	86,743	45,011	Access	122	42	51	7	14
A39 main	Karabakh Canal	86,670	45,019	Main	1,267	3	79	18	106
A39 access	Karabakh Canal	86,670	45,019	Access	184	4	90	6	18
A40 access	St Kozan	86,566	45,030	Access	771	30	63	7	70
A41 access	Goranboy	86,560	45,031	Access	720	10	83	6	61
A42 access NE	Bursunlu	86,421	45,018	Access	1,333	3	72	24	109
A42 access NW	Bursunlu	86,421	45,018	Access	730	7	84	10	73
A47&A49 access	Dalmamedli	86,324	45,084	Access	2,557	6	79	15	193
A47&A49 access	Dalmamedli	86,324	45,084	Access	2,857	8	77	15	189
A50 main	Ganja Central E.	86,183	45,065	Main	4,793	8	83	9	497
A50 access	Ganja Central N.	86,183	45,065	Access	6,273	37	58	5	480
A51 access E	Gandja North, access roa	86,178	45,107	Access	1,215	17	70	13	117
A51 access SW	Gandja North, access roa	86,178	45,107	Access	2,061	13	77	10	217
A55 main	Shamkirchay Main Road	85,940	45,200	Main	1,619	3	81	16	150
A55 access	Shamkirchay Access Roa	85,940	45,200	Access	1,106	13	77	10	116
A57 access NE	Dallar Pipe Dump Access	85,873	45,268	Access	555	41	57	2	53
A57 access NW	Dallar Pipe Dump Access	85,873	45,268	Access	975	43	50	7	127
A61 access N	Zavam North	85,763	45,316	Access	393	20	74	6	67
A61 access S	Zavam South	85,763	45,316	Access	783	11	80	9	81
A62 main	Duz Kirikli Main Road	85,660	45,344	Main	1,403	13	82	4	129
A62 access	Duz Kirikli Access Road	85,660	45,344	Access	250	12	81	8	28
A64 main	Tovus Main Road	85,544	45,393	Main	2,677	14	78	8	280
A64 access	Tovus Access Road	85,544	45,393	Access	732	12	79	9	71
A68 main	West of Hasansu Chay, f	85,405	45,526	Main	1,150	22	75	3	101
A68 access	West of Hasansu Chay, f	85,405	45,526	Access	141	14	78	9	18
A70 main	St Poylu Main Road	85,370	45,673	Main	335	23	71	6	49

MAIN ROAD TRAFFIC PROFILE



RIVER CORRIDOR SURVEY

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1 RIVER CORRIDOR SURVEY

1.1 INTRODUCTION

The proposed Baku-Tbilisi-Ceyhan (BTC) crude oil pipeline and the South Caucasus natural gas pipeline (SCP) follow a common route. The 442km section within Azerbaijan crosses over five hundred watercourses and irrigation channels. Many of the watercourses are dry during all or most of the year.

A river corridor survey was undertaken to record morphological and ecological features around the crossing points of the more significant rivers crossed by the proposed BTC pipeline and SCP. The rivers selected for survey were those that are usually flowing and have a wet channel in excess of 2 metres wide at, or close to, the proposed crossing point.

1.2 SURVEY METHODOLOGY

River Corridor Surveys (RCS) were carried out during October/November 2001, by Dr Janet Swan of RSK Environment Ltd., using the standard UK methodology (NRA 1992, Conservation Technology Handbook No.1). A few modifications were made to the recorded information (Section 1.3) to take account of the differences between UK and Azerbaijani rivers and to provide specific information relevant to pipeline construction.

Generally the surveys covered a section approximately 100m upstream and 200m downstream of the proposed crossing point. At a few locations lack of access led to a modified survey section; the actual sections surveyed are identified on each record sheet.

The proposed crossing points were located using a hand held GPS (Magellan 315) which was calibrated before the start of the survey. Each survey section was paced to identify the approximate location of 100 metres upstream and 200 metres downstream; the co-ordinates of the upper and lower limits of each survey section and any significant features were recorded.

Each survey section was sketched using the standard symbols identified in the NRA methodology, and a record sheet was completed (Section 1.3). Photographs were taken of each survey section (not included in this report).

In the absence of accurate base mapping at a suitable scale for an RCS, the course of each river section was mapped from aerial photos. Ortho-rectified photographs were not available which reduced the accuracy of this process. Information from the field sketches was transferred to the base maps and is included in Section 1.3.

1.3 SURVEY RESULTS

The River Corridor Survey records are presented in the order in which the rivers are crossed by the proposed BTC pipeline and SCP.

References to +ve and -ve banks relate to the direction of pipeline product flow and have no relevance to the direction of river flow. In all cases the -ve bank is on the 'Baku' side of the crossing and the +ve bank is closer to the Georgian border.

Record No.: 1
River Name: Djeýrankechmes
Approx KP (Route D2): 9.3
Date of Survey: 31/10/01

Grid Reference of upstream limit of section: 088 73 161E; 044 59 473N
Grid Reference of downstream limit of section: 088 73 095E; 044 59 303N
Grid Reference of approx centreline: 088 73 163E; 044 59 425N

Weather & flow conditions: Partial sun /cloud. Calm. Rained previous night and previous 4 days. Flow rate c.0.5m sec⁻¹.

Special & typical features of the river channel: Very meandering river with steep eroding cliffs. Stepped banks.

Marginal vegetation: None to flowing channel.

Bank zone habitats: *Tamarix*; *Salsola nodulosa*; *Alhagia pseudoalhagia*; *Crassuola sp*; emergent grasses; *Artemisia fragrans* growing within main (normally dry) channel.

Adjacent land-use: Desert. Some grazing. Gobustan Cultural Reserve on +ve bank.

Notes of insects/birds/mammals of special interest: Bird burrows in sand cliffs; many birds singing in *Tamarix* bushes. Numerous ant holes in sand.

Recreation features: Vehicle track crosses river in vicinity of centreline.

Known downstream sensitivities:

- Drains into the Caspian
- Flows through the Gobustan Cultural Reserve for approximately 1km south of the pipeline crossing point
- Flows through the southern outskirts of Sangachal before entering the Caspian
- No endangered flora or fauna.

Existing management of river banks etc.: None.

Additional Comments: Cliff stability will require careful planning if open cut or graded for Right of Way.

Record No.: 2
River Name: Pirsagat
Approx KP (Route D2): 42.1
Date of Survey: 1/11/01

Grid Reference of upstream limit of section: Western Route Export Pipeline
Grid Reference of downstream limit of section: 088 46 669E; 044 45 726N
Grid Reference of approx centreline: 088 46 666E; 044 45 753N

Weather & flow conditions: Sunny & breezy. Flow 0.25 m sec⁻¹

Special & typical features of the river channel: Dredged earlier this summer. Steep banks with all spoil on +ve bank.

Marginal vegetation: *Phragmites* dominated.

Bank zone habitats: Very disturbed. *Tamarix*; *Salsola sp*; *Alhagia pseudoalhagia*.

Adjacent land-use: Semi-desert with small scale agriculture.

Notes of insects/birds/mammals of special interest: 2 eagles. Frogs.

Recreation features: None.

Known downstream sensitivities:

- Drains into the Caspian
- Flows through Navagi 3.5km to south of pipeline crossing
- No protected flora at site
- *Nephron percnopterus* (Bird of European Conservation Concern) recorded approximately 2km from site

Existing management of river banks etc.: Dredged within last 6-12 months.

Additional Comments: Banks were left graded after installation of the WREP; this has altered flow characteristics and the banks are devoid of vegetation. Low ecological sensitivity but, subject to engineering constraints, the banks should be re-profiled after construction of new pipelines to match pre-existing status.

Record No.: 3
River Name: Agsu Canal
Approx KP (Route D2): 111.2
Date of Survey: 4/11/01

Grid Reference of upstream limit of section: 087 84 680E; 044 64 384N
Grid Reference of downstream limit of section: 087 84 816E; 044 64 161N
Grid Reference of approx centreline: 087 84 649E; 044 64 305N

Weather & flow conditions: Overcast and calm. Flow c. 1m sec⁻¹.

Special & typical features of the river channel: Wide straight channel. Bank erosion and vegetation indicates significant fluctuations in river level. High sediment load.

Marginal vegetation: +ve bank devoid of vegetation. –ve bank has fringe of *Phragmites*.

Bank zone habitats: +ve bank bare. –ve bank has scattered *Tamarix sp.* with some grass.

Adjacent land-use: Both banks have track with grazing. During survey, herders were present on both banks with sheep and cattle.

Notes of insects/birds/mammals of special interest: Birds. Rodent holes away from river. Burrows in all banks.

Recreation features: May be fished, but no activity observed.

Known downstream sensitivities:

- The Agsu canal flows into the River Kura approximately 40km south of the pipeline crossing point
- The villages of Ashali, Daiykyazimli and Piracheta lie close to the canal downstream from the crossing point
- No endangered flora or fauna records from close to site

Existing management of river banks etc.: Canalised river but no evidence of active/recent management.

Additional Comments: Reinstatement plan should address post-construction bank stability during periods of peak flow.

Record No.: 4
River Name: Goakchay
Approx KP (Route D2): 171.3
Date of Survey: 4/11/01

Grid Reference of upstream limit of section: 087 29 745E; 044 85 306N
Grid Reference of downstream limit of section: 087 29 655E; 044 85 156N
Grid Reference of approx centreline: 087 29 725E; 044 85 251N

Weather & flow conditions: Calm & fine but overcast. Flow c.1m sec⁻¹.

Special & typical features of the river channel: Wide channel with mud substrate where exposed. Vegetation indicates water level fluctuates significantly.

Marginal vegetation: Dense reed and rush.

Bank zone habitats: Steep banks. Stable on +ve side but slipping on -ve. Some willow on +ve bank. Top of -ve bank = *Artemisia fragrans*; *Salsola nodulosa*; pomegranate; legume; elm; bramble; broom; white poplar.

Adjacent land-use: Agricultural (arable) on -ve bank. Land beyond +ve bank not visible or accessible.

Notes of insects/birds/mammals of special interest: Pomegranate on -ve bank; none visible on +ve bank, but no access for survey therefore cannot be precluded. Most likely to be cultivated variety.

Recreation features: track running along -ve side.

Known downstream sensitivities:

- Flows into the River Kura (a considerable distance to the south)
- Villages likely to be affected within 10km to the south are: Kazyan, Lak, Khaladz and Boyat
- *Hystrix indica* (proposed RDB) recorded within 0.5km of river

Existing management of river banks etc.: None.

Additional Comments: Bank stability will require detailed planning if open cut.

Record No.: 5
River Name: Turianchay
Approx KP (Route D2): 193.5
Date of Survey: 5/11/01

Grid Reference of upstream limit of section:
Grid Reference of downstream limit of section:
Grid Reference of approx centreline: 087 05 565E; 044 86 750N

Weather & flow conditions: Warm, sunny & calm. Flow 1m sec⁻¹.

Special & typical features of the river channel: Wide, possibly canalised, channel.

Marginal vegetation: Almost none – probably reflects fluctuating water level and fast flow. Occasional *Phragmites*.

Bank zone habitats: Various grasses, *Phragmites sp*, *Tamarix*; *Salix sp* (probably *S alba* or *S fragilis* – but inaccessible); *Artemesia sp*.

Adjacent land-use: Scrub with track on +ve bank – no access or view of –ve bank.

Notes of insects/birds/mammals of special interest: Small aquatic mammal – probably water vole but not seen clearly (c. 20cm long with burrows at water level). Crested larks.

Recreation features: Some fishing – children upstream of survey section.

Known downstream sensitivities:

- Flows into the River Kura (a considerable distance to the south)
- No villages marked on map within 10km downstream of crossing
- No endangered flora or fauna close to site

Existing management of river banks etc.: None.

Additional Comments: Careful bank reinstatement will be required if open cut. WREP has reinstated well. Water vole survey advisable.

Record No.: 6 (+ve bank)
River Name: Kura (east crossing)
Approx KP (Route D2): 223.6
Date of Survey: 5/11/01

Grid Reference of upstream limit of section: 086 85 044E; 044 96 307N
Grid Reference of downstream limit of section: 086 85 222E; 044 96 141N
Grid Reference of approx centreline: 086 85 085E; 044 96 272N

Note: grid references are for top of bank and not water's edge.

Weather & flow conditions: Calm and sunny. Flow c2m sec⁻¹.

Special & typical features of the river channel: Very wide channel with reedbed on inside of bend.

Marginal vegetation: *Typha angustifolia*.

Bank zone habitats: Grass with *Salix alba*, *Tamarix*; scattered scrub.

Adjacent land-use: Grass/bare ground on top of bank. Further back is rough grazing and scrub.

Notes of insects/birds/mammals of special interest: Abundant wildfowl and waders including snipe, night heron and mallard; frogs; mosquitos. Many burrows in banks.

Recreation features: Fishing. Grazing.

Known downstream sensitivities:

- Drains into the Caspian, provides water supplies for innumerable communities
- Communities within approximately 10km downstream of crossing: Ashagi Karkhun, Arabsheki
- Endangered fauna found within 1km of crossing point:
 - *Bufo bufo* (RDB)
 - *Monticola solitarius* (European Conservation Concern: vulnerable)
 - *Phalacrocorax pygmeus* (European Conservation Concern: vulnerable and Species of International Conservation Concern: low risk)
 - *Botaurus stellaris* (European Conservation Concern: vulnerable)
- No endangered flora close to site
- Area of Potential Mineral Extraction 0.5 km downstream of the crossing point

Existing management of river banks etc.: None

Additional Comments: Disturbance of birds. Sediment/oil spills would affect wetland areas and fishing. Very high sensitivity.

Record No.: 6 (-ve bank)
River Name: Kura (east crossing)
Approx KP (Route D2): 223.6
Date of Survey: 5/11/01

Grid Reference of upstream limit of section: 086 85 123E; 044 96 476N
Grid Reference of downstream limit of section: 086 85 335E; 044 96 414N (N.B limit of access - approx.170m downstream from centrline)
Grid Reference of approx centreline: 086 85 212E; 044 96 451N

Weather & flow conditions: Calm & sunny. Flow 2m sec⁻¹

Special & typical features of the river channel: Very wide

Marginal vegetation: Grass

Bank zone habitats: Grass - grazed

Adjacent land-use: Grazing

Notes of insects/birds/mammals of special interest: Pomegranate 086 85 145E; 044 96 524N, but thought to be a cultivated variety. Many burrows. Bird nests in trees. Butterflies.

Recreation features: Fishing. Car access –recreational use likely at weekends.

Known downstream sensitivities:
See Kura (east crossing, +ve bank)

Existing management of river banks etc.: None

Additional Comments:Very wide crossing.

Record No.: 7
River Name: Karabakh Canal
Approx KP (Route D2): 245.1
Date of Survey: 4/11/01

Grid Reference of upstream limit of section: 086 66 148E; 044 99 273N
Grid Reference of downstream limit of section: 086 66 243E; 044 99 053N
Grid Reference of approx centreline: 086 66 180E; 044 99 216N

Weather & flow conditions: Warm. Sunny & calm.

Special & typical features of the river channel: Wide canal. Centre flowing faster (0.6m sec⁻¹) than margins (0.3m sec⁻¹). Loose weed floating downstream.

Marginal vegetation: Patches of *Phragmites*.

Bank zone habitats: Grass and *Salsola dendroides*.

Adjacent land-use: Agricultural.

Notes of insects/birds/mammals of special interest: Birds in reeds.

Recreation features: Fishing. Water abstraction for irrigation from point near road bridge over canal (immediately N of survey section).

Known downstream sensitivities:

- Flows to the south
- Villages within 10km downstream of the crossing point: Yaldilly, Karamamedli, Malbinasi
- No endangered flora or fauna close to site

Existing management of river banks etc.: Dredging upstream of survey section.

Additional Comments: None; non open-cut crossing proposed for engineering reasons. Pollution prevention measures must be adequate to protect quality of abstracted water.

Record No.: 8
River Name: Goranchay
Approx KP (Route D2): 257.8
Date of Survey: 6/11/01

Note: Dry river – not mapped.

Grid Reference of upstream limit of section:
Grid Reference of downstream limit of section:
Grid Reference of approx centreline: 086 54 180E; 045 02 987N

Weather & flow conditions: Calm & sunny.

Special & typical features of the river channel: Dry. Channel c.2m deep; 8m between banks.

Marginal vegetation: No riverine vegetation.

Bank zone habitats: Grass with *Alhagia pseudoalhagia* and *Tamarix*.

Adjacent land-use: Desert on +ve side; narrow strip of desert then agricultural on –ve.

Notes of insects/birds/mammals of special interest: Birds singing.

Recreation features: Stream bed used as sheep herding track.

Known downstream sensitivities:

- Flows towards the Mingechaur Reservoir (which feeds into the Kura River)
- No mapped communities within 10km downstream of pipeline crossing
- No endangered flora or fauna close to site
- Soil extraction areas border the river on either side of the crossing point

Existing management of river banks etc.:

Additional Comments: Dried black material, possibly oil, in stream bed c.200m upstream of crossing point.

Record No.: 9
River Name: Kurekchay
Approx KP (Route D2): 276.5
Date of Survey: 6/11/01

Grid Reference of upstream limit of section: +ve bank 086 36 955E; 045 03 642N
-ve bank 086 36 957E; 045 03 543N
Grid Reference of downstream limit of section: +ve bank 086 37 179E; 045 03 767N
-ve bank 086 37 206E; 045 03 691N
Grid Reference of approx centreline: +ve bank 086 37 053E; 045 03 656N
-ve bank 086 37 083E; 045 03 556N

Note: +100m and –200m paced along river bed; grid references recorded on banks.

Weather & flow conditions: Calm & sunny

Special & typical features of the river channel: Very wide braided channel with narrow, meandering flowing channels. All channels very shallow with emergent broad leaved plants and grasses – watercress dominant in main channel.

Marginal vegetation: Grass and *Tamarix* with occasional *Typha latifolia*.

Bank zone habitats: Mud cliffs with abundant burrows. Many landslips – not individually mapped.

Adjacent land-use: Agriculture with village on –ve bank from –160m downstream.

Notes of insects/birds/mammals of special interest: Pomegranate on –ve bank at 086 37 051E; 045 03 547N (approximately centreline) – likely to be cultivated variety.
Frogs in some back channels. Bird holes in banks – significant numbers at +100m including possible bee-eater.

Recreation features: River used by villagers for clothes & vehicle washing; vehicle track; sheep/goat herding; children playing. Gravel extraction at various locations on river bank.

Known downstream sensitivities:

- Flows towards the Mingechaur Reservoir (which feeds into the Kura River)
- Communities downstream of the pipeline crossing include: Sametabad, Khasadali
- No endangered flora or fauna close to site

Existing management of river banks etc.: None identified.

Additional Comments: Minimise sediment disturbance during construction because of water use by villagers.

Record No.: 10
River Name: Korchay
Approx KP (Route D2): 292
Date of Survey: 7/11/01

Grid Reference of upstream limit of section: -ve bank 086 30 111E; 045 15 667N
+ve bank 086 29 975E; 045 15 802N
Grid Reference of downstream limit of section: -ve bank 086 30 227E; 045 15 874N
+ve bank 086 30 090E; 045 15 956N
Grid Reference of approx centreline: -ve bank 086 30 146E; 045 15 754N
+ve bank 086 30 009E; 045 15 856N

Note: +100m and –200m paced on bank tops – difficult to adjust for meanders.

Weather & flow conditions: Hazy sun; breeze.

Special & typical features of the river channel: Dammed upstream of survey section. *Typha latifolia* throughout with some submerged and floating dicots.

Marginal vegetation: *Typha latifolia* with occasional *Tamarix* and some stands of *Phragmites*. Some celery leaved buttercup.

Bank zone habitats: Closely grazed grass in river valley. *Salsola*, *Alhagia pseudoalhagia* on bank sides and top. Relatively few burrows.

Adjacent land-use: Track with agriculture beyond.

Notes of insects/birds/mammals of special interest: Many terrapins in reeds, frogs, good variety of birds, dragonflies, snake (30cm, grey, pencil thickness).

Recreation features:

Known downstream sensitivities:

- Flows towards the Mingechaur Reservoir (which feeds into the Kura River)
- Korchay State Forbidden Area is 4km downstream (to north)
- No mapped communities downstream from crossing point within 10km
- No endangered flora close to site
- Endangered fauna recorded within 1km of crossing point:
 - *Francolinus francolinus* (RDB and European Conservation Concern: vulnerable)
 - *Tetrax tetrax* (RDB and European Conservation Concern: vulnerable)
 - *Alectoris chukar* (European Conservation Concern: vulnerable)
 - *Botaurus stellaris* (European Conservation Concern: vulnerable)

Existing management of river banks etc.: None

Additional Comments: If open cut, construction will be easier during drier months. Bog matting (or equivalent) through the rushes is likely to be required. Duration of works should be kept to a minimum. If possible, treat as special section and avoid using as main right of way. Timing is important – there are likely to be breeding birds in rushes and banks. Dewatering may

be necessary, in which case due regard must be paid to ecological issues. Very boggy among reeds at time of survey.

Record No.: 11
River Name: Ganjachay
Approx KP (Route D2): 296
Date of Survey: 7/11/01 (-ve bank); 8/11/01 (+ve bank)

Grid Reference of upstream limit of section: -ve bank 086 26 619E; 045 17 185N
+ve bank 086 26 567E; 045 17 230N
Grid Reference of downstream limit of section: -ve bank 086 26 688E; 045 17 421N
+ve bank 086 26 543E; 045 17 411N
Grid Reference of approx centreline: -ve bank 086 26 615E; 045 17 272N
+ve bank 086 26 539E; 045 17 306N

Weather & flow conditions: 7/11/01 – sunny with breeze; 8/11/01 overcast with breeze. Very low flow – only perceptible where channel narrow.

Special & typical features of the river channel: Dammed c300m downstream from centreline. Channel v. variable width with negligible flow. Steep earth cliffs – slumped and eroded in places. Filamentous green algae suggesting eutrophic conditions. Narrow permanent stream with much wider flood channel. Some cobbles in flood area.

Marginal vegetation: Patches of *Tamarix*. *Ranunculus sp.* Grasses.

Bank zone habitats: Grass with *Salsola dendroide*, *Alhagian pseudoalhagia*, thistles and *Tamarix*. Heavily grazed and eroding.

Adjacent land-use: Agricultural.

Notes of insects/birds/mammals of special interest: Many burrows in banks and mud cliffs. Terrapins. Birds. Frogs. Small fish.

Recreation features: None.

Known downstream sensitivities:

- Water abstraction from impoundment behind dam
- Flows towards the Mingechaur Reservoir (which feeds into the Kura River)
- Korchay State Forbidden Area is 2.5km downstream (to north)
- No mapped communities downstream from crossing point within 10km
- No endangered flora close to crossing point
- *Falco tinnunculus* (Bird of European Conservation Concern: declining) within 2km of crossing point

Existing management of river banks etc.: None

Additional Comments: Bank stability and burrows in cliff should be taken into account during the planning phase.

Record No.: 12
River Name: Gancachay
Approx KP (Route D2): 298.6
Date of Survey: 7/11/01
Surveyor : Dr Janet Swan

Dry river , therefore not surveyed.

Grid Reference of upstream limit of section:
Grid Reference of downstream limit of section:
Grid Reference of approx centreline:

Weather & flow conditions: Dry river – now agriculture plants .
.

Special & typical features of the river channel:

Marginal vegetation:

Bank zone habitats:

Adjacent land-use:

Notes of insects/birds/mammals of special interest:

Recreation features:

Known downstream sensitivities:

Existing management of river banks etc.:

Additional Comments:

Record No.: 13
River Name: Sarysu
Approx KP (Route D2): 316.1
Date of Survey: 7/11/01

Grid Reference of upstream limit of section: 086 10 570E; 045 26 025N
Grid Reference of downstream limit of section: 086 10 543E; 045 26 199N (<200m downstream, but limit of access)
Grid Reference of approx centreline: 086 10 573E; 045 26 078N
Note: distances are very approximate as no level ground to pace.

Weather & flow conditions: Flow c. 0.5m sec⁻¹. Warm & sunny. Light breeze.

Special & typical features of the river channel: Choked with tall reeds. Steeply incised channel except at WREP crossing which has been left graded.

Marginal vegetation: Dense reeds.

Bank zone habitats: Dense reeds and scrub with willow and alder. *Salsola* at WREP crossing.

Adjacent land-use: Desert with grazing.

Notes of insects/birds/mammals of special interest: Birds, butterflies, frogs. Terrapins heard but not seen. A lot of bird song and movement in the undergrowth.

Recreation features: None

Known downstream sensitivities:

- Flows into the Kura River, upstream of the Mingechaur Reservoir
- The communities of Kadirli and Yenikend are located within 10km downstream
- Shamkir Reserve is 3.5km downstream
- Samukh State Hunting Area is 1km downstream
- No endangered flora close to crossing point
- Endangered fauna recorded within 0.75km of crossing point:
 - *Hystrix indica* (proposed RDB)
 - *Chettusia leucura* (RDB)

Existing management of river banks etc.: None.

Additional Comments: Good reinstatement will be required and should include encouragement of marginal & bankside vegetation.

Record No.: 14
River Name: Gashgarachay
Approx KP (Route D2): 316.7
Date of Survey: 7/11/01

Grid Reference of upstream limit of section: 086 09 986E; 045 26 188N
Grid Reference of downstream limit of section: 086 10 025E; 045 26 188N
Grid Reference of approx centreline: 086 09 934E; 045 26 071N

Weather & flow conditions: Sunny & calm.

Special & typical features of the river channel: Fast flowing. Cobble bed with patches of loose sediment.

Marginal vegetation: Grasses and dicots. *Ranunculus spp.*

Bank zone habitats: Earth cliffs in places 0 up to 1.5m high. Otherwise cobble and grass with *Tamarix* scrub. Burrows in banks.

Adjacent land-use: Pasture.

Notes of insects/birds/mammals of special interest: Frogs. Birds. Probably good for invertebrates – fast flowing over cobble.

Recreation features:

Known downstream sensitivities:

- Flows into the Kura River, upstream of the Mingechaur Reservoir
- The communities of Kadirli and Yenikend are located within 10km downstream
- Shamkir Reserve is 3.5km downstream
- Samukh State Hunting Area is 1km downstream
- No endangered flora close to crossing point
- Endangered fauna recorded within 1.3km of crossing point:
 - *Hystrix indica* (proposed RDB)
 - *Chettusia leucura* (RDB)

Existing management of river banks etc.: None

Additional Comments: None.

Record No.: 15
River Name: Karasu
Approx KP (Route D2): 320.9
Date of Survey: 9/11/01

Note: no grid references and not drawn because no access along channel

Grid Reference of upstream limit of section:

Grid Reference of downstream limit of section:

Grid Reference of approx centreline:

WREP crossing (about 100m downstream of proposed BTC crossing) 086 06 402E; 045 24 567N

Weather & flow conditions: c 1m sec⁻¹

Special & typical features of the river channel: 1.5m wide. Fast flowing at WREP crossing – widens out immediately downstream as flows into rushes. Depth unknown but >0.5m.

Marginal vegetation: Dense tall reeds – prevented access for full survey.

Bank zone habitats: Mosaic of reed species with *Salsola* desert away from channel. Many areas of reed recently cut.

Adjacent land-use: Agriculture.

Notes of insects/birds/mammals of special interest: Birds among reeds. Small burrows in grassland.

Recreation features: None. Extensive grazing along valley.

Known downstream sensitivities:

- Flows into the Kura River, upstream of the Mingechaur Reservoir
- The community of Yenikend is located 10km downstream
- Shamkir Reserve is 4km downstream
- Samukh State Hunting Area is 1km downstream
- No endangered flora close to crossing point
- Endangered fauna recorded within 0.15km of crossing point:
 - *Hystrix indica* (proposed RDB)
 - *Falco tinnunculus* (Bird of European Conservation Concern: declining)
 - *Plegadis falcinellus* (Proposed RDB, Bird of European Conservation Concern: declining)

Existing management of river banks etc.: Bund left/created on –ve bank of WREP crossing

Additional Comments: None.

Record No.: 16
River Name: Shamkirchay
Approx KP (Route D2): 332
Date of Survey: 9/11/01

Grid Reference of upstream limit of section:
Grid Reference of downstream limit of section:
Grid Reference of approx centreline: 085 97 205E; 045 26 951N

Weather & flow conditions: Sunny & calm.

Special & typical features of the river channel: Dry river bed – cobble in silt. Extensive gravel/cobble extraction. Main channel has bank 405m high on –ve side and 1m on +ve.

Marginal vegetation: None.

Bank zone habitats: Ecological desert. Sparse grasses and ruderal species.

Adjacent land-use:

Notes of insects/birds/mammals of special interest: Occasional birds. Burrow in –ve bank.

Recreation features: None.

Known downstream sensitivities:

- Flows to north into the Shamkir Reservoir (which feeds the Kura River)
- Shamkir Reserve is 4km downstream
- Shamkir State Forbidden Area is 6km downstream
- Communities within 10km downstream: Yenyabad, Kur
- No endangered flora or fauna close to crossing point

Existing management of river banks etc.: Quarrying

Additional Comments: None.

Record No.: 17
River Name: Zayamchay
Approx KP (Route D2): 357
Date of Survey: 9/11/01

Note: Not mapped because no ecological sensitivity.

Grid Reference of upstream limit of section: 085 74 302E; 045 34 255N
Grid Reference of downstream limit of section: 085 74 309E; 045 34 467N
Grid Reference of approx centreline: 085 74 344E; 045 34 329N

Weather & flow conditions: Calm & sunny.

Special & typical features of the river channel: Broad dry cobble/silt river bed c. 400m wide. Eroded banks both sides c 2m high on +ve bank and 4m on -ve bank at centreline. Further flood zone 2-300m wide on +ve side = grass.

Marginal vegetation: None.

Bank zone habitats: Grass.

Adjacent land-use: Grazing.

Notes of insects/birds/mammals of special interest: Burrows in banks and river margins. Particularly large burrow in -ve bank at 085 74 487E; 045 34 243N.

Recreation features:

Known downstream sensitivities:

- Flows to north into the Shamkir Reservoir (approximately 8km)
- Shamkir State Forbidden Area is 7.5km downstream
- No communities adjacent to the river downstream from crossing point
- No endangered flora close to crossing point
- Endangered fauna within 0.5km of pipeline crossing:
 - Testudo graeca (RDB)
 - Falco tinnunculus (Bird of European Conservation Concern: declining)
- Archaeological site (burial mounds and bridge) 0.5km to east

Existing management of river banks etc.: Gravel extraction c. 150m upstream.

Additional Comments: Archaeologically important camel dung bridge supports upstream from proposed crossing point. Will require clear briefing of workforce about their archaeological importance.

Record No.: 18
River Name: Tovuschay
Approx KP (Route D2): 377.1
Date of Survey: 10/11/01
Surveyor : Dr Janet Swan

Grid Reference of upstream limit of section: 085 56 748E; 045 42 378N
Grid Reference of downstream limit of section: 085 56 910E; 045 42 604N
Grid Reference of approx centreline: 085 56 814E; 045 42 450N

Weather & flow conditions: Calm; partial sun.

Special & typical features of the river channel: Wide cobble river bed with small flowing channel. Vehicle track along river bed – crosses channel in many places.

Flowing channel: Flow rate c.0.3m sec⁻¹. Cobble/silt bed. Water depth 0.1- 0.2m Channel width 1.5 – 6.0. Seriously eutrophic with green/yellow algal mats and *Lemna*.

Marginal vegetation:

Grass with some patches of *Mysotis* xxx water forget-me-not and *Mentha* sp.

Bank zone habitats:

Sand /cobble cliff to main river channel.

Cobble for flowing river channel.

Adjacent land-use:

-ve = semi-desert

+ve = agricultural

Notes of insects/birds/mammals of special interest:

Some birds.

Occasional burrows in cliffs.

Economic features:

Upstream has gravel/cobble extraction and rubbish tipping.

Several dwellings close to river bank with water extraction for irrigation.

Known downstream sensitivities:

- Flows towards Shamkir Reservoir (11km downstream)
- No mapped communities along river between crossing point and reservoir
- No endangered flora close to crossing point
- Endangered fauna recorded downstream (4km):
 - *Testudo graeca* (RDB)
 - *Aquila rapax* (RDB, Bird of European Conservation Concern: vulnerable)
 - *Hystrix indica* (proposed RDB)

Existing management of river banks etc.: None.

Additional Comments: None.

Record No.: 19
River Name: Hasansu
Approx KP (Route D2): 397.8
Date of Survey: 11/11/01

Grid Reference of upstream limit of section: no GPS readings (military installation nearby)
Grid Reference of downstream limit of section:
Grid Reference of approx centreline:

Weather & flow conditions: Sunny & windy. Flow 2m sec-1.

Special & typical features of the river channel: Shallow mountain stream in deeply incised valley. Clear water with some algae and monocots. Probably good for invertebrates.

Marginal vegetation: Grasses & dicots – no access for ID except for small section of grassy bank.

Bank zone habitats: Earth cliffs with dense shrubs and tall reeds. Some *Tamarix*. *Vitis sp.* Some burrows.

Adjacent land-use: -ve is semi-desert. +ve is semidesert and agricultural

Notes of insects/birds/mammals of special interest: Crabs, birds (surprisingly few). Good vegetation diversity and structure. Dragonflies. Wagtail.

Recreation features: Trout fishing from small holding.

Known downstream sensitivities:

- Small holding dependant on river for water supply.
- Electrofishing.
- Waterbuffalo and other livestock drink from river.
- Flows towards the Kura River (4.5km downstream)
- No mapped communities along river between crossing point and Kura River
- Endangered fauna recorded at crossing location:
 - *Plegadis falcinellus* (Proposed RDB, Bird of European Conservation Concern: declining)
 - *Manduca atropos* (RDB)
 - Endangered fauna recorded 1.25km from crossing point:
 - *Testudo graeca* (RDB)
 - Endangered flora recorded 1km from crossing point:
 - *Glycyrrhiza glabra* (Proposed RDB)

Existing management of river banks etc.: None

Additional Comments: Ecologically diverse. Sediment release from bank grading and crossing must be very carefully controlled.

Record No.: 20
River Name: Kura (west crossing)
Approx KP (Route D2): 411
Date of Survey: 12/11/01

Grid Reference of upstream limit of section: -ve bank 085 37 543E; 045 67 631N
+ve bank 085 37 521E; 045 67 827N
Grid Reference of downstream limit of section: -ve bank 085 37 777E; 045 67 691N
+ve bank 085 37 674E; 045 67 871N
Grid Reference of approx centreline: -ve bank 085 37 627E; 045 67 650N
+ve bank 085 37 547E; 045 67 839N

Weather & flow conditions: Overcast & breezy (force 3-4). Cool (10°C). Flow 2-3m sec⁻¹.

Special & typical features of the river channel: Wide fast flowing river. Some *Myriophyllum* sp., *Ceratosterna* sp., algae.

Marginal vegetation: Submerged filamentous plants near margins.. Hawksbit. Plantain (?water dock)

Bank zone habitats: Mud cliff 1-2m high. Grass with *Tamarix*. Some burrows.

Adjacent land-use: Grazing.

Notes of insects/birds/mammals of special interest: Kingfishers. Mouse burrows among *Tamarix*. Terrapins. +ve bank has much more diverse habitats than -ve bank, especially downstream of crossing point.

Recreation features: Grazing. Fishing.

Known downstream sensitivities:

- Birds
- Flows towards east, ultimately reaching the Caspian
- Kariyazi Aquifer immediately upstream from this location
- Kariyazi-Agstafa State Forbidden Area immediately upstream from this location
- Community 5.5km downstream: Kesaman
- No endangered flora close to crossing point
- Endangered fauna recorded just upstream and up to 5km downstream of crossing point:
 - *Chettusia leucura* (RDB)
 - *Alcedo atthis* (Bird of European Conservation Concern: declining)
 - *Testudo graeca* (RDB)
 - *Circus cyaneus* (Bird of European Conservation Concern: vulnerable)
 - *Porphyrio porphyrio* (Proposed RDB, Bird of European Conservation Concern: rare)

Existing management of river banks etc.: Recent burning – probably controlled burn for scrub control but may have been accidental.

Additional Comments: High sensitivity. Many opportunities to improve marginal habitats.

Record No.: 21
River Name: Kurudera
BTC RVX No.: 422.3
Date of Survey: 12/11/01

Grid Reference of upstream limit of section:
Grid Reference of downstream limit of section:
Grid Reference of approx centreline:

085 29 508E; 045 74 120N

Note: Not mapped

Weather & flow conditions: Cool and overcast.

Special & typical features of the river channel: Narrow flowing channel 0.5 to 2m wide and 0.1m deep in wider dry river bed.

Marginal vegetation: None.

Bank zone habitats: Sand cliffs to main +ve bank and downstream on –ve side.

Adjacent land-use: Semi-desert.

Notes of insects/birds/mammals of special interest:

Recreation features: None

Known downstream sensitivities:

- Flows into Kura River 10km downstream (to SE)
- Located within Kariyazi Aquifer
- Comes close to Kariyazi-Agstafa State Forbidden Area approximately 10km downstream
- No communities directly on route of Kurudera between crossing point and Kura River
- No endangered flora close to crossing point
- Endangered fauna recorded less than 1km from crossing point:
 - Testudo graeca (RDB)

Existing management of river banks etc.: None

Additional Comments: Fly tipping on –ve bank included barbed wire, metal, tiles (possibly asbestos) and many small bottles (possibly chemical).

1.4 SUMMARY

Table 1-1 summarises the ecological sensitivity of each river crossing on a scale of 1 to 5, where 1 denotes high sensitivity and 5 denotes low sensitivity. The assessment is inherently subjective, but is intended as an indication of the relative importance of each river, in ecological terms.

The Kura and Hasansu rivers are the most sensitive along the route; this has been taken into account during the environmental assessment and design of the pipeline.

Table 1-1 Main Azerbaijan river crossings - ecological sensitivity

River Ref. No.	River	Crossing Point (KPs based on Route D2)	Ecological Sensitivity (1 = high; 5 = low)	Width ¹ & flow rate of wet channel Nov. 2001	Comments
1	Djerankechmes	9.3	2	3m; 0.4m sec ⁻¹	Wide river bed with narrow stream flowing at time of survey. Sensitivity relates to overall species diversity within river system rather than aquatic fauna; many burrows were observed in banks. Bank stability is an issue due to the erodable nature of the bank materials and the lack of vegetation. River flows highly seasonal (flow increases considerably during spring). Typically exhibits high sediment load
2	Pirsagat	42.1	3/4	3m; 0.25m sec ⁻¹	Narrow canalised river with slow flow. High sediment load. Dredged within last 12 months.
3	Agsu Canal	111.2	4	25m; 1m sec ⁻¹	Wide canalised river. High sediment load. Low apparent ecological sensitivity but has the potential to transport contaminants to more sensitive areas.
4	Geokchay	171.3	3	15m; 1m sec ⁻¹	Narrow canalised river in deep cutting. Vegetation indicates wide fluctuations in water level. High sediment load. Diverse bank flora and bird life.
5	Turianchay	193.5	2	15m; 1m sec ⁻¹	Incomplete survey because dense scrub precluded adequate access. Possible habitat for water voles. Potential to carry contaminants downstream rapidly.
6	Kura (east crossing)	223.6	1	>150m; 2m sec ⁻¹	Wide fast flowing river with extensive fishing and wildlife value. Reedbed downstream from crossing point is particularly valuable for birds. Given the high flow rate, the river has the potential to transport contaminants downstream rapidly.
7	Karabach Canal	245.1	4	25m; 0.5m sec ⁻¹	Canalised river with marginal vegetation. Abstraction point for irrigation immediately <u>upstream</u> of crossing point. Low apparent ecological sensitivity but has the potential to transport contaminants

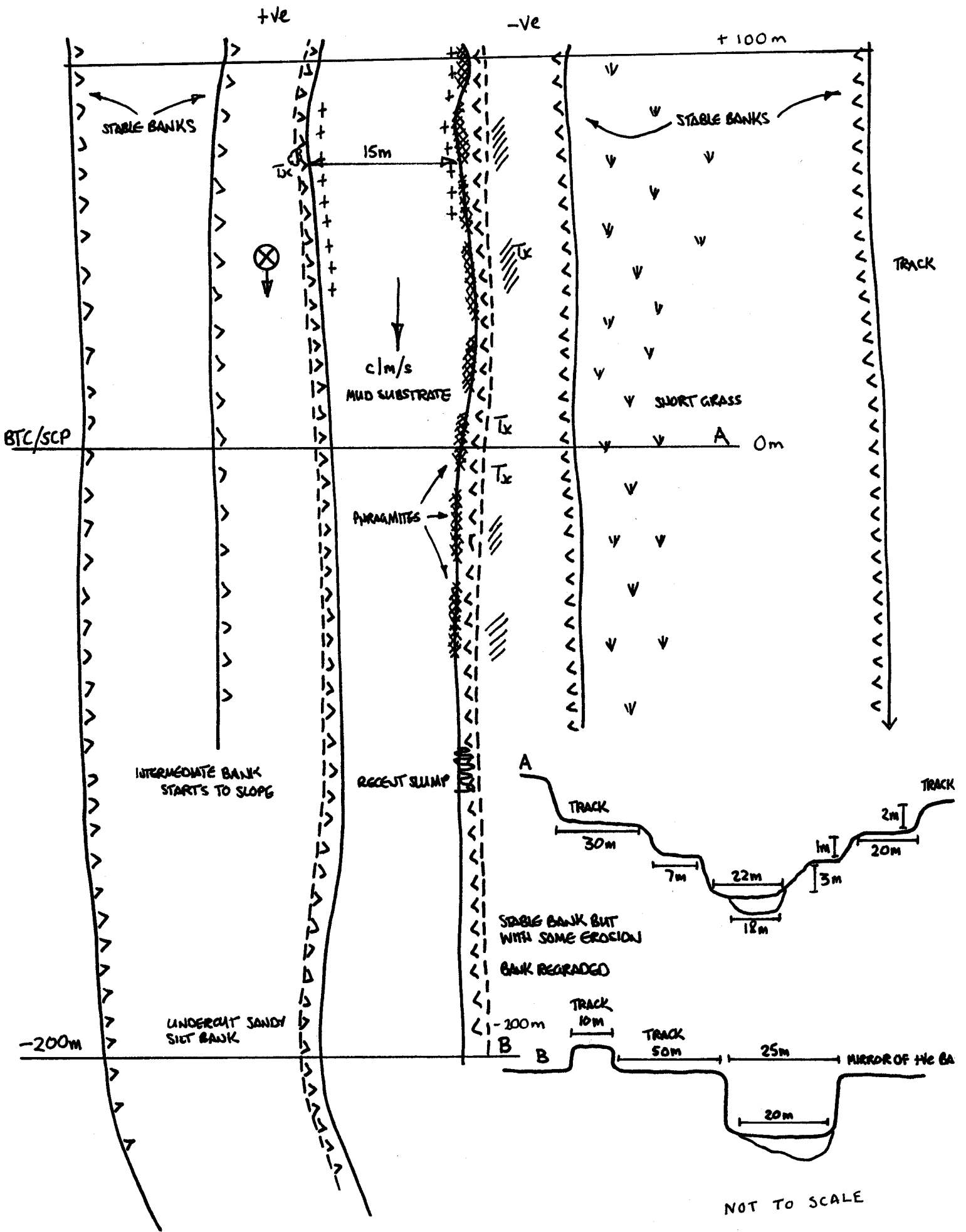
¹ Widths and flow rates are visual estimates only and relate to a single site visit at each location.

Table 1-1 Main Azerbaijan river crossings - ecological sensitivity

River Ref. No.	River	Crossing Point (KPs based on Route D2)	Ecological Sensitivity (1 = high; 5 = low)	Width¹ & flow rate of wet channel Nov. 2001	Comments
					to more sensitive areas
8	Goranchay	257.8	5	dry	Small and dry (at the time of the survey)
9	Kurekchay	276.5	2/3	3m; 0.3m sec ⁻¹	Wide braided channel – only narrow channels flowing. Mud cliffs have abundant holes. River well used by villagers for washing etc. Also used widely for watering livestock.
10	Korchay	292	2/3	3m; 0.5m sec ⁻¹	Braided river with narrow flowing channels within extensive areas of marshy reedbeds. Ecologically diverse (habitat for terrapins and a wide range of birdlife). Also used widely for watering livestock. In the event of a spill, contaminant migration might be partially impeded by the reeds but could have significant local effects. Believed to have greater flow in Spring.
11	Ganjachay	296	3/4	3-13m; 0.2m sec ⁻¹	Channel of variable width but negligible flow. Many burrows in cliffs. Dammed c.300m downstream from pipeline crossing point. It is probable that contaminant migration would be limited by the presence of the dam in the event of a pollution incident upstream of it.
12	Gancachay	298.4	5	dry	Dry river – currently agricultural plots.
13	Sarysu	316.1	3	1.5m; 0.5m sec ⁻¹	Small stream with good species diversity.
14	Gashgarachay	316.7	2/3	2-3m; 2m sec ⁻¹	Fast flowing with good species diversity. Also used widely for watering livestock.
15	Karasu	320.9	3	1.5m; c. 0.5 sec ⁻¹	Narrow watercourse within a wide channel, mainly vegetated by reeds. Valuable bird habitat. In the event of a spill, contaminant migration might be partially impeded by the reeds but could have significant local effects.
16	Shamkirchay	332	5	dry	Wide but dry channel. Very low ecological value or sensitivity. The dry river bed has been extensively exploited for gravel extraction,

Table 1-1 Main Azerbaijan river crossings - ecological sensitivity

River Ref. No.	River	Crossing Point (KPs based on Route D2)	Ecological Sensitivity (1 = high; 5 = low)	Width¹ & flow rate of wet channel Nov. 2001	Comments
					with extraction taking place upstream at time of survey.
17	Zayamchay	357	5	0.4m;	Very low ecological sensitivity and almost no flowing channel. Archaeological feature (bridge supports) within dry area of channel.
18	Tovuzchay	377.1	4	1.5-6m; 0.3m sec ⁻¹	Wide cobble river bed with narrow flowing channel. Main channel eutrophic. Flow may increase in spring and therefore introduce the risk of any pollution incident impacting downstream receptors.
19	Hasansu	397.8	1	3-6m; 2m sec ⁻¹	Fast flowing clear stream. Ecological diverse and valuable habitat. Smallholding immediately downstream with livestock drinking from the river. Locals regularly catch large trout in the river – thought to spawn locally. A pollution incident at the crossing point could have serious adverse impacts and could be carried considerable distance downstream.
20	Kura (west crossing)	411	1	>100m; 2-3m sec ⁻¹	Fast flowing and wide. Extensive fishing. Diverse birdlife (including kingfishers). Wetland & islands used by birds just downstream from proposed crossing. Pollution incidents at the crossing point could lead to rapid migration of contaminants downstream.
21	Kurudera	422.3	3	2-3m; 0.5m sec ⁻¹	Narrow flowing channel c. 0.1m deep at the time of the survey with sand/silt substrate. Cobbles/sand throughout dry portions of river bed. Sand cliffs downstream provide potential nesting habitat. Fly tipping including chemical bottles on bank. Karyazi wetland downstream increases sensitivity.



AGSU CANAL

+ve

-ve

SCATTERED TAMARIX, SALSOLA,
ARTEMISIA & ALLIAGIA

STABLE
SAND CLIFF

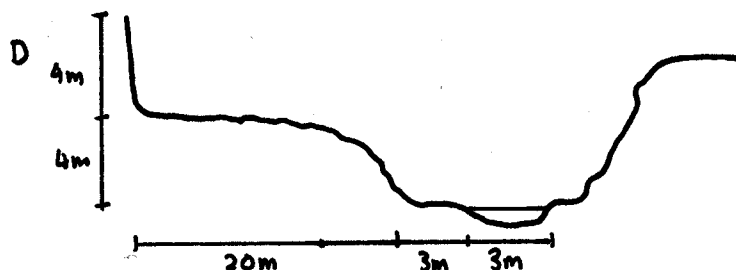
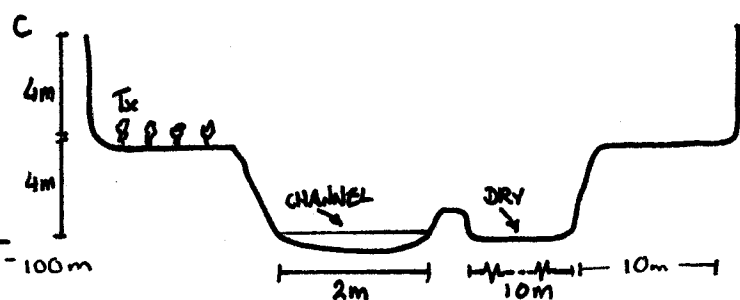
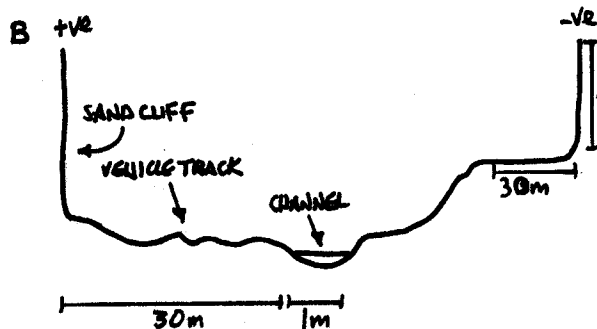
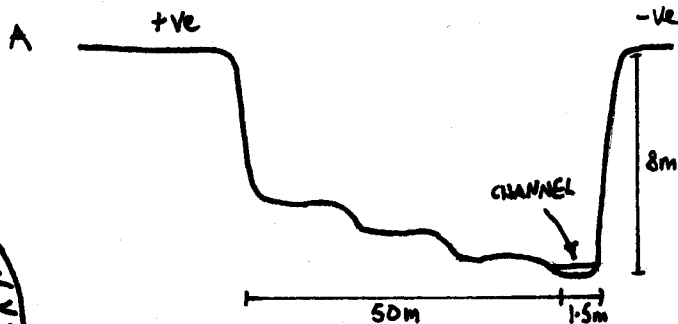
A + 100 m

BURROWS
IN SAND
CLIFF

TRACK

CLIFF:
COMPACTED ROCK & SAND
SLUMPING

B 0 m



0.5m/s
RIVER BED SAND W
PARTS WITH SILT,
COBBLE & GRAVEL

CLIFF
GRADES OUT

- 200 m

NOT TO SCALE

DJEYRANKECHMES

CONTAMINATED LAND

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1 CONTAMINATED LAND

1.1 INTRODUCTION

The purpose of this report is to describe areas of contamination, which may be crossed by the proposed pipeline corridor, and to identify such areas that may put the proposed pipeline or workforce at risk. It should be noted that this report is a preliminary contamination review. A separate Contamination Baseline Report will be produced under the requirements of the HGA.

1.2 DATA SOURCES

In the preparation of this report a number of reference sources have been reviewed. As the proposed pipeline follows the existing “Western Route Export Pipeline” (WREPA) for much of its route, reference materials detailing areas of contaminated land along the WREPA have been used, together with more up to date baseline information collected in summer 2000 and winter/spring 2001. Information provided in the EIA for the WREPA was based on field survey work, literature review reports prepared by members of the Azeri scientific community, and clarification meetings held with the authors of the reports, as detailed below.

The contaminated land section has been based on the following sources of information:

- September 2001 – Contamination survey of Pipe Dumps and Camp Locations undertaken by RSK Environment Ltd on behalf of BP
- January/February 2001 - baseline survey of those areas where the proposed proposed pipeline route deviates significantly from the WREPA undertaken by Azerbaijan Environment and Technology Centre (AETC) on behalf of BP
- August/September 2000 - rapid reconnaissance survey of the WREPA undertaken by Environment Resources Management (ERM) on behalf of BP
- 1997 - baseline survey of WREP undertaken by AETC on behalf of Azerbaijan International Operating Company (AIOC) as part of the Environmental Impact Assessment of the WREP
- Literature review on contamination along the WREPA corridor by Dr R Mamedov, Scientific Center ‘Nafta’, Institute of Geology (December 1996)
- Supplementary details and clarifications provided by Dr R Mamadov in meeting with Dr. Heike Pflasterer held in Baku (February 1997)
- Literature review on soils and agrochemistry along the WREPA corridor by Prof. G Yagubov, Institute of Soils and Agrochemistry (December 1996)
- Supplementary details and clarifications provided by Prof. G Yagubov in meeting with Dr. Heike Pflasterer held in Baku (February 1997)

1.3 AREAS OF OBSERVED CONTAMINATION

Table 1-1 outlines the findings of field work carried out during 2000 and 2001. This work identified twenty three sites of observed soil contamination close to the proposed route of the pipeline.

In the majority of instances, the observed contamination was the result of uncontrolled disposal of wastes (fly tipping).

Table 1 Observed contamination along the proposed pipeline route

NEAREST KP	CONTAMINATION SOURCE	POTENTIAL CONTAMINANTS	APPARENT DEPTH	PROXIMITY TO PIPELINE CENTRELINE (M)
0	Oil industry	Hydrocarbons	Surface	600
51	Fly tipping/asbestos tiles	Mixed wastes	Surface	Within 20
52	Fly tipping	Mixed wastes	Surface	120
55	Oil industry - old oil exploration site with degraded oil, separation ponds and cuttings	Hydrocarbons	Unknown	70
64	Other Industrial (proposed camp/pipe dump site). White fibrous deposit in patches	Unknown, possible asbestos	Surface	500
77	Oil industry - old well site	Hydrocarbons	Unknown	Within 20
92	Oil industry – probable former oil exploration site with iron rich water in ponds	Heavy metal/iron	Unknown	40
223	Vehicle oil 4m from East bank of Kura in waterlogged ground	Hydrocarbons	Unknown	Within 20
224	Fly tipping/asbestos tiles	Asbestos tiles	Surface	400
227	Municipal	Household waste	Surface	40
231	Oil industry	Hydrocarbons	Unknown	300
254	Fly tipping - possible asbestos tiles plus household waste, paint cans, oil cans	Asbestos	Surface	50
271	Oil industry - disused oil well. Actively leaking oil and water into 3 lagoons around wellhead	Hydrocarbons	Unknown	40
276	Oil industry pumping station	Possible hydrocarbons	Surface	80
304	Fly tipping/asbestos tiles. Close to river, stream and earth dam	Asbestos tiles	Surface	Within 20
308	Industrial activities and fly tipping - possible smelting site-building rubble	Metals, hydrocarbons, mixed wastes	Unknown	Within 20
338	Fly tipping - possible asbestos tiles	Asbestos	Surface	20
343	Fly tipping - possible asbestos tiles	Asbestos	Surface	Within 20
354	Fly tipping	Asbestos tiles	Surface	60
364	Fly tipping including possible asbestos tiles, rubble, car remains, wire, cans	Asbestos, mixed wastes, solvents, metals	Surface	40
377	Fly tipping - possible asbestos tiles	Asbestos	Surface	60

Table 1 Observed contamination along the proposed pipeline route

NEAREST KP	CONTAMINATION SOURCE	POTENTIAL CONTAMINANTS	APPARENT DEPTH	PROXIMITY TO PIPELINE CENTRELINE (M)
395	Building rubble and fly tipping with possible asbestos tiles.	Asbestos	Surface	30
422	Fly tipping - barbed wire, metal, glass (chemical) bottles, tiles (possibly asbestos) on East bank of Kurudera River	Asbestos, mixed wastes, solvents, hydrocarbons, metals	Unknown	Within 20

1.4 HYDROCARBON CONTAMINATION

In the Gobustan Area (KP0-52), the proposed pipeline has been routed to avoid existing pipelines. No contamination from oil pipeline leakages was observed. The proposed pipeline corridor appears not to be affected by contamination from the three exploration fields crossed in this area (Miaidjik, Turagay and Solakhay).

In the Shirvan Steppe section (KP52 to 224) the pipeline crosses, or is routed close to, three exploration drilling fields where drilling activities have been undertaken in the past: Small Harami (north of Kazi-Magomed), Padar and Karadjarle. Contamination within these oil fields is usually restricted to the immediate vicinity of the drill site.

In the Karabakh Plain area (KP224 to 256) the proposed pipeline route crosses the Amirax oil prospecting area where oil contamination due to bombing of a well during the conflict with Armenia has been reported (Mamedov, 1996). Elsewhere, contamination within these oil fields is usually restricted to the immediate vicinity of the drill site. No wells were identified within the pipeline corridor with visible contamination.

In the Lesser Caucasus Plain and Lowlands area (KP256-442) the pipeline traverses the Borsunlu, Dalimammedli, Giragkasaman, Dallar-Tovuz, Khatunli and Akstafa oilfields, some of which are in operation. There is only local contamination around the drill sites within these fields. One disused oil well near Borsunlu (KP271) was identified as actively leaking oil and water.

1.5 RADIATION

The exploration and production of oil creates a number of potential sources of contamination. Radiation from radionuclides may be released by hydrocarbon operations such as exploration drilling wells, oil collection points and oil storage tanks. Mamedov (1996) indicated that the Gobustan region has a general background radiation level of between 4 and 15 μ rh⁻¹. However, in areas of intense tectonic and mud volcano activity, the background levels become elevated to 20-22 μ rh⁻¹. These levels are considered to be within 'normal' background radiation levels of <33 μ rh⁻¹ (2.5mZvyr⁻¹) according to the established standard (NRPB 76/87).

The background radiation level in the Shirvan Plain area is lower than in Gobustan, at between 5-8 μ rh⁻¹, due to the less active tectonic regime. There is still the potential for elevated levels of radiation in the form of radionuclides, hydrocarbons, phenols and heavy metals to be released from hydrocarbon operations.

In the Karabakh Plain area the background radiation level is low and stable at $5.5-6 \mu\text{ryr}^{-1}$ due to the less active tectonic regime. Hydrocarbon operations could also have released elevated levels of hydrocarbons, phenols, heavy metals and radionuclides.

The background radiation level in the Lesser Caucasus Plain and Lowlands area is believed to be relatively low and stable (around $6 \mu\text{ryr}^{-1}$), although the area has not been as intensively surveyed as the eastern areas traversed by the pipeline corridor.

1.6 FLY TIPPING AND ASBESTOS

Contamination in the form of surface fly tipping was observed at a number of sites during the 2000/2001 surveys. It generally comprised municipal waste consisting of various materials such as glass, metal, rags etc. The sites often contained remains of roofing tiles, which may consist of asbestos and as such may pose a hazard to health and safety of the workforce during pipeline construction activities. Two sites were identified where possible asbestos roofing tiles occurred on the sites of demolished buildings.

Figure 1 Site of surface contamination (fly tipping)



The principal concern relates to the nature of the tiles that were observed on the surface. If the tiles are composed of asbestos (which is a high possibility in such areas), then they will pose a Health and Safety risk to employees during construction of the proposed pipeline.

Figure 2 Surface contamination (suspected asbestos tiles)



1.7 INDUSTRIAL CONTAMINATION

In the Shirvan Plain section of the proposed pipeline, Kazi Magomed and Ucar are small industrial bases where industries such as printing, brick making and cotton processing take place. They are also oil storage bases. The proposed pipeline corridor is located 1km to the north of Kazi Magomed and 5km to the south of Ucar.

The Karabakh Plain area traversed by the proposed pipeline route has the potential for contamination mainly due to the industrialization at Yevlakh. The industry at Yevlakh includes concrete and ferro concrete production, asphalt production, wool processing and oil storage facilities. The proposed pipeline corridor is located 1 km to the south-west of Yevlakh.

Industry, military activity and oil exploration in the Lesser Caucasus Plain and Lowlands area have the potential to cause contamination within the proposed pipeline corridor. The town of Ganja has a high level of industrial activity including concrete production, aluminium oxide production, machinery manufacturing, non-ferrous metal plant, instrument engineering plant, wood processing, furniture manufacture and oil storage facilities. The towns of Tovuz, Kazakh and Akstafa also have oil bases and light industry such as wine distilleries and bread baking. The lack of up-to-date technology for controlling emissions to air and water leads to the potential for heavy contamination in such areas. The proposed pipeline corridor is located approximately 8 km north of the outskirts of Ganja.

Where the proposed pipeline route is located in close proximity to such industrial areas, there is a possibility that it may be impacted by contamination from these sources through airborne emissions, soil, groundwater or surface contamination.

1.8 AGRICULTURAL CONTAMINATION

The Gobustan region, east of Kazi Magomed is too dry and the soils too saline to be used for extensive agricultural purposes.

Within the Shirvan Steppe section of the proposed pipeline route, the area from Ranjbar to the Kura River east of Yevlakh is a flat land area that has been used extensively for agriculture. The intense farming practices in the area have had a profound effect on the soil characteristics. The land is intensively cultivated arable farmland used mainly for cotton and cereals, with smaller areas of rice and pasture. The soils have become depleted and crops are patchy and sparse in places. There is a possibility that the soils in this area may be contaminated with high levels of pesticides and/or herbicides.

Soils are reportedly contaminated with pesticides and herbicides throughout the Karabakh Plain area.

Agriculture in the Lesser Caucasus Plain and Lowland area is similar in type and intensity to the Shirvan and Karabakh Plains, with the addition of vineyards and orchards towards the west in the foothills of the Small Caucasus. There is therefore a possibility that the soils may be contaminated with high levels of pesticides and/or herbicides.

1.9 MILITARY AREAS/ORDNANCE

In the Gobustan region, the proposed pipeline crosses a military area between KP5 and KP13. This area was apparently used for military training purposes and is reputed to contain anti-personnel mines. There is also the possibility of live ordnance being found.

In the Karabakh Plain area the proposed pipeline route crosses the Amirarx oil prospecting area which, as mentioned, was reportedly damaged by bombing during the conflict with Armenia, resulting in local crude oil contamination and the possibility of live ordnance still being found.

In the Lesser Caucasus Plain and Lowland area, there is a military training area north of the western Kura crossing at Poylu, extending westwards to Jandari Lake and the Georgian Border. The presence of ordnance (and possibly radioactive materials) in this area may be significant. Therefore this area has been avoided by the proposed pipeline route by re-routing to the south through the Karayazi Aquifer area.

1.10 NATURAL CONTAMINATION

In the Gobustan Area, between KP0 and KP29, natural seepages of crude oil occur in small quantities from mud volcanoes and faults. Similarly, there may be elevated levels of hydrocarbons and phenols in the vicinity of the proposed pipeline due to natural (mudflow and seepage) and industrial sources, such as leaking oil pipelines. Heavy metals can also be associated with natural mud flows emanating from the numerous mud volcanoes e.g. the Turagay mud volcano, the flanks of which are approximately 0.5 km to the south of the proposed pipeline at KP17.

1.11 CONTAMINATION SURVEY OF PIPE DUMPS AND CAMP LOCATIONS

Walkover surveys were carried out at the beginning of September 2001 at the following proposed pipe dump locations:

- Sangachal
- Mugan
- Kurdemir

- Ucar
- Laki
- Yevlak
- Ganja
- Dollar
- Zayam
- Polyu
- Bayuk Kassik

And the following camp location:

- Ganja

At each location, surface soil samples were taken for laboratory analysis and internationally recognised guidelines were used to assess the samples. The following guidelines were used, 'Guidance on the assessment and Redevelopment of Contaminated Land' ICRCL Guidance Note 59/83 - UK, New Dutch List Guidelines and EH40/98 Occupational exposure limits (HSE 1998).

The ICRCL (Interdepartmental Committee for the Redevelopment of Contaminated Land) was set up in 1976, to consider the development of contaminated sites. In order to assess whether a particular site was contaminated, two 'trigger' values were created, called the 'threshold' and 'action' values. These trigger values create three possible contamination concentration zones:

- Below the 'threshold' value was declared uncontaminated
- Above the 'action' value, the presence of the contaminant has to be regarded as undesirable or even unacceptable, so some kind of remedial action is required
- Between the two values, there may be a need to consider the contamination and take action where circumstances demand it. The decision to do so will be based on "informed judgement".

Analysis was carried out on the samples to identify the levels of Arsenic, Cadmium, Lead, Chromium (and Chromium VI) and Selenium that are harmful to human and animal health by ingestion. Samples were analysed for Zinc, Copper and Nickel, as they are known to be phytotoxins (substances harmful to plants). In addition to the above, samples were taken in order to analyse for the following contaminants, Poly-Aromatic Hydrocarbons (PAH), Total Petroleum Hydrocarbons (TPH) and Diesel Range Organics (DRO) and Chrysotile (white asbestos).

The following results were obtained:

- 3 sites (Sangachal, Laki and Yevlak) exceeded ICRCL threshold values for arsenic. 1 site was above the ICRCL action value (Ganja pipe dump)
- 2 sites (Laki and Ganja Pipe Dump) were above ICRCL threshold values for Mercury
- 3 sites (Kurdemir, Yevlak and Dollar) were above ICRCL threshold values for Nickel
- No sites were above ICRCL threshold values for Cadmium, Chromium or Chromium VI, Lead, Selenium, Zinc, Copper
- No sites were above the ICRCL threshold value for PAHs
- No sites were above the Dutch Intervention level for TPH – DRO
- 4 sites (Kurdemir, Ucar, Yevlak and Dollar) have elevated chrysotile (white asbestos) levels

In summary the levels of contamination were low, indicative of light industrial use. Only one site (Ganja pipe dump) had a determinand (arsenic) level over the ICRL action value.

1.12 PUBLIC HEALTH ISSUES

Large areas of population along the route such as Kazi-Magomed, Kurdamir, Ucar, Yevlakh, Ganja, Tovuz, Akstafa and Kazak are associated with industry, industrial discharges and municipal sewage. In the majority of settlements, central sewage collection and treatment facilities are absent. The situation is aggravated during periods of high precipitation, when contamination of surface and groundwater bodies by sewage, domestic and industrial wastes takes place. This is a particular problem in the area between Kazi-Magomed and Yevlakh, where cases of malaria and anthrax were reported in 1996.

1.12.1 Malaria

Malaria is a febrile disease caused by a parasite that is transmitted by mosquitoes. Of the four types of malaria (*faciparum*, *vivax*, *ovale* and *malariae*), *falciparum* can be lethal.

The most common form of malaria in Azerbaijan is *vivax malaria*, which is responsible for milder diseases. Unless correctly treated it can hide in the liver, causing relapses months or even years later. However, if treated immediately and correctly, recovery is complete.

There was an alarming upsurge in malaria cases in Azerbaijan during the mid-1990s. This is being reversed through the efforts of a public-private partnership brokered in 1998 by the Roll Back Malaria global partnership.

During its first year of operation the malaria program, funded by a private sector multinational company and supported by international and other UN agencies, helped reduce malaria cases in the country by over 50 percent.

Twenty years ago malaria was virtually eradicated from Azerbaijan. However, over the past three years there has been a 120 fold increase in its incidence, 23 cases being reported in 1993 and 2802 in 1995. (British Medical Journal, 25 May 1996)

Certain mosquito control programmes can be adopted to reduce the mosquito population, and hence the occurrence of malaria. These include draining swamps and ditches, eliminating standing water and preventing mosquito access to living areas.

Protection from malaria is a personal responsibility, with preventative measures including the use of mosquito nets, “covering up” after dusk and the use insect repellent. Antimalarial medication is also an option, which either prevents or represses malarial symptoms.

1.12.2 Foot and Mouth disease

Foot and mouth disease occurs only in cloven hoofed animals, and does not affect humans. Animals affected include sheep, cattle, pigs, goats, deer and rats.

The disease is highly contagious and is spread rapidly through livestock. Humans, although unlikely to contract the disease, are often responsible for spreading it, as it can be carried on skin, clothing and shoes. Similarly, motor vehicles can spread the disease. In certain climatic conditions, foot and mouth can be borne by the wind to distances of 60 km (over land) to 300 km (over water).

The disease causes reduced fertility, low milk yields and death. It is not possible to treat the disease other than by vaccination although animals can recover from it in several weeks.

The most effective method for combating the spread of foot and mouth disease is early detection, coupled with culling of infected animals.

The last reported case of foot and mouth disease in Azerbaijan was in 1996. A vaccination programme has recently been investigated in order to prevent an influx of the disease to the country.

1.12.3 Anthrax

Anthrax is an acute infectious disease carried by the bacterium *Bacillus anthracis*. Anthrax occurs most commonly in wild and domestic vertebrates (sheep, cattle, goats, camels and other herbivores). It may also occur in humans exposed to infected animals or tissue from infected animals.

Anthrax is most common in agricultural regions (particularly southern and eastern regions of Europe). When outbreaks are found in humans, this is generally due to occupational exposure to affected animals or their products.

Transmission occurs by inhalation, ingestion or through the skin. Spores can survive in the soil for many years, and can result in infection of humans who are involved in handling products from infected animals, or by inhaling anthrax spores. However, direct person-to-person communication of anthrax is extremely unlikely to occur.

Anthrax vaccines for both humans and animals are available, and are said to be 93% effective.

Anthrax occurrences in humans in Azerbaijan between 1992 and 1996 are indicated in table 1-2. The disease is treatable with antibiotics, but these must be started early in the infection. If anthrax remains untreated it can be fatal. There have been reports of anthrax affecting areas of the proposed pipeline route in Azerbaijan in 2000/2001, however, no further information is currently available on these outbreaks.

Table 2 Anthrax cases in Azerbaijan

YEAR	NUMBER OF CASES OF HUMAN ANTHRAX
1992	33
1993	55
1994	50
1995	45
1996	76

1.12.4 Cholera

Cholera is a bacterial disease affecting the intestinal tract. It is caused by the Vibrio cholera germ. Epidemics occur mainly in Central and Southern America. In recent years, there have been outbreaks of cholera in the former Soviet Union, including the north Caucasus area.

The disease is passed in faeces. It is spread either by eating food or drinking water contaminated by the faecal waste of an infected person. This is more common in underdeveloped countries lacking adequate water supplies and proper sewage disposal.

A vaccine for cholera is available; however, this offers only 50% efficacy. The best guard against contracting cholera is, therefore, thought to be careful personal hygiene and the avoidance of unsafe food or water in countries where the disease is incident.

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1 GEOHAZARDS

1.1 INTRODUCTION

This report clarifies the different types of geohazards (geological hazards) that will be incident on the SCP during construction and operation. Geohazards are defined as geological phenomena or conditions, either natural or man-made that are dangerous (or potentially dangerous) to the environment and its inhabitants. Natural hazards include earthquakes and volcanic eruptions, and, in this instance, fluvial erosion at watercourse crossings, particularly those associated with larger, or ephemeral rivers. Ground subsidence due to mining would be an example of a man-made geohazard.

1.2 DATA SOURCES

Reference has been made to the following reports and documents during the preparation of this section on geohazards affecting the SCP. As in other sections, reference materials relating to the WREP have also been consulted:

- January-February 2001 - baseline survey of those areas where the proposed SCP route deviates significantly from the WREP undertaken by Azerbaijan Environment and Technology Centre (AETC) on behalf of BP
- August/September 2000 - rapid reconnaissance survey of the WREP undertaken by Environmental Resources Management (ERM) on behalf of BP
- Baseline survey of WREP undertaken by AETC on behalf of Azerbaijan International Operating Company (AIOC) as part of the Environmental Impact Assessment of the WREP. (1997)
- Review of Publications on Geology along the Western Pipeline Route. (1996)
- Report on Anthropogenic Impacts on the Seismic Regime (1995)
- Atlas of Mud Volcanoes of the Azerbaijan Republic (1971)
- USA Uniform Building Code, Volume 2. Structural Engineering Design (1997)
- Seismic Review Report (2000)
- Preliminary Assessment of Mud Volcano Risk to Pipelines and Proposed Facilities Sites (August 2000)
- USGS National Earthquake Information Centre
- ESO Earthquake Database,
- Series of reports relevant to river crossings and hydrology (see section 1.6.2)

1.3 SEISMICITY

Much of the seismic information included in this appendix report was gathered during the production of the Seismic Review Report (August, 2000) carried out for the SCP. The main objectives of the document were to summarise the seismic activity in the area through which the SCP is routed, to identify SCP, facilities and AGI specific risks, and to identify and describe possible mitigation measures for the design and construction of the SCP.

The region through which the SCP is routed in Azerbaijan is subject to earthquakes, which have the potential to disrupt the SCP by deforming or shearing the pipe due to ground faulting or flexing.

The region between the Black Sea and the Caspian Sea is part of the central Asian segment of the Alpine-Himalayan foldbelt and comprises the Great Caucasus fold and thrust belt in the

north, and the Lesser Caucasus-Pontides fold and thrust belt in the south. The mountain ranges of the Caucasus were formed by the collision of the African, Arabian and Indian tectonic plates with the Eurasian plate.

The Great Caucasus Mountains are geologically very young, having formed during the Middle Pliocene. The Lesser Caucasus, found to the south, have been folded and thrust towards the north just east of the Black Sea. Compressional uplift and thrusting separated a once continuous basin into western and eastern parts, the eastern part of which was to become the Kura basin.

The eastern and western parts of the Great Caucasus Mountains are found to differ in structure with respect to trends and seismicity. One of the main distinctions is the presence of deep earthquakes in the eastern Caucasus at depths of up to 100 km. Earthquakes in the western region occur at much shallower depths, typically 30 km.

Continuing plate convergence means that Azerbaijan experiences high seismic activity. Over 500 seismic events of varying intensity have been recorded since 1600 (Aganirzoyev, 1987). Recent research and monitoring has been carried out in order to identify general background seismic characteristics, define possible factors which lead to destabilization of the seismic regime and to determine the degree of seismic danger. Some theories postulate that the high tension stress regime under the Caspian has increased by 1.5 degrees due to anthropogenic effects (eg, oil extraction) and resulted in an increase of background seismic levels from 7.5 degrees to 9 degrees (Kerimov, 1995).

1.3.1 Earthquake severity

Three classes of seismic activity are generally recognized, namely tectonic, volcanic and artificially induced. The tectonic variety is by far the most devastating and is caused by stress build up due to movements of the plates that make up the earth's crust. The Caspian is located in a zone stretching from the Mediterranean to the Himalayas that is characterised by tectonic earthquakes.

Data about the severity of earthquakes in Azerbaijan are usually given in Energy Classes (K), whereas Europeans are used to Magnitude (M). Both these systems are comparable and describe the energy at the source of an earthquake. Intensity figures based on the Richter Scale cannot be directly compared as they relate to surface effects of an earthquake. Many local earthquake reports use units of intensity measured on a scale of 1-12. Intensity is a relative measure of earthquake effect at any given location dependent on the size of the earthquake and the distance from the epicentre. Table 1 compares these three units, which describe the energy released at the epicentre, the so-called focus of the earthquake.

Table 1 Comparison of energy classes and magnitudes of earthquakes

ENERGY CLASS (K)	MAGNITUDE (M)	INTENSITY (EPICENTRE)	DESCRIPTION (INTENSITY)
9	3	I	Felt by few under especially favourable conditions
10	3.5	II	Felt by few at rest, especially on upper floors of buildings
11	4	III	Felt noticeably: houses and cars shake, exaggerated effect indoors compared with outdoors
12	5	V	Felt by all: windows broken, unstable objects overturned.
13	5.5	VI	Felt by all: heavy furniture moved, instances of fallen plaster. Damage is slight
14	6.1	VII	Tangible damage to poorly constructed buildings, damage to buildings of good design and construction is negligible.

The SCP route crosses a seismic area where earthquakes occur that are up to magnitude 8 on the Richter scale. Highest densities of earthquake epicentres with energy classes (K) greater than 9 occur north of the SCP route in the foothills of the Great Caucasus, near Shemaka and Ivanovka, where strong earthquakes have led to the complete destruction of cities in the past.

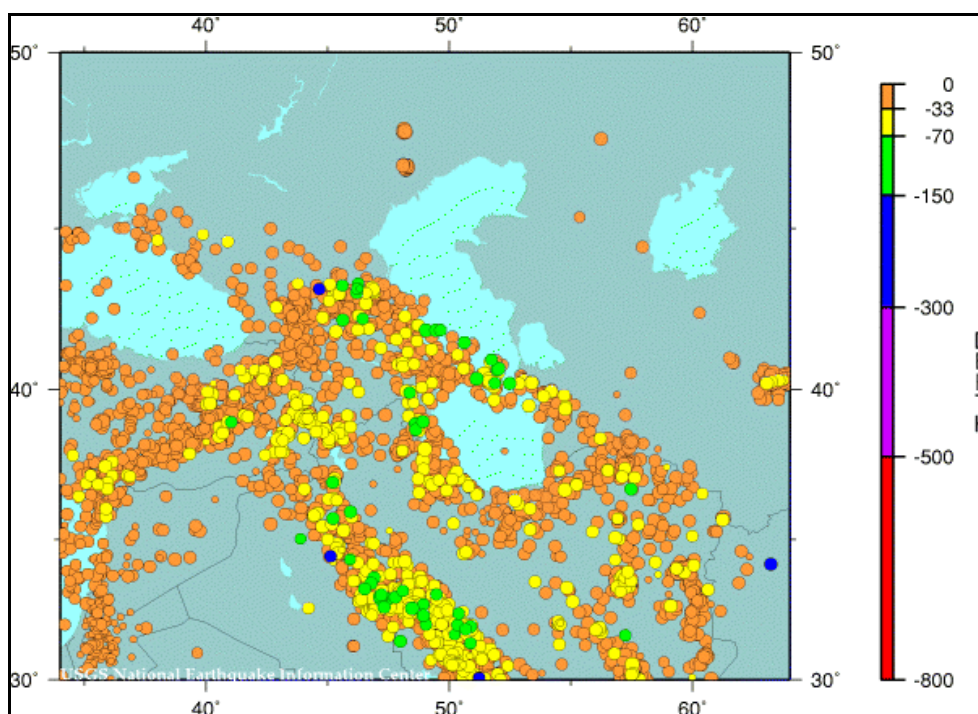
Earthquake data from 1960-1990 were recorded from the Baku archipelago, near Apsheron, indicating numerous earthquakes with energy class (K) up to 11 (up to 4 magnitude). Seismic events of energy class 12 (K) (magnitude 5) were recorded in the Lower Kura lowland. Statistical data from 1990 - 1997 indicate the occurrence of events with energy classes (K) of 13 (magnitude 5.5) in the coastal part of East Azerbaijan including the Baku archipelago, and also strong earthquakes in north-eastern Iran. Generally, a zone of earthquakes surrounds a large part of the Southern Caspian (as shown in Figure 1), however, most of the strongest earthquakes occur onshore, associated with tectonic movement in the Caucasus mountain regions.

However, strong earthquakes with an epicentre further away from the SCP route can still have strong intensities along the SCP route, as shown in Table 2.

Table 2 Intensity of earthquakes occurring in other areas within the SCP corridor

LOCATION	YEAR	INTENSITY ON SURFACE ABOVE EPICENTRE (I)	INTENSITY ALONG PIPELINE (I)	DISTANCE OF EPICENTRE FROM PIPELINE
Shemaka	18591 87219 02 ?????	8 — 9	5 - 6	ca. 35km
Dagestan	1948	7 — 8	6	ca. 250km
Saatli — Sabirabad	1959	8	8	ca. 25km
Tovuz Region	1962	7 — 8	7 - 8	0km
Caspian	1961	8	7	ca. 100km

Figure 1 Measured earthquake event distribution and depth (in metres), 1973-2000



The probability of the occurrence of earthquakes along the Kura trough has been calculated by the Azerbaijan Institute of Geology (see Table 3). They also recorded intensities of earthquakes in periods of 3 and 4 years as shown in Table 4.

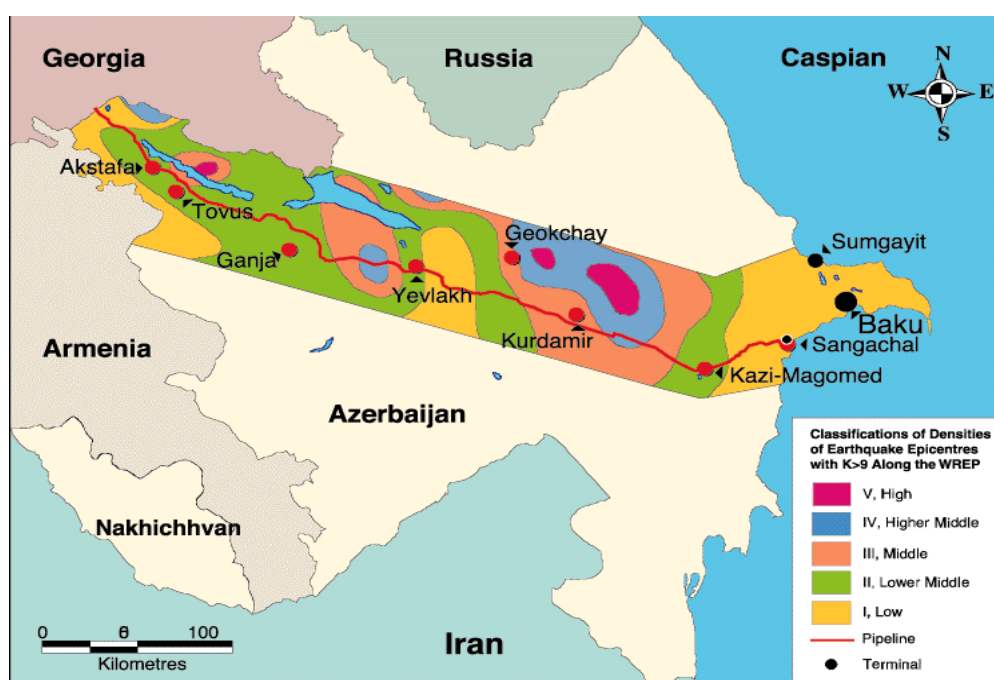
Table 3 Probability of strong earthquakes in the Kura Trough and the Shemaka - Ismaili area (calculated per 1000 km²)

MAGNITUDE (M)	YEARS TO OCCUR
6.7 - 7.2 (Kura Trough)	10,000
6.7 (Kura Trough)	2,000 - 3,000
6.1 (Kura Trough)	800-1,000
6.1 - 7 (Shemaka Area)	15 - 35

Table 4 Severity of earthquakes along the pipeline route for different periods between 1965 and 1994

ENERGY CLASS (K)	1965 - 1967	1970 - 1972	1973 - 1975	1976 - 1978	1979 - 1981	1982 - 1985	1986 - 1989	1990 - 1994	TOTAL
K = 9	18	22	23	35	48	20	25	23	214
K = 10	13	4	8	10	12	10	24	10	91
K = 11	3	1	3	4	2	3	3	1	20
K = 12	1	--	--	1	4	--	--	3	9
K = 13	--	--	--	--	2	--	--	--	2
Total	35	27	34	50	68	33	52	37	

Figure 2 Classification of densities of earthquake epicentres of K > 9 along the SCP, based on the WREP



1.3.2 Seismicity along the SCP route

Medium density earthquake zones cover about one third of the length of the SCP route, with more than 200 epicentres identified within 30km of the route since 1962. Larger earthquakes further removed from the route may still be significant.

The highest densities of earthquake epicentres occur along the SCP route in a zone from Kazi-Magomed to 25km east of Kurdamir (KP52 to KP107) and for another 15km from Mingechaur (KP243) to Goranboy (KP258), as indicated in Figure 2 based on the WREP pipeline route.

Due to the disproportionate density distribution of the epicentres, four seismic zones can be classified along the SCP route. These are described from east to west below.

1.3.2.1 Sangachal to Kazi-Magomed (KP0-52)

Only a few epicentres are located within the zone around Gobustan and the severity of earthquakes here are mainly of energy class (K) 9. However, the Apsheron Basin in which this area is located is generally a zone of high tectonic and seismic activity, and the risk of an earthquake affecting the SCP either by displacement or landslide should not be discounted.

The most recent severe earthquake with an epicentre affecting this region occurred in November 2000.

The frequency of earthquakes for the areas of Shemaka and Apsheron is given in Table 5.

Table 5 Frequency of earthquakes for the Shemaka and Apsheron regions

AREA	PERIOD OF YEARS	INTENSITY (I)	NUMBER OF OCCURRENCES	AVERAGE PERIODICITY IN YEARS
Shemaka	1872 - 1963	7 - 8	7	12 - 13
	1902 - 1954	6 - 8	136	2 - 3
	N/A	7	N/A	17 - 20

1.3.2.2 Kazi-Magomed to Ucar (KP52-178)

Earthquakes of energy class (K) 9 - 11 are registered in this highly active seismic zone, the boundaries of which are delineated by the fault at Kazi-Magomed and a major fault running parallel to the Kura River from approximately the Karasu river crossing as far as the Georgian border.

1.3.2.3 Ucar to Yevlakh (KP178-223)

The density of epicentres present in this zone corresponds to a lower to middle density and the earthquakes mainly have energy class (K) values of 9 and 10.

1.3.2.4 Yevlakh to the Georgian border (KP240-442)

This zone is characterised by a more even distribution of epicentres, mainly with energy class values (K) of 9 and 10. However, this section is a zone of high tectonic and seismic activity and the risk of an earthquake impacting the SCP, either by displacement or landslide, has been investigated during detailed surveys being undertaken by seismic specialists.

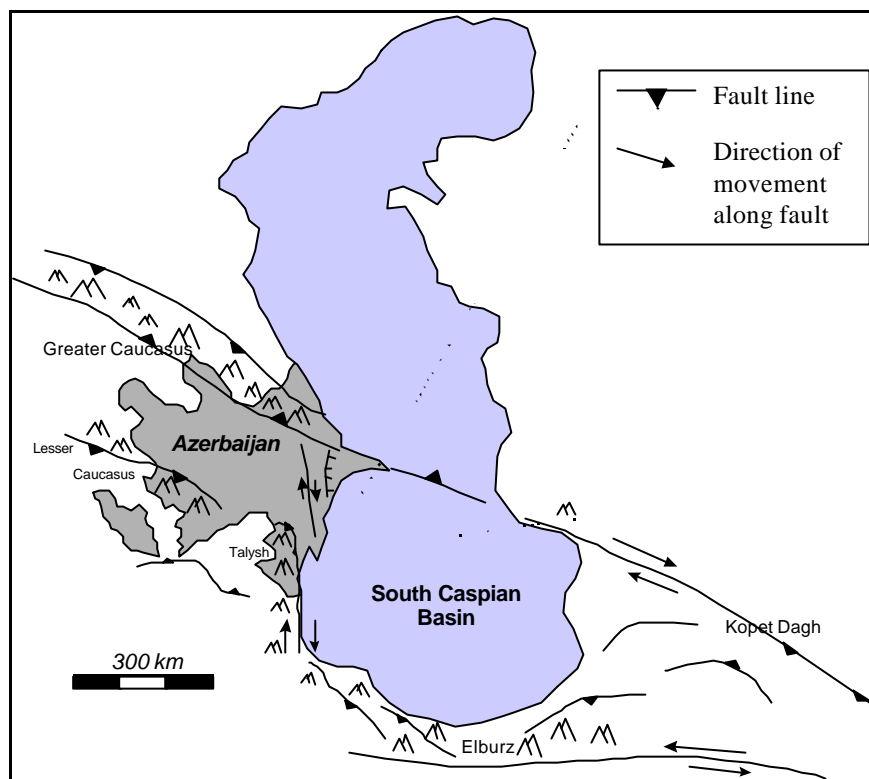
1.3.3 Active fault zones

The SCP route crosses several fault zones and tectonic units. A seismic survey commissioned by BP has identified several major faults traversed by the SCP route. The sources of earthquakes can quite often be traced to these major faults. The general orientation of active faults is from the north-west to the south-east.

Earthquake intensities (K) in active fault zones are generally considered to be in the range of 8. The highest earthquake intensities are found in areas where known active faults are present. Pipeline failure due to displacement along active fault zones during seismic events cannot be excluded, and the areas of highest activity are located at the eastern and western ends of the SCP in Azerbaijan. Landslides caused by events of high intensity are possible in the steep, unconsolidated areas of Gobustan and the Lesser Caucasus bwlands. In addition, damage

caused by strong events further away from the SCP (eg breaching of the Mingechaur water reservoir) will also be considered. Figure 3 shows the tectonic regime along the SCP route.

Figure 3 Tectonics of the Caspian region (modified after Allen and Tull, 1997)



1.3.4 Fault identification

A thorough investigation into seismic hazards presented by faults was carried out by EQE International, on behalf of BP Exploration (Shah Deniz) Ltd. The main scope of works was to identify active faults, characterise them for engineering design purposes and carry out ground motion hazard assessments.

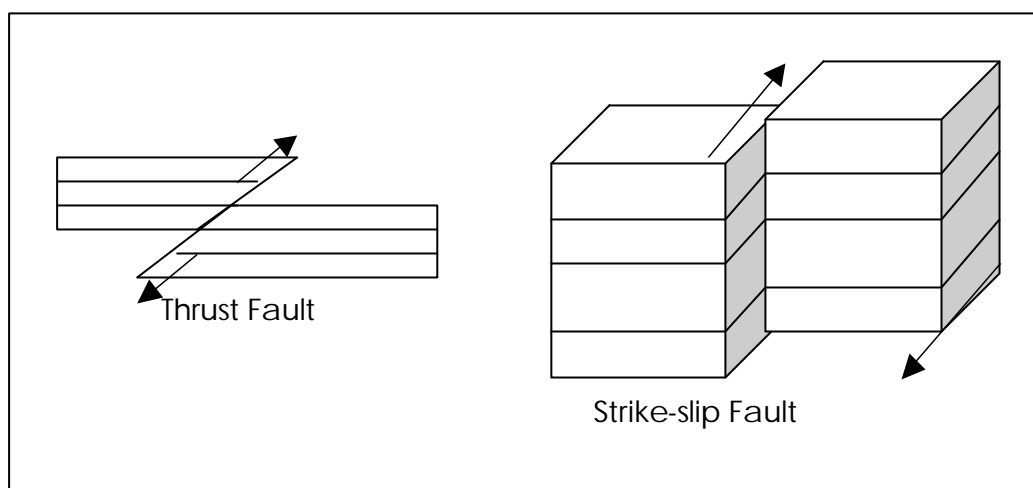
The Kura Valley, through which the SCP passes for much of its route, is not prone to active tectonic faulting. At both the western and eastern ends of the route, the active geological structures of the Great and Lesser Caucasus Mountains are encountered.

Where east-west faults are present, the fault type is generally of a compressive thrust nature, whilst northeast or northwest trending faults exhibit generally lateral strike-slip movements. Thrust faults are typified by one block being forced over the other, with the angle of dip of the fault plane being less than 45°. In strike-slip faulting, the two blocks move laterally past each other. A combination of these two fault types can occur, where blocks involved in thrust faults also move laterally. Thrust faulting and strike-slip faulting are both shown in Figure 4.

In many areas, slope instability hazards coincide with active faulting, which suggests that the faulting is at least in part responsible for the presence of slope instabilities.

Study of aerial photographs of the SCP route revealed that the SCP route crosses five active faults. Details of these are provided below.

Figure 4 Thrust and strike-slip faulting



1.3.4.1 Fault crossing number 1 (KP24)

This fault has strike-slip displacement, and is found in association with two active mud volcanoes. This fault can be seen to be a secondary feature associated with the primary displacement noted on the main fault located at KP29. The surface rupture can be seen to be approximately 7km in length. This fault is thought to be of secondary risk, as it is expected only to rupture in association with the main fault at KP29.

1.3.4.2 Fault crossing number 2 (KP 29)

This fault has been classified as a thrust fault, although there is no noticeable offset of the younger alluvial sediments. Fault location at the crossing point with the SCP has been extrapolated from obvious surface faulting to the south of the pipeline/fault intersection. The fault has a length of at least 22km. Movement of this fault can be predicted from data collected from the surface offset south of the SCP route.

1.3.4.3 Fault crossings number 3 and 4 (KP50-51)

Two fault scarps are found near KP50-51. The eastern scarp is an older fault with multiple surface faulting offsets. The western scarp is a young surface fault that has deviated from the older eastern fault. At the SCP crossing locations, the two fault scarps are approximately 0.5km apart. The fault scarps then join approximately 1.5km north of the SCP crossing.

The overall sense of movement of this fault system is thrust. Where the SCP crosses the scarps, right-lateral strike-slip movement is anticipated, with a small vertical offset. This change in sense of movement on the fault is due to a change in fault strike close to the SCP crossing. The overall fault trend is northwest to southeast. This alters to a north-south orientation at the SCP crossing, forming an S shape.

The mapped length of this fault is over 100km, and marks the boundary of the Great Caucasus thrust terrain and the alluvial Kura Valley.

1.3.4.4 Fault crossing number 5 (KP412-420)

The SCP route in this area abuts the northwest trending fault scarp at KP412-413 and again at KP420 (as observed on aerial photographs). The scarp is a northwest-southeast trending, southwest directed thrust scarp. Small drainage channels have formed deep trenches in the

scarp slope, and no offset of the young sediments is noted. This indicates that the fault has not moved in the time required for small drainages to dissect the fault scarp. This fault extends for approximately 100km. The fact that the scarp face is very old suggests that recurrence of significant ruptures is very infrequent, and this fault therefore provides a lower risk than faults exhibiting younger scarps or compound scarps. (Compound scarps indicate repeated movement along the same fault trace in the recent geological past).

The fault offsets sediments of the Kura River Valley. In this area, the compressive structures of the Lesser and Great Caucasus begin to merge, resulting in active deformation of the sediments in the relatively narrow valley.

1.3.5 Soil Liquefaction

Tremors during an earthquake can cause the water pressure within sediments to increase to the point at which the soil particles can readily move with respect to each other. This phenomenon is known as liquefaction and may be triggered as a result of seismic activity. Preferential conditions for liquefaction occur in saturated soils when the strength or stiffness of a soil is reduced by earthquake shaking or other rapid loading. Earthquake shaking can often trigger this increase in water pressure, but this can also be caused in connection with construction related activities such as blasting.

In relation to the SCP route, this hazard is minimal, as most of the sediments are rich in clay, which is far less prone to liquefaction than well-sorted sands. The area where this is most likely to occur is between the West Kura crossing (KP409) and the Georgian Border.

During the course of the review of aerial photographs, an effort was made to identify geomorphic evidence of liquefaction. Soil liquefaction is a concern along the Kura Valley, as overbank sediments are prone to liquefaction and lateral spread during ground shaking. The aerial photographs did not show any evidence of liquefaction in Azerbaijan. The most logical explanation for this is that the poorly sorted deposits of gravel, sand and silt, with a high clay content, are not highly prone to liquefaction. However, analysis based on aerial photographs cannot be considered definitive, and geotechnical sampling and testing has been undertaken, which will quantify liquefaction potential and soil susceptibility along the proposed route.

1.3.6 Significant historical earthquakes

The most significant historical earthquake to occur in the Eastern Caucasus region was recorded on January 1st 1668. The magnitude of the earthquake was measured on the uniform Moment Magnitude (Mw) scale to have a magnitude of 7.5 Mw. This scheme allows for the physical properties of the earthquake and is therefore seen to be the most appropriate measure for representing the true force of the earthquake. The area of strongest seismic activity was located 300 km west of Baku in a relatively small area of the eastern Caucasus that has a history of relatively frequent earthquakes. Other major historical earthquakes were registered in both Georgia and Armenia.

The largest earthquake to occur within the SCP region in recent years took place on November 25th 2000, close to the Caspian Sea (USGS, 2000). At least 27 people were killed (three from the earthquake, 21 from heart attacks and three on November 26th from a natural gas explosion associated with a Soviet era pipeline which resulted from the failure of a valve damaged by the main shock) and more than 400 were injured in the Baku area. Some structural damage occurred and utilities were disrupted in the Baku area. The magnitude of the earthquake was recorded as 6.3 Mw, with the epicentre located very close to Baku. The effects were felt across Azerbaijan and in Turkmenistan, Russia, Georgia and in northern Iran.

An earthquake was recorded on June 4th 1999 in the Eastern Caucasus region. The approximate location of the epicentre was greater than 50 km to the north of the SCP route. With a magnitude of 5.5 Mw, the earthquake caused up to US\$2.5 million damage in the Agdas area, Azerbaijan. The epicentre was registered at a depth of 33 km. 15 people were injured and approximately 50 houses damaged in the immediate area. Three people were injured at Ucar (a town close to the proposed SCP route, near KP79) and several houses damaged at Agali, with the total damage for central Azerbaijan estimated at US\$5 million. The effects of the earthquake were felt in parts of Armenia and Georgia and in the Ardabil region of Iran.

A search centred on the mid-point of the SCP route, with a search radius of 250 km was carried out using the database present on the ESO web page. The search period selected was from 1994 to the present day, to augment previously carried out earthquake searches. The results of this search indicated that two earthquakes of magnitudes 3.8 and 4.1 Mw were recorded in February of 1998 and 1994 respectively. Both of these earthquakes had epicentres located in Russia, and as such only minor effects would have been evident in the SCP locality.

1.4 MUD VOLCANOES

Mud volcanoes, which form both onshore and offshore, are a feature of the geology of eastern Azerbaijan, producing a potential geohazard to pipeline construction and operation. Mud volcanoes are the points at which pressure within the earth's crust (up to 6km deep) is released. Mud and larger clasts of rocks, liquids and gases erupt from the ground surface. Mudflows form as the mud travels downslope. With time the material erupted creates a conical or plateau-like structure. Mud volcanoes are associated with a neotectonic setting, and weak undercompacted gas and clay-rich sequences.

Mud volcanoes form in only a few areas worldwide, with almost half of all known mud volcanoes globally being situated in Azerbaijan. More than 300 have been discovered in the marine or terrestrial environment of the country (Guliyev & Feizullayev, 1997). These surface features are generally relatively short-lived (in geological terms), and they tend to migrate along fault lines or planes of weakness.

Eruptions can be violent and unexpected, ejecting debris many hundreds of metres into the air, and some are associated with pyroclastic flows. A further potential issue is that gases discharged by mud volcanoes may be flammable.

Over 300 mud volcanoes are present in Azerbaijan, the majority of which are associated with anticlinal fold structures. Mudflows 10m thick, several hundred metres wide and 5-10 km in length have been recorded in Azerbaijan (Jagubov *et al.*, 1972). Mud volcanoes found along the SCP route are concentrated in the Gobustan region (KP0-29).

1.4.1 Morphology of mud volcanoes

Mud volcanoes have source areas in the form of a caldera (basin-like rimmed structure) at their summits. The summits are often marked by small conelets or liquid filled hollows. From this summit area mud tracks are seen, along which the mud will preferentially flow. In certain conditions mudflows may radiate from the source, mantling the entire hillside. The mud is collected in an accumulation zone of low-angled, overlapping mudflow lobes, with characteristic compressional and tensional structures. Recent lobes are dark blue/grey/green and unvegetated. Weathering lightens the colours of the lobes to brown/yellow/grey. The

maximum recorded flow run-out from the source is 2.9 km (Otman-Bozdag volcano), with the average distance for accumulation zones being 0.8-2.3 km from the source.

Ground rupturing may occur in association with mud volcano activity, and further associated hazards include loading by mudflows, subsidence and ground displacement. Mudflows under certain conditions can be quite fast moving, which could put stress on pipelines due to unexpected loading. Erosion of mudflow lobes results in the formation of gullies, with eroded material being formed into piedmont plains.

Eruptions of varying magnitudes have been recorded, and are classified into four categories:

- **Type I** - Eruption of a large volume of mud volcano breccia with numerous rock fragments, accompanied by explosions of varying strength, the emission of powerful gas jets (with or without combustion) and the formation of fissures
- **Type II** - Explosion of gas and formation of large fissures, without emission of flowing mud
- **Type III** - Relatively small outflow of mud volcano breccia without intense gas emission
- **Type IV** - Extrusion of breccia, with negligible gas emission

The likelihood of a new mud volcano developing at a previously unaffected site is considered to be very low. Only four new mud volcanoes have been recorded within a 17,600km² area in Azerbaijan over the last 100 years. Newly formed mud volcanoes tend to be very small features, with many phases of eruption being required to develop the pronounced cone or plateau-like form.

Figure 5 Mud Volcano Vent



1.4.2 Risks to pipeline and facilities

The nature of the hazard posed to the SCP varies in relation to the type of mud volcano encountered. Hazards within the source area of the volcano are associated with the release of combustible gases. These can be expelled at rates up to 16m³ per minute. Approximately 40% of eruptions are believed to include associated gases that spontaneously ignite, with flame heights exceeding 100m. Extremes of temperature are felt up to 2km away (core temperatures reach 1,200°C).

Mud volcanoes can be extremely hazardous, for example the eruption of the Bozdag- Gezdeg volcano in 1902 resulted in the deaths of 6 men and 2,000 sheep. A further incident in 1961 resulted in the hospitalization of eight casualties, several of whom died.

Ground rupturing is also associated with the mud volcano source area. Consequences of this include extrusion, subsidence or displacement along fissures and faults around the vent area.

Mudflow tracks, which may be up to 100m wide, can be 1m thick (although less than 5m is more usual). In addition to this, areas of subsidence or ground displacement along fissures and faults may extend from the vent to these regions.

1.4.3 Mud volcanoes along the SCP

Mud volcanoes with a potential impact on the SCP route are displayed in Figure 6 and on the Environmental Route Maps, Volume 2. They are concentrated at the eastern end of the SCP route, in the Gobustan area (KP0-52).

Otman-Bozdag volcano, one of the largest in Azerbaijan, lies a few kilometres to the north-west of the Sangachal Terminal (KP0). The 300m diameter crater peaks at over 400m above the surrounding plain. Mud breccias flow from the volcano onto the existing plain, producing a complex fan of overlapping mud flows and reworked sediment.

Figure 6 Locations of mud volcanoes along the SCP route



The Otman-Bozdag volcano is active, with eruptions being registered in 1845, 1904, 1922, 1951, 1965 and 1994. Three major fissures have been recorded on the volcano summit. Mudflows would be required to reach lengths of 4.9km in order to affect the SCP. This is considered to be unlikely, even if an event of the maximum predicted magnitude were to occur.

The Turagay Mud Volcano (approximately 2.5km to the south of the SCP route at KP17) last erupted in 1955 and although it is not currently active, further eruptions are considered likely.

In the region of the Structural-Front Mud Volcano Complex (Mud Volcano Ridge, shown in Photograph 1-1) there is an estimated moderate risk to the SCP structure. In this region, two parallel faults (crossed by the SCP route at approximately KP 24 and 30) running north-west to south-east define an area in which mud volcanoes form along the trend of the fault lines.

The main concern at this site is where the pipelines cross broad mud breccia fields where active mud volcanism is occurring. As mud volcanism is fracture-controlled in this region, there is a reasonable potential for the opening and/or shear of fresh fractures, which could damage buried pipelines. The possibility for gas emission and ignition occurs in this area, although there are considerable uncertainties over the lifetime of the SCP. Existing mud volcanoes in the Mud Volcano Ridge area have been avoided.

Table 6 Proximity of mud volcanoes to the SCP route

MUD VOLCANO	DISTANCE FROM PIPELINE ROUTE
Otman-Bozdag	4.9km
Turagay	2.5km
Mud Volcano Ridge	Crossed by route

1.5 GEOHAZARDS RELATING TO TERRAIN

1.5.1 Erosion and soil-related geohazards

Although the majority of the route passes through easily dug soils and rocks, it is possible that in certain areas there will be a requirement for ripping or hammer breaking prior to back hoe excavation. In addition to this, badlands (highly dissected terrain) are encountered for approximately 30km west of Ganja (KP352-382). Here, a combination of highly erodible, silty clay soils and steep slopes and narrow ridges may lead to severe erosion problems alongside or adjacent to the SCP corridor. Soil erosion control measures will be required to minimise both the environmental impact and the long-term risk of pipeline exposure. See section 1.6.4 for information on the low threshold velocities required to entrain erodible soils in the SE slopes of the Great Caucasus (Kuznetsov et al., 1998).

1.5.2 Terrain-related hydrological geohazards

Risks to the SCP caused by hydrological issues include the potential for sheet flooding across the Sangachal Coastal Plain.

The Mud Volcano Ridge region is home to many trench-like wadis. These channels have a tendency for rapid migration. There is a high potential for gully-head retreat with small soil pipe collapses occurring along the narrow ridgeline to the north of the mud volcanoes. On the plains to the west of Kurdamir lateral movement of straight artificial channels (canalised rivers and deep drainage canals) also occurs, as they are gradually transformed into meandering channels.

Other hydrological issues include the presence of small soil collapse features, known as sinkholes, which occur frequently along surface drainage lines. Possible impacts resulting from these features include differential settlement of foundations in the Sangachal Terminal area and collapse around the SCP.

1.5.3 Landslides

Landslides in the Azerbaijan region generally occur as a result of rainstorms, earthquakes, volcanic activity and various human activities. The greatest potential for landslides to occur would therefore be at the eastern end of the SCP route, where earthquakes are more prevalent.

1.5.4 Debris flows

Debris flows tend to be rivers of rock, earth and other surface fragments saturated with water. They are caused when water accumulates rapidly in the ground, for example during heavy rainfall or rapid snowmelt, when the earth is changed into a flowing river of mud. Debris flows move rapidly down slopes or through channels. Debris flows can reach several kilometres from their origins, carrying trees, cars and other materials.

Flows are generally thick, viscous mixtures of water and sediment, with flow velocity being highly dependent on water content. A higher water content will result in a faster flow. Typical speeds are approximately 15kmhr^{-1} although speeds up to 20kmhr^{-1} are not uncommon in Azerbaijan. Mudflows, a specific type of debris flow associated with mud volcanoes, are dealt with in Section 1.4. Other types of debris flow may be expected in regions of higher relief, where elevated levels of precipitation occur.

1.5.5 Other hazards

Saline soils and associated groundwater may cause pipeline corrosion. Soil erosion also occurs in certain areas (see Geology and Soils Report, Part 8, Baseline Reports Appendix).

The re-instatement of silt-rich soils that are highly erodible is anticipated to be difficult. The SCP corridor may be subject to severe erosion events. Sinkholes (soil collapse features) are also a frequent occurrence along surface drainage lines.

1.6 GEOHAZARDS AFFECTING PRINCIPAL PIPELINE RIVER CROSSINGS

1.6.1 Aims and scope of section

The purpose of this section is to describe and interpret available baseline information on the main river crossings for the SCP route; to make a preliminary assessment of the nature of river channel instability along the route corridor; and to identify the key crossings which could potentially impact detrimentally on the SCP and which require special attention in crossing design. Recommendations for subsequent mitigation and monitoring of the actively-eroding sections are made in Section 10 of the ESIA.

The level of appraisal is that of a desk study, supplemented by linewalk data and reconnaissance reports produced by other workers for the SCP and WREP pipelines. This section should be read in conjunction with the Hydrology and Water Quality (Part 10) and Hydrogeology (Part 3), Baseline Reports Appendix. This section, and the reports and sections cited, should provide a basis for appraisal of river crossing impacts, problems and mitigation measures recommended.

The specific objectives are to:

- Present and discuss information on and bank erosion, channel instability problems
- Identify the key crossings of the route, i.e. those potentially posing a hazard to the SCP

Data sources based on reconnaissance field data and linewalk approaches are listed in Section 1.6.2.

1.6.2 Information sources

This section is based on the following information sources, produced from 1996 to 2001:

- Fookes and Bettess 6/9/2000 report 'Field visit to Azerbaijan, August 2000, to assess geohazards to principal pipeline river crossings, of existing and future routes and ground truthing of the Azerbaijan desk studies' (Rev02, October 2000)

- Environmental Assessment of Alternative Export Options: Volume 5 - River Crossing Survey. Dames and Moore, July 2000
- Environmental constraints report; Kvaerner 2000
- Literature Reviews by Azerbaijan scientists, including those of Professors Kashkay of the Institute of Geography at the Academy of Sciences in Baku and Professor Firdowsi Aliyev of the State Committee of Geology and Mineral Resources for the Azerbaijan Republic, produced in 1996, 1998 and 2000, and the State Committee of Geology, 2001
- Prof. Rena Kashkay (2000) 'River hydrology along the AZERIGAZ pipeline route' report, written as a desk study for the Azeri Gas Line
- Linewalk re-route information generated by AETC and ERM staff in 2000-2001
- Reconnaissance field data collected by D.M. Lawler in November and December 1996
- The Hydrological sections written for the Western Route Export Pipeline in Azerbaijan (WREPA) EIA, produced by AETC in April 1997

Note that there is an absence of published scientific papers relevant to river crossing appraisal in Azerbaijan, such as river processes, fluvial geomorphology, river engineering or hydraulics.

1.6.3 River crossing datasets

A number of basic hydrological datasets exist in Azerbaijan (see Hydrology and Water Quality Baseline, Part 10, Baseline Reports Appendix). However, very limited hydraulic and fluvial geomorphological or sedimentological information exists in Azerbaijan, and the few flow data that are readily available have been produced for gauging stations often far removed from pipeline crossing sites. Mean discharge data are available, and these have been converted into gross stream power data for selected major rivers. Shear stress data and cross-section geometry information at river crossings are not yet available.

The following limitations of the datasets should be noted:

1. Technique uncertainty. Generally, little information is readily available on the hydrological monitoring techniques adopted, so it is difficult to place confidence limits on the published datasets.
2. Dated data. The hydrometric network in Azerbaijan was severely curtailed after 1991/92, so few datasets exist for the last ten years: this makes quantification of current conditions difficult. Early hydrological data will not reflect subsequent climatic variations, basin landuse changes, shifts in channel cross-sectional geometry shifts, channelization projects, gravel winning operations, new abstractions, water resource development schemes and, for coastal stations, fluctuations in the level of the Caspian Sea.
3. Remote data. Many flow measurement sites (river gauging stations) tend to be located in, or near the foot of, the Caucasus Mountains, mainly because this is considered to be the limit of significant runoff generation in these rivers. Therefore they are sometimes considerable distances upstream (or occasionally downstream) of the SCP route. Substantial caution is warranted, therefore, in extrapolating data from the point of flow measurement to the SCP crossing itself. Some rivers, as in many semi-arid environments, actually lose discharge in a downstream direction, because transmission, irrigation and abstraction losses outweigh runoff generation in the lower reaches.

4. Few data on extremes. The data provided tend to be means, and further information is needed on hydrological extremes, such as flood magnitude and frequency, especially bankfull conditions, in order to assess environmental risk to pipeline integrity.
5. Limited analytical publication. Very little hydrological or fluvial data or analyses (e.g. flow frequency/duration curves; recurrence interval statistics) have been published for Azerbaijan in the peer-reviewed international scientific literature.

1.6.4 Fluvial geomorphological setting

Erodible soils, steep mountain terrains, and highly seasonal snowmelt and semi-arid hydrological regimes drive active erosional processes throughout many of the drainage basins crossed by the route. High fluvial sediment transport rates relate to high soil erosion rates driven by steep slopes, intense rainstorms (despite low annual precipitation totals), highly seasonal snowmelt-driven flows, flash floods, freeze-thaw processes in the mountain zones, fine erodible soils and limited vegetation cover. In fact, the rivers of the Great Caucasus such as these carry more suspended sediment than almost any other region in the FSU (Bobrovitskaya, 1996). Erosion scars are visible in many places on the existing WREPA ROW (URS/Dames & Moore, 2000), e.g. Korchay and Shamkirchay. Severe erosion and sediment transport problems are key issues in pipeline engineering and integrity in Azerbaijan (URS/Dames & Moore, 2000). Soils are easily eroded once vegetation is removed and surface sediments disturbed (e.g. during pipeline construction). For example, Kuznetsov et al. (1998) found that for pre-mountain cinnamonic steppe-like soils, chestnut soils and light-chestnut soils on the surface of the south-eastern slope of the Great Caucasus, average scouring velocities required for a flow 2 cm deep varied from just 0.20 - 0.24 m s⁻¹.

1.6.5 Regional scale channel instability

Many of the fluvial systems examined near or on the SCP route are meandering or braided and appear to be active and dynamic, especially in the west, where the SCP approaches the foothills of the Lesser Caucasus. Many of the Kura tributaries are high-energy, mountain rivers many occupying laterally mobile floodplain zones or incised into narrow gorges. These will require careful crossing.

Braided systems are normally characterised by large channel width-depth ratios, high energy conditions, high bedload transport rates, a flashy (quickly-responding) discharge regime and active lateral instability. Braided systems tend to occur on steeply-sloping valley floors where large quantities of coarse sediment are frequently mobilised to build the braid bars, and copious but variable flows are available to reorganise the bed materials frequently and erode the banks relatively easily. The steep channel slopes of the Caucasus rivers and their seasonally concentrated meltwater regimes generate high-energy conditions ideal for channel degradation, bank erosion and channel course switching. Necessary sediment supplies are probably generated by mountain landslides, gully washouts, channel bank, erosion, and occasional mud flows and sheetwash events. This snowmelt domination of the regime for most of the rivers in Azerbaijan is a key control (Lawler, 1997), which explains the high river flow seasonality (see Hydrology and Water Quality Report, Part 10, Baseline Reports Appendix).

The strongly seasonal and snowmelt-dominated flow regimes of almost all Azerbaijan rivers also encourage braiding activity. Strong seasonality also means that the timing at which river systems are inspected or surveyed in the field is vital. It is easy to form the impression of Azerbaijan rivers being tame, quiescent rivers, if they are visited in the late summer to late winter low-flow period (July to February), when despite a large cross-section, commonly only one or two small divided channels, if any, are occupied by water. To appreciate fully the

power of the rivers crossed by the SCP, it is necessary to visit during the March – June snowmelt period when flows, erosion rates and sediment fluxes are rising or peaking.

1.6.6 Indicators of channel dynamism

Dynamic channels result from the interaction of high river energy levels with erodible boundary materials. Strong indicators of channel dynamism in the major Kura tributaries crossed by the SCP, especially in the west, include:

- Extensive and severe bank erosion at many of the sites visited, including around existing pipelines and structures (eg Figures 7 to 9) evidenced by:
 - Undercut bank profiles creating overhangs
 - 'Fresh', steep, bare, bank faces supporting limited short-root vegetation, with concave-upward bank profiles
 - Erosion cliffs running for many metres upstream and downstream of the crossing locations
 - Tension cracks behind certain bank faces (often the precursor to mass failure)
 - Loose, easily-erodible sand and gravel bank materials, readily disturbed by touch or walk-over
 - Some damage to existing revetments and other bank protection works
 - Damage to bridge supports and old pipelines in places
- Sparse vegetation on the braid bars, and an absence of algae on the gravel bed material: this normally indicates recent particle transport. Imbrication and particle size distribution information (Dames & Moore, 2000).
- Velocities and stream power levels high enough to set typical bed materials in motion and to deform the channel boundary (see Table 2, Hydrology and Water Quality Report, Part 10, Baseline Reports Appendix)
- High suspended sediment concentrations and loads (see Hydrology and Water Quality Report, Part 10, Baseline Reports Appendix)

1.6.7 Assessment of channel instability at pipeline crossings

Bank erosion and channel-change problems should always be viewed in a drainage basin context, because:

- Instability zones can themselves migrate downstream over timescales similar to the design life of a pipeline
- Coarse sediments from upstream activities can change local cross-section shapes and sizes and influence velocity structures and bed scour and bank erosion rates in the vicinity of pipelines
- The river flows responsible for on-site erosion are generated by snowmelt and/or rainstorms in headwater zones

A full contemporary channel erosion survey was outside the scope of this ESIA. AETC and ERM personnel carried out walkover surveys during summer 2000 and winter 2001. Channel reconnaissance survey sheets (partly based on Thorne (1998) proforma) were completed for each watercourse crossing, upon which were recorded information on: channel width and depth (low flow and bankfull estimates); identification of channel pattern (planimetric form); water presence/absence at time of survey; mean flow velocity estimates; bank erosion inventory, including spatial extent and dominant failure mode; bed/bar material grain size and qualitative information. A river corridor survey (following UK EA guidelines) was also undertaken for all main rivers crossed by the route during November 2001 (see River Corridor

Survey Report, Part 5, Baseline Reports Appendix). An extensive library of indexed colour print and digital photographs of river reaches (upstream and downstream views) has been assembled by AETC and Kvaerner along with particular features such as collapsing banks, vulnerable braid bars, exposed pipeline sections etc. Simple river water quality measurements were also made in December 1996 by D.M. Lawler (1997) and by Environmental Resources Management (2000).

Linewalk data have revealed fairly widespread lateral channel activity along the SCP route, indicating regional-scale instability. Bank materials are relatively fine-grained in the lowland river reaches, but are coarse in the mountain rivers, especially in the west. Bank erosion scars are numerous, and affect a number of crossings (see below for specific rivers). The main retreat mechanism appeared to the surveyors to be mass failure, with some tension cracking in the riparian zone evident. In some of the meander bends, undercutting of the outer banks has been reported, with associated cantilever collapse of the overlying sediments. Bank protection schemes have already been implemented, indicating an awareness of previous problems by the authorities. Some rivers (e.g. Aksu and Girdemanchay in the east) have been channelised for long stretches to stabilise flows and reduce erosion problems.

Selected actively-eroding reaches are shown in Figures 7 to 9.

Figure 7 Extensive bank erosion at a branch of the Ganjachay River (KP 295)



Figure 8 Close-up of erosion processes at the Geokchay River (KP 175)

Note: Erosional notches cut into soft, unconsolidated silts and clays. Evidence of instability.



Figure 9 Pipe exposed by erosion in wadi



1.6.8 Bed scour / degradation

River bed gravels appear fresh, without significant algal growths, and are likely to be mobile during parts of the high-flow season, in March - June). Some evidence of severe bed scour and channel degradation was found by some reconnaissance surveyors, including in Fookes and Bettess (2000). A good example of severe bed degradation was revealed by the presence of the old AGP pipeline suspended several metres above the channel bed where it was originally positioned some 20 years earlier (See Fookes and Bettess (2000) & AEO 2000). Anthropogenic disturbance of bed fabrics through gravel winning is important in some rivers (e.g. Shamkirchay River).

1.6.9 Hydraulic data

Information on river hydraulic conditions is lacking in many developing countries, including Azerbaijan. Data on velocity, stream power, boundary shear stress and energy slope is important in pipeline construction, hydrotesting and operation, especially in the following impact areas:

- River channel instability at river crossings especially bed scour
- Sediment transport rates, which are correlated with specific stream power to a power of 1.5 (Thorne et al. 1996)
- Direct fluid abrasion effects on exposed pipelines or supporting structures
- Estimates of time-of-travel and dispersal patterns for introduced contaminants to migrate to receptors (e.g. fuel and lubrication oil leakages from pipeline construction plant)

Average stream powers in Azerbaijan are high by global standards, reflecting the high discharges and slopes of their montane character. Channel stability analysis for the purposes of estimating setback distances or burial depths at pipeline crossings will be undertaken during detailed design.

1.6.10 Sensitive river crossings

Different reports consider a differing range of watercourse crossings, and identify a varying subset of sensitive, actively-eroding or unstable crossings. This probably reflects the paucity of the data and the few analyses undertaken, as well as the different project briefs, the nature of sensitivity being appraised and the different pipelines examined. It may also relate to the timing of any associated field visits with respect to the critical seasonal flow period between March and June. Examples include the following: the WREPA Environmental Monitoring Plan (1997, p.17) identifies 13 key crossings from 35 considered; Fookes and Bettess (2000) following a desk study of numerous crossings, examined 13 crossing locations on 7 principal rivers, identifying 4 as sensitive (class C or above); while the Dames & Moore (2000) AEO report consider 10 river crossings on the WREPA in Azerbaijan, 7 of which are assessed as highly sensitive, with 4 of these discussed in detail.

The following discussion is based on the reasonably detailed AEO Report by Dames & Moore (2000), which aims to identify those crossings which deserve special attention at the design stage either because bank erosion/bed scour problems could threaten pipeline integrity and/or of elevated risk of watercourse pollution. There are many gaps in the dataset, as Dames & Moore (2000) acknowledge, and no details are given of how the variables have been derived (e.g. bed material sampling: has this been achieved through a Wolman count to give frequency-by-number particle size distribution data or bulk-sieving or image analysis?). Nor

is information presented on particle size distribution measures, average river discharges or scour depth calculations.

The four key rivers identified in the Dames & Moore (2000) report are as follows:

- Shamkirchay River
- Karabakh Canal
- Kura River East (downstream of Mingechaur reservoir)
- Kura River West (upstream of Mingechaur reservoir)

Further discussion of these four key crossings follows, largely reproduced from Dames & Moore (2000).

1.6.10.1 Shamkirchay River (KP332)

The Shamkirchay River in the west (KP332) experiences high levels of scour and erosion. Therefore, detailed engineering design was undertaken for this crossing during rehabilitation work in early 1999. This design is based on a 1 in 100-year flood event, which is relatively typical for design in this area (though the 1 in 500-year flood event may be a stronger planning basis). Data availability here is reasonably good, and flood frequency estimates, scour depth calculations and grain size analyses have been completed at this crossing. The existing crossing location will be affected by the continuing gravel mining upstream and downstream of the site, and Dames & Moore (2000) argue that the crossing location and type requires significant evaluation in the future.

Figure 10 Shamkirchay River (Dames & Moore, 2000)



Figure 11 Shamkirchay River (Dames & Moore, 2000)



1.6.10.2 Karabak Canal

The main canal crossed by the pipeline is the Karabakh Canal (KP245). The Karabakh Canal, which is concrete lined and recharges from the Kura River at the Mingchevir Reservoir carries significant amounts of water for many important uses including irrigation and industrial supply.

Figure 12 Karabakh Canal



1.6.10.3 Kura River East (KP223.5)

The Kura River is arguably the most important water resource for Azerbaijan. It provides an essential source of water for human use and is a key habitat for many important fauna and flora.

The river at the current Kura River East crossing has traditionally experienced bank erosion problems, with remedial works to stabilise banks evident. Despite being primarily controlled by the Mingechaur reservoir, the river has a very large drainage basin area here (some 66800 km²) and still has considerable potential for flow fluctuations. The site is subject to added complications associated with downstream sand and gravel mining operations which may compound scour and bank migration effects.

Figure 13 Kura River East (KP 223.5)



1.6.10.4 Kura River West

The Kura River West crossing is upstream of the key Mingechaur and Shamkir Reservoirs. As a result, many of the issues associated with the Kura River East crossing are amplified as the environmental significance of a spill event or construction disturbance are likely to be far greater at this point. This section is subject to extremely high uncontrolled discharges and far more seasonal fluctuation in flow compared to the Kura River East location. Data availability for this crossing is relatively good. The river is highly active and has the potential for significant lateral migration. The site is subject to added complications associated with several upstream crossings and gravel mining operations which apparently compound scour and bank migration effects.

Figure 14 Kura River West (KP 410)



1.6.10.5 Other river crossings

In addition, Fookes and Bettess (2000) identify the Tovuzchay crossing as requiring extra attention (KP377). Crossings of the smaller wadis in the drier eastern parts of the route in Gobustan also require extra attention. Channel instability is potentially a significant issue in the Gobustan region which is characterised by high erosion rates (Kashkay, 1996; Lawler, 1998). Although semi-arid channels by nature, and generally dry, they can be subject to intense flash flooding. This normally leads to considerable scour-and-fill of the bed, upslope migration of gully headcuts (eg Leopold et al., 1964), and some lateral instability.

1.6.11 Conclusions

Erodible soils, steep mountain terrains and highly seasonal snowmelt and semi-arid/flash-flood hydrological regimes drive active erosional processes throughout many of the drainage basins crossed by the route. Many of the fluvial systems examined near or on the SCP route are active, dynamic and meandering or braided, especially in the west, where the SCP approaches the foothills of the Lesser Caucasus.

Bank erosion, channel course switching and bed degradation are relatively common. Bank erosion is evidenced by steep, bare, undercut banks, extensive erosion cliffs, tension cracks behind certain bank faces, loose, easily-erodible sand and gravel bank materials, and damage to existing revetments and bridge and trestle supports and old pipelines. Bed scour is apparent through suspension of old pipelines as 'pseudo-aerial' crossings which were once installed on the river bed.

Each river crossing will have a different range of disturbances and potential impacts to be mitigated, as well as different levels of risk of damage by erosion or flash floods.

Different sources argue for varying number of sensitive river crossings. However, there are at least 7 major river crossings which deserve special attention in crossing design because they are of high sensitivity, 4 of which special consideration and further analysis. These are

Shamkirchay, Karabak Canal and Kura East and West crossings. Tovuzchay may also prove problematic to the SCP, as may some of the wadis in the east (Gobustan region).

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1 GEOLOGY AND SOILS

1.1 INTRODUCTION

This geology and soils report describes the nature of geological units and features of the proposed proposed pipeline route corridor. There is also a comprehensive section on soil types, with a subsequent section on topography and geomorphology.

1.2 DATA SOURCES

The geology and soils information included in this appendix has been collated from a number of sources. Due to the similarities between the proposed route and the “Western Route Export Pipeline” (WREP), some of these reference sources were produced originally in connection with the original surveying for the WREP. Baseline information specific to the proposed was collected between summer 2000 and winter/spring 2001. All of these sources have been used in producing this report, namely:

- January-February 2001 - baseline survey of those areas where the proposed proposed route deviates significantly from the WREP undertaken by AETC on behalf of BP
- August/September 2000 - rapid reconnaissance survey of the WREP undertaken by Environment Resources Management (ERM) on behalf of BP
- Baseline survey of WREP undertaken by AETC on behalf of Azerbaijan International Operating Company (AIOC) as part of the Environmental Impact Assessment of the WREP. 1997
- Supplementary details and clarifications provided by Dr R Mamadov in meeting with Dr. Heike Pflasterer held in Baku (February 1997)
- Supplementary details provided by Prof. G. Yagubov in meeting with Dr Heike Pflasterer held in Baku (February 1997)
- Literature review on contamination along the WREP corridor by Dr R Mamedov, Scientific Center ‘Nafta’, Institute of Geology (December 1996)
- Review of Publications on Geomorphology and Relief Along the Western Pipeline Route. 1996
- Mamedov, G.Sh. & Yagubov, G. Sh. 1996. Review of Publications on Soil Cover Along the Western Pipeline Route
- Review of Publications on Geology Along the Western Pipeline Route. 1996
- Literature review on soils and agrochemistry along the WREP corridor by Prof. G. Yagubov, Institute of Soils and Agrochemistry (December 1996);
- Soils of Azerbaijan (Map). 1991
- Atlas of Mud Volcanoes of the Azerbaijan Republic. 1971

1.3 GEOLOGY

1.3.1 Introduction

The proposed pipeline route is mainly underlain by extensive areas of alluvial sediments. Active seismic fault zones are known to be present in the region, and mud volcanoes are also a significant issue.

The proposed pipeline route follows the east-west line of the extensive lowlands in Azerbaijan which lie between the Greater Caucasus mountains (maximum elevation 5047m) and the Lesser Caucasus mountains (maximum elevation of 3,740m).

1.3.2 Underlying geology

The area along the proposed pipeline route, from the Sangachal Terminal in the east to the Georgian border in the west, is located along the southern extension of the Greater Caucasus mountain range at a distance of approximately 60-70km. The formation of the Caucasus is associated with the Alpine-Himalayan orogenic belt which originated due to the closure of the Tethyan ocean and the subsequent collision of the Eurasian continental plate with the African and Indian continental plates.

The regional structure is dominated by compressional deformation of sedimentary rock, which led to the formation of nappes verging towards the south-east. There was some volcanic activity during this long period of compressional tectonism. Thrust faulting in the Late Miocene period lifted Jurassic and Cretaceous rocks over the Pliocene deposits of the Great Caucasus. Associated fault zones are located along the margins of this zone and have been a focal point for seismic events. Of particular importance are vertical faults orientated in a north-east/south-west direction which also led to block faulting of the basement.

The area to the south and north of the Caucasus extension is dominated by Oligocene to Quaternary age sediments. These are relatively flat lying in the north (mainly Quaternary) whilst in the south they have been subjected to minor folding events which have exposed Oligocene and Quaternary rocks at the surface (as shown in Table 1).

The whole area has been subject to much tectonic activity and the proposed pipeline route crosses an active seismic area where fault-related earthquakes up to intensity 8 on the Richter scale occur, principally between Kazi-Magomed and Borsunlu.

Relatively recent (Cretaceous, Tertiary and Quaternary) sedimentary rocks are divided into several tectonic units by a number of active fault zones.

Highly folded and faulted sedimentary rocks (sandstones, clays, marls, schists and limestones) dating back to the Jurassic are intruded by volcanics. The tectonic units and associated faulting found along the proposed pipeline are indicated in Figure 1.

Table 1 General stratigraphic column of sedimentary rocks along the proposed pipeline

ERA	PERIOD	DIVISION
		Recent (QIV)
	Quaternary	Late (QIII)
		Middle (QII)
		Early (QI)
		Late (N2)
	Pliocene	Middle (N2)
	Neogene	Early (N2)
CENOZOIC		Late (N1)
	Miocene	Middle (N1)
		Early (N1)
	Oligocene	Late (P3)
	Palaeogene	Early (P3)
	Eocene	(P2)
	Palaeocene	(P1)

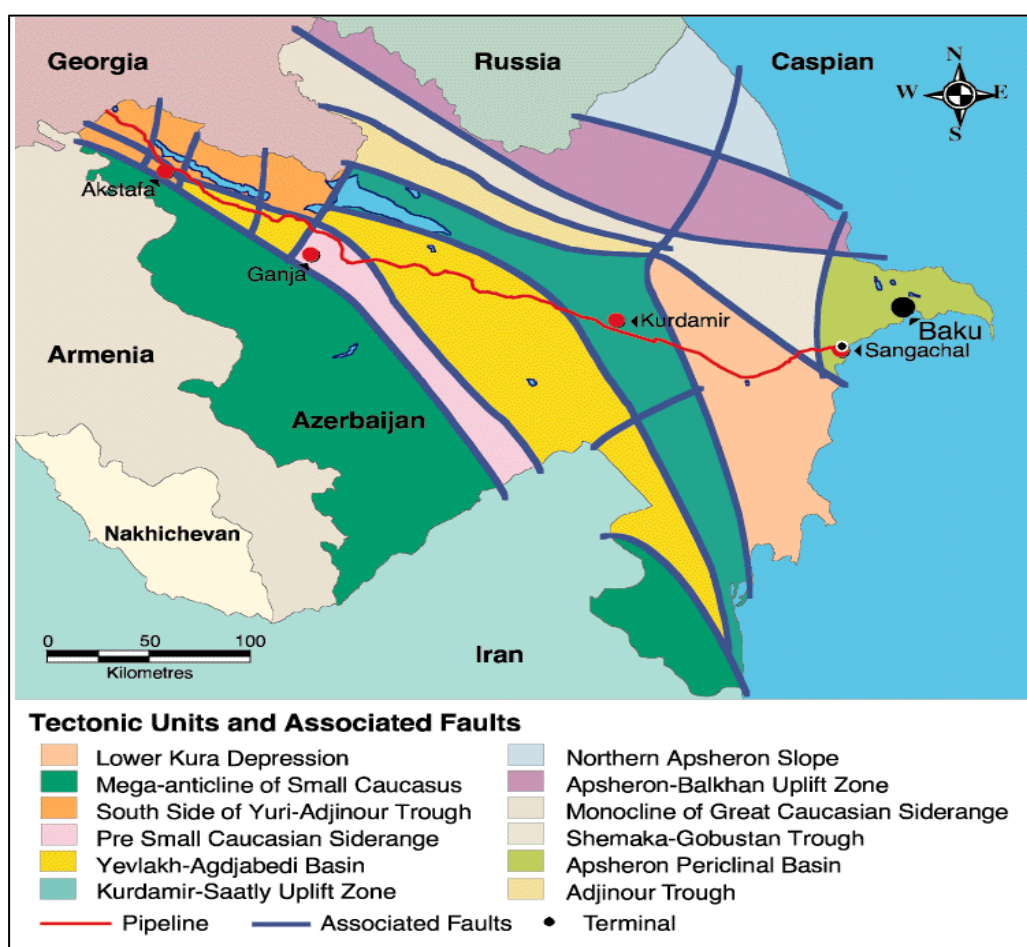
Table 1 General stratigraphic column of sedimentary rocks along the proposed pipeline

ERA	PERIOD	DIVISION
MESOZOIC		Late (K2)
	Cretaceous	Early (K1)

The proposed pipeline corridor passes through several tectonic units which are separated by major faults. These units are from east to west:

- Apsheron Periclinal Basin
- Shemaka - Gobustan Trough
- Lower Kura Depression
- Kurdemir - Saatly Uplift Zone
- Yevlakh - Agdjabedi Basin
- Pre-Lesser Caucasian Side Range (Monocline)
- Shamkor Anticline
- South Side of Yori - Adjinour Trough, and
- Mega-Anticline of Lesser Caucasus

Figure 1 Tectonic Units and Associated Faults Along the proposed pipeline



The major fault zones that separate the tectonic units are:

- Yashma Flexure
- Agichay - Alyat Fault (Jurassic - Neogene)
- Western Caspian Fault (Jurassic - Neogene)
- Mingechaur - Lenkoran Fault
- Kura Fault (Jurassic - Palaeogene)
- Pre-Lesser Caucasian Fault (Jurassic - Palaeogene)
- Ganjachay - Alazan Fault
- Kazakh - Signakh Fault

The geology of the proposed pipeline corridor can be divided into three distinct terrains. These are, from east to west:

- Sangachal to Kazi-Magomed (KP0-52)
- Kazi-Magomed to Borsunlu (KP52-272)
- Borsunlu to the Georgian border (KP272-442)

The geological setting of each of these areas is described in turn below.

1.3.2.1 Sangachal to Kazi-Magomed (KP0-52)

From Sangachal to the south-eastern slopes of the Big Harami mountain range the proposed pipeline route crosses a small scale anticline and syncline zone which is orientated in a north-west to south-east direction. This area is part of the Apsheron Periclinal Basin and the Shemaka-Gobustan Trough. Locally developed anticlinal structures, complicated with faulting of various orientations and magnitude, expose a variety of sediments. They are dominated by Cenozoic sediments of Palaeocene to Quarternary age, comprising many different and various thicknesses of argillaceous and arenaceous deposits. These molasse sediments are erosion products derived from the uplifted Caucasus mountain range to the north-west, and overlie a basaltic basement which is located at approximately 20-25km depth.

The anticlinal zones consist of mainly Pliocene deposits which are composed of sandy argillites, marls and limestones locally intercalated with shingle beds. The intramountainous basins are made of Quarternary clay, sand and shingle of alluvial, proluvial or lacustrine origin. These sediments are mainly unconsolidated and did not experience diagenesis. The north/south or north-west/south-east oriented Yashma Flexure, the faults at Kazi-Magomed and Agichay-Alyat are considered to be active and cut through Neogene to Quarternary layers. However, the amount of displacement along these faults is unknown. In this area mud volcanoes also occur and these features are described in detail in the Geohazards Report, Part 7 of the Baseline Reports Appendix. Neotectonic movements have led to subsidence with amplitudes of 400-600m in the Apsheron Basin.

1.3.2.2 Kazi-Magomed to Borsunlu (KP52-272)

In this section the proposed pipeline crosses the Lower and Middle Kura Depression which is a vast alluvial/proluvial plain. The sedimentary cover of the mesozoic basement reaches 5,000m thickness and is composed of Palaeogene and Neogene aged deposits. The Quarternary sediments have a thickness of 800-1,400m. A subsidence rate of up to 5,600m is recorded for the Middle Kura zone, and 1600m for the Lower Kura zone. Tectonics in this section are difficult to assess, however smaller tectonic structures such as the Naftalan and Khasanbulag Anticlines reveal fold structures. Deep seated faults are located at a depth of 3-7km and have a north/south or north-west/south-east direction. They are not cutting through

sediments of Pliocene to Quaternary age, but are a source for seismic events eg the Western Caspian Fault which is situated in a depth of 3-3.5km. The amount of dislocation along these faults is uncertain, and it is unclear whether some of the faults are still active. Furthermore, a magma chamber has been identified which is causing bulging of the Mesozoic basement.

1.3.2.3 Borsunlu To The Georgian Border (KP272-442)

In this section the proposed pipeline corridor is located within a narrow band of the Kura River alluvial plain, the continuation of the Middle Kura zone, situated between the Great Caucasus in the north and the Lesser Caucasus in the south. Smooth, Quaternary anticlinal structures, with amplitude of 400-600m are developed due to the tectonics of the Lesser Caucasus. They expose rocks of Middle to Upper Jurassic, Upper Cretaceous and Neogene to Palaeogene age which have a varying lithology (eg, carbonates, intrusives and volcanics). The proposed pipeline corridor is located approximately parallel to the Pre-Lesser Caucasian Fault which effects Jurassic to Palaeogene sediments and forms the southern border between the alluvial plain and the Lesser Caucasus. The northern boundary is formed by the Kura Fault which cuts through Jurassic to Palaeogene formations. The tectonic setting is complicated with faulting of various orientations and magnitude. The Mesozoic basement is block faulted and the overlying geology, of Cretaceous to Palaeocene age, has also experienced intense fault formation (overthrusts, reverse faults, etc.) which are today hidden under the Quaternary cover. Remote sensing and geophysical data reveal transversal faults which are located along the river valleys coming from the north-eastern slopes of the Lesser Caucasus. However, no information about the amount of displacement along these faults is available.

1.3.3 Surface geology

Over most of the route, the solid geology is mantled by varying thicknesses of alluvial deposits.

The first 25km of the proposed pipeline route is typified by alluvial deposits and stony clays. Also found in this region between KP0 and KP29 are active mud volcanoes. Associated mudflows occur in this area and comprise breccias up to 10m in thickness. Mud volcano breccias, mud and wash-down deposits occur, particularly at the base of the Turagay Mud Volcano (KP17) and the Mud Volcano Ridge area (KP25-28). In some areas the mud flows are susceptible to rapid rates of erosion.

Limestone, marls and mud breccia outcrops occur in the section between Sangachal and Kazi-Magomed and rock is likely to be encountered near the surface in this area.

The rest of the proposed pipeline route from Kazi-Magomed to the Georgian border is covered by alluvium. The alluvial plain is still accreting due to the high sediment load of the rivers with catchments in the Great and Lesser Caucasus mountains, which are among the highest of any rivers in the world.

In the Kazi-Magomed region, the underlying geology is typified by sandstones, interspersed with limestones and other deposits. The rocks are highly weathered and consequently very soft.

The flood plains of the Kura River have an underlying geology typified by mainly loose, unconsolidated sand and alluvium. There is some occurrence of mountain outwash deposits and lacustrine sediments.

Surface cover is only expected to be thin where underlying rock is resistant to erosion or where weathered material has been moved downslope. This is possible on the higher ground of the Gobustan area and hilly sections of the Lesser Caucasus Lowlands.

1.3.4 Economic geology

The pipeline is, however, routed close to three areas where sand and gravel extraction occurs:

- Downstream (approx. 200m) from the Kura East River crossing (KP224) there is active sand and gravel dredging
- At the Shamkir River crossing gravel extraction is currently taking place at the crossing point and immediately downstream (KP332)
- Upstream (approx. 1km) of the Tovuz River crossing (KP377)

With the exception of the Shamkir River crossing, the scale of aggregate extraction in these areas appears to be limited, probably providing a source of aggregate for the local area. The extent of extraction at Shamkir is greater, and is likely to be of regional importance.

Oil and gas exploration and production has taken place along certain sections of the route and some areas are still active concessions. However, although the route passes close to disused (and sometimes leaking) oil exploration or production wells, current production facilities have been avoided. This is discussed further in the Contamination Baseline Report, Part 6 of the Baseline Reports Appendix.

1.3.5 Mud volcanoes

Mud volcanoes are the dominant geological features in the eastern part of the proposed pipeline corridor.

Over 300 mud volcanoes are present in Azerbaijan, the majority of which are found in the Gobustan region (which the proposed pipeline route passes through between KP0 and KP29). Their distribution is related to anticlines and they are orientated in chains along the axes of these folds and/or along the lines of larger faults, in a north-west to south-east orientation. They are formed at the points at which pressure within the earth's crust (up to 6km deep) is released.

Generally they are found where high Pliocene sedimentation rates were able to keep up with rapid subsidence. Deposits of the Caspian Depression, mainly derived from the Caucasus mountain range, are heated, possibly due to interaction with hydrocarbon deposits. They rise to form mud diapirs intruding into the overlying sedimentary layers which crack and effuse into the submarine or terrestrial environments.

Mud and larger clasts of rocks, liquids and gases erupt from the ground surface. Eruptions can be violent and unexpected, and the gases discharged may be flammable. Mudflows form as the mud travels downslope away from its source. With time the erupted material will form a conical or plateau-like structure.

As mud volcanoes are geologically short-lived and tend to move along fault lines, the direction of migration of mud volcanoes should be considered, as well as the existing locations.

Only three mud volcanoes are located close enough to the proposed pipeline route to be considered a potential threat (Environmental Route Maps, Volume 2)). Otman-Bozdag mud

volcano, one of the largest in Azerbaijan, lies 4.6km to the north-west of the Sangachal Terminal (KP0). The Otman-Bozdag volcano is active, eruptions being registered in 1845, 1904, 1922, 1951, 1965 and 1994.

The Turagay Mud Volcano (located approximately 2.5km to the south of the proposed pipeline route at KP17) last erupted in 1955 and although not currently active, further eruptions are considered likely.

In the region of the Structural-Front Mud Volcano Complex (Mud Volcano Ridge), two parallel faults (crossed by the proposed pipeline route at approximately KP24 and 29) running north-west to south-east define an area in which mud volcanoes form along the trend of the fault lines (Environmental Route Maps, Volume 2).

During strong eruptions the basic mud containing rock fragments, water, oil and gas at temperatures of up to 1200°C can be ejected up to 100m into the air. Although only some mud volcanoes of Gobustan show recent mudflows, all are believed to be active.

Further information on mud volcanoes and also faulting, earthquakes and seismicity is provided in the Geohazards Report, Part 7 of the Baseline Reports Appendix.

1.4 SOILS

1.4.1 Methodology

The contents of this section are based on the results of an original survey carried out for the WREP and further surveying conducted for the proposed pipeline. The survey based its observations on terrain analysis, which identifies soils from their correlation to landscape features.

Although various soil types have been identified along the proposed pipeline corridor, according to their grain size they are all clays or loam, and many are highly saline. In the eastern area carbonaceous clays give rise to desert vegetation. Significant deposits of alluvial soils are found along the central and western portion of the proposed pipeline route. With adequate irrigation these soils are extensively used for agricultural purposes all year round.

1.4.2 Soils along the proposed pipeline route

The principal differentiating characteristic of soils in the study area is the soil moisture regime, the main elements of which involve interaction of factors such as climate, soil evolution, and drainage. Landform is also an important issue with regard to soils, due to issues of drainage and soil erosion.

Several characteristics are common across the range of soils identified within the study area. All soils react vigorously with dilute hydrochloric acid, which classifies them as calcareous (strongly alkaline). The soils observed are predominantly clayey and dense; in many areas they are also saline.

Mamedov & Yagubov (1996) identified various soil types along the proposed pipeline corridor. From the Sangachal Terminal at KP0 to Mingechaur, north of KP244 the soils can generally be classified as dense clays. From Mingechaur to the Georgian border (KP442) the clays tend to be more silty and therefore less dense. However, close to the rivers, which originate in the Lesser Caucasus, shingle beds are also developed.

Table 2 Classification of particles according to their grain size (1mm = 1,000 μ m)

GRAIN SIZE	PARTICLE
> 63mm	Cobble
63mm – 2,000 μ m	Gravel
2,000 - 63 μ m	Sand
63 – 2 μ m	Silt
< 2 μ m	Clay

The soil types along the proposed pipeline can be classified into four distinct areas, which are described from east to west below.

1.4.2.1 Eastern section (Gobustan-KP0-52)

The Gobustan area covers the foothills of the south-eastern Great Caucasus (KP0-52). All soils observed were locally highly alkaline and saline in nature. Grey-brown soils prevail, but immature grey soils also occur. These soils can be very dense with permeabilities ranging from 0.05-0.1m day⁻¹ due to the fine clays and silts deriving from mud volcanism. However, grain size composition given by Mamedov & Yagubov (1996) ranges from 21% to 69% of particles smaller than 0.01mm and they are therefore classified as silt/clay. Carbonaceous clays were observed along part of the route.

Close to the Sangachal Terminal (KP0) in the eastern part of the Gobustan area light coloured (light grey-brown), saline, carbonaceous clays which contained shell fragments and pebbles were observed. Rock outcrops of sandy carbonates occurred in places. Further to the west the soils were locally saline or very saline and showed gypsum crusts, especially along silty wadis. Outcrops of carbonate and marls, intercalated with mud volcanoes producing basic, and often oily, mud were found. Water erosion of the soil has led to the creation of gully and ravine complexes in the foothills of the Gobustan area.

The soils in the first 25km of the proposed pipeline route comprise yellow brown silty and stony clays and loams with consistencies varying from soft and loose to slightly hard. The soil structure is generally fine to medium and subangular. Vegetation in this area is extremely sparse, as the area is typified by semi-desert. Shrubs and grasses are present in some areas (particularly in association with watercourses), amongst large expanses of bare ground.

The area between the Caspian Sea and the Kura River is generally hot and dry. The vegetation, out of necessity, is adapted to drought and, in much of the area, to soil salinity. The majority of the landscape is occupied by plains, which are interrupted at different locations by stream channels (fluvial lands), sloping lands and disturbed lands.

Plains soils between Sangachal and KP52 are prone to overland flow. In locations where runoff concentrates, one often finds steep-sided ravines deeply etched into the surface. The soil surface often has a platy structure 3-5mm thick that, until disturbed or thoroughly saturated, serves as a partially impenetrable barrier to infiltration and results in high soil aridity. Where overland flow is an important part of the local hydrology, small dunes occur at the base of clusters of grasses and shrubs.

1.4.2.2 Central section (Shirvan Plain-KP52–224)

This flatland area extends from near the village of Ranjbar, east of Kazi-Magomed to the east of the Kura River near Yevlakh (KP52-224), and covers a large area of the Kura River zone. The soils are silty grey soils with a high organic content around Kurdemir and a low to medium humus content in the area between Ucar and Yevlakh (KP177-224). The grain size of

these soils ranges from clays to alluvial sands. Fans of alluvial wetland meadow soils occur around the various branches of the Geokchay and Turianchay rivers.

The soils consist mainly of pale and dense clays which are mostly saline (although grain size does vary widely across the region). Due to intensive agriculture they seem to be depleted and crop growth is often low. Humus rich soils were not observed.

The soils found in the region of Kazi-Magomed (KP52) are similar to those found in the Gobustan region, with a pale brown colour, sandy loam texture and slightly sticky and friable consistency. Vegetation is classed as mainly grass, although this is very patchy. Grazing of grassland by sheep and goats is common.

West of Kurdamir (around KP130), in the area of the former lake of Shilian, the clays are grey to dark grey, and are classified as meadow marsh and marsh soils. Deep desiccation cracks and teepee structures typical of salty soils were often observed. Wind and water erosion of the soils in this area is not significant.

The plains occupy the majority of the landscape east of the Kura River crossing at KP224. Beginning at sea level at the edge of the Caspian Sea, the plains landscape gains altitude until it abruptly returns to sea level in the vicinity of the village of Ranzbarilar, where it becomes part of the Shirvan plain of central Azerbaijan. The plains landscape is interrupted at different locations by stream channels (fluvial lands), sloping lands and disturbed lands.

The soils found on the plains of the study area are depositional soils that are generally pale coloured (light yellowish brown) loam with a composition that includes significant quantities of silt, clay or sand. Cultivation has been carried out in the Kura flood plain. Crops include wheat and cotton, and much of the land is employed for grazing cattle and sheep.

West of Ranzbarilar the soils characteristics alter. Unless irrigated, they tend to be highly cracked, these rifts staying open for much of the year. Highly cracked soils in hot climates are known to accumulate salts. Salt pollution of soils is a problem throughout the irrigated area east of the Kura River at KP224. Poor irrigation practice is generally the cause of salination. Some soils are so severely affected by soil salinity as to have a salt flock structure or crust to their upper surface.

Tillage in this region is deep, usually using mouldboard ploughs followed by harrowing. During surveys, there was no evidence of disk ploughs or cultivators being used. Agriculture has destroyed the berm over parts of the existing WREP pipeline, especially on the plains near Ganja. In other areas fill material has settled to below the level of the soil surface, creating a kind of parabolic channel. This is most prominent in saline soils having a hard to very hard, blocky structure, and may result from inadequate preparation of fill material.

Slopes perpendicular to the proposed pipeline route occasionally traverse the plains. Soil erosion and deposition play a role in soil formation in these regions, so that gravel from upland areas might cover soils lower on the slopes. Where the landscape is rolling or hilly, sand is therefore likely to be a greater constituent of the soil, with pale colour and infertility being typical. Such soils have little resistance to erosion, and when severely eroded become classified as 'badlands'.

Soils in the fluvial regions differ from their drier counterparts in that they are often associated with hilly, rolling, and undulating terrain: their occurrence is rarely abrupt, but results as a transition with other land forms. In fluvial regions the soils tend to convey water and lie entrenched below the level of the natural land surface.

In landscapes with a cooler climate than the plains close to Sangachal, a higher level of rainfall is registered which makes the area suitable for some forms of rain-fed agriculture. Regions in the study area are used for a mix of rain-fed and irrigated farming of such crops as maize, cereals, hay, and grapes. Their landscape is more diverse and higher in altitude than are the warmer plains. Rivers, some of which are deeply incised, act to divide upland plains into discrete segments. Wet lowlands have more relief than dry lowlands. Their soils resist salt accumulation. As with most plains soils, the soils found on wetter plains develop a thin platy crust (3–4mm thick), which reduces infiltration. Tillage breaks up the crust, so that it is less of a feature on valley and plains soils than on sloping lands, where the potential for runoff and soil erosion is high.

Within the study area, there are areas of disturbed land associated with roadways, construction of different kinds and the existing WREP pipeline corridor. For example, there is evidence of highly cracked soils concentrated along the working width of the existing WREP pipeline corridor. In these areas soils have been so mixed as to lack observable diagnostic characteristics. As they contain subsoil mixed with soil from the surface, their general impact is to reduce soil fertility. This becomes extreme in areas that are compacted which may also be prone to drought and on sloping ground where the topsoil may be washed away completely. The effect of disturbed lands is to reduce plant density, vigour and biomass. In agricultural areas, the existing pipeline corridor serves as an entry point for invasive weeds. Areas of disturbed soils, which have a soft consistency, attract burrowing animals such as rabbits and foxes.

1.4.2.3 Western section (Karabakh Plain KP224-256)

The proposed pipeline route crosses the northern part of this plain from east of Yevlakh to the Goran railway station near the village of Goranboy (KP224-256). The soils consist of alluvial flood plain meadow forest soils near the Kura River. West of the Kura River grey soil with low or medium humus content prevails with intercalated alluvial soils, which consist of the alluvium of various watercourses sourced in the Lesser Caucasus. Grey soils, as well as light chestnut coloured soils, which are occasionally saline, also occur.

In this area alluvial deposits are present irregularly, with soils typified by grey-brown silty, sandy and clayey loams. The vegetation encountered is mixed, varying from natural, uncultivated regions, to semi-natural and agricultural lands. Grazing is widespread, with a few cultivated areas that have been used predominantly for the cultivation of vines and maize. A general trend was noted of grazed areas on valley sides, with cultivation and irrigation in the valley bottoms.

1.4.2.4 Western section (Lesser Caucasus Plain - KP256-442)

This area covers the western part of the Kura River Plain and the foothills of the Lesser Caucasus. It stretches from the Goran railway station up to the Georgian border (KP256-442). Close to the rivers alluvial wetland meadow and Tugay soils occur. In other places chestnut soils which are partly saline prevail. The proportion of grain size of < 0.01mm varies between 16% and 60%, which classifies it as a loam.

Pale to grey brown, saline and partially loamy clays occurred in the area between the villages of Goran (KP256) and Borsunlu (KP273). Light grey-brown/brown, silty clays prevailed in the area between Borsunlu and Deller (KP341), whilst further to the west pale grey-brown silty clays, which are locally saline, are found. From the village of Asagli to the Georgian border chestnut coloured clays prevail. Soil erosion caused by rainwater run-off and the

subsequent creation of gullies occurs in the hilly parts of the proposed pipeline route along the south side of the Shamkir Lake (KP329-387) and north of Agstafa (KP392-400).

The permeabilities of the described soils to pure water ranges from 0.05-0.1mday⁻¹ at Gobustan, through < 0.8mday⁻¹ for the Shirvan and Karabakh Plains to values of up to 10mday⁻¹ in the Lesser Caucasus Plain and Lowland.

At the western end of the proposed route, from the west Kura River crossing to Jandari Lake, the soil is generally a sandy or clayey loam, light brown in colour, with a slightly hard consistency and angular structure. Natural vegetation in this area ranges from mosses, shrubs and low grasses in upland regions to reeds, low trees and shrubs (Tugay forest-type vegetation) on the flood plain.

In the cool, upland environments typical soils are depositional soils with little soil horizon development. They support deep ploughing, but trenching (as for the pipeline) may well exceed their ability to retain soil fertility, and soil quality will diminish. Most soils in this category are irrigated for hay or maize during the summer, followed by rain-fed cereal production during the winter. Fields are small and although tillage will be by tractor-drawn mouldboard ploughs, much of the subsequent labour is by hand.

Seasonally cracking soils are present in some areas with fairly low levels of moistness. This means that they are pale-coloured, often brown with a tendency towards shades of grey. These soils tend to be more of a nuisance than a problem. They tend to become sticky when wet, and vehicles can be difficult to manage during irrigation or the rainy season. Tillage requires careful attention to soil moisture content: too wet and ploughs become difficult to pull; too dry and they become hard. Well managed, these soils will retain their fertility and provide good yields.

Where hills (or undulating or rolling lands) associate with plains-like valleys in close proximity the soils are typically pale-coloured and shallow soil on sloping lands, where soil erosion is a factor in soil development. Because the soils are thin, they are easily damaged by construction and compaction. Their principal uses include watershed, habitat, and limited grazing; they are unsuited to most forms of horticulture.

Undulating, rolling or hilly lands often precede, or follow, fluvial lands in the landscape sequence. If undulating, their soils may resemble those of the plains. If occurring downslope of rolling or hilly terrain, however, their surface may become covered by gravels transported from above. They have a low suitability for farming because of soil drought enhanced by internal drainage. Rolling and hilly lands usually contain soils similar to those described in the preceding paragraph. They often are skeletal, which means that gravel makes up an important part of their composition.

1.4.3 Occurrence of gypsum-rich soils

Gypsum (hydrated calcium sulphate) is often found both on and just below the soil surface. The resulting saline conditions are highly aggressive towards steel and concrete used in pipeline construction. Gypsum growth within soil can also lead to heave, with solution of gypsum resulting in ground collapse beneath foundations and pipes.

1.5 TOPOGRAPHY AND GEOMORPHOLOGY

The topography and geomorphology along the proposed pipeline route can be characterised into three distinct sections as described below.

1.5.1 Sangachal to Kazi-Magomed (KP0-52)

The Gobustan area consists of plains and low mountains with elevations of up to 400m. They are part of the tectonic structure of the Apsheron Basin and the Shemaka-Gobustan Trough.

The landscape along the first 25km of the proposed pipeline route is mainly semi-desert. Erosion and denudation occur in the hilly areas with a series of flat-topped steep-sided hills crosscut by highly eroded seasonal channels creating steep slopes, badlands, gorges, gullies and the local exposure of carbonaceous bedrock.

The topography rises to meet the ridge of mud volcanoes at KP25, reaching elevations of up to 400m, for example the Turagay mud volcano and a slope of up to approximately 15°. This is where the proposed pipeline route reaches its greatest altitude. Mud volcanoes are distinct features of this area and are described in detail in the Geohazards Report, Part 7, Baseline Reports Appendix. Intra-mountainous basins which consist of alluvial, proluvial and deluvial sediments of the mountain ranges and mud volcanoes are intercalated.

The landscape in the region of Kazi-Magomed has moderate undulating relief, with generally gentle slopes dissected by erosional stream channels.

1.5.2 Kazi-Magomed to Yevlakh (KP52-224)

From the west of Kazi-Magomed to the Kura Valley at Yevlakh the central part of the proposed pipeline route consists of the vast Shirvan Plain. In this area Quarternary alluvial deposits from the Great and Lesser Caucasus form huge fans, cones and terraces (Novocaspian formations). The topography is flat and altitudes are low, varying from -12 to 10m amsl. The sedimentary cover of the basement reaches more than 5,000m thickness and is of Mesozoic and Cenozoic age. The Shirvan Plain is highly intersected by rivers sourced in the Great Caucasus and by irrigation canals.

The landscape of the Korchay region is comprised mainly of undulating plains with slight slopes and fairly low relief.

1.5.3 Yevlakh to the Georgian Border (KP224-442)

The western section of the proposed pipeline route consists of the Karabakh Plain and the foothills of the Lesser Caucasus up to Poylu, where the proposed pipeline route crosses the Kura River. The cover of Palaeogene to Miocene sediments reaches a maximum thickness of 2,000 to 3,000m. The monoclinical deformation dips towards the Kura River in the north. This section is characterised by Quarternary alluvial and proluvial deposits which are derived mainly from the Lesser Caucasus.

North of the Kura River the plain is fed by alluvium from the Great Caucasus Mountains, the watershed being situated near Poylu at an altitude of 197m. The major braided rivers are located in this section, where altitudes range from 80 to 330m.

Close to Shamkir, to the east of the western crossing of the Kura River, the proposed pipeline route crosses undulating hills and valleys. The valleys sometimes comprise fairly wide alluvial plains. Due to the moderate relief, drainage is generally good, with rivers draining the hills, and drainage ditches on more level cultivated areas of ground.

To the west of the river, the route crosses the Lesser Caucasus Plain and Lowlands. This low relief topography has good drainage in the form of drainage ditches and canals. Within this

region an area of badlands has developed for approximately 30km to the west of Ganja (between approximately KP352 and 382).

The topography in the region of the Karayazi aquifer (KP411-442) is generally flat, being on the wetland flood plain of the Kura River.

1.5.4 Summary of geomorphological features

In summary, in the east, the main geomorphological features are the mud volcanoes and the wadis. The wadi channels only contain flowing water on an irregular basis and are characteristic features of semi-arid or arid environments prone to flash floods.

The central section comprises the flat agricultural lands of the Kura floodplain.

Towards the western end of the route, the river channels are mainly wide and braided with channel width typically in excess of 100m.

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1 CLIMATE AND METEOROLOGY

1.1 INTRODUCTION

This report describes the climatic environment along the proposed pipeline route through Azerbaijan, mainly based upon information collected along the existing Western Route Export Pipeline (WREP), focusing in particular on thermal conditions, humidity, precipitation and wind speed.

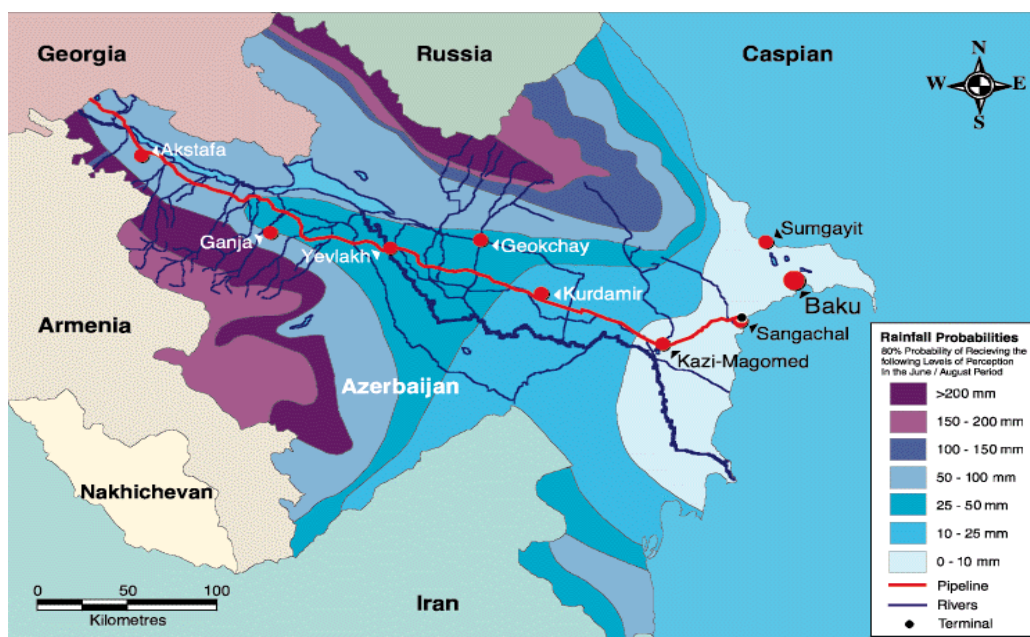
1.2 DATA SOURCES

A desktop study or literature review of existing data regarding climate and air quality in the pipeline corridor was prepared by Professor Eyubov, Head of the Climatology Department at the Institute of Geography (Eyubov, 1996). The information in this section is based on this study. In addition, other publications, including one on bioclimate resources (Eyubov, 1993b) and the detailed maps contained within the Agroclimate Atlas of Azerbaijan (Eyubov, 1993a), were referred to in the preparation of this study.

Azerbaijan has numerous meteorological stations, some of which have been collecting data for over 100 years. This means that long-term climatic averages are relatively reliable. Ten of the stations are in proximity to, and at fairly regular intervals along, the proposed pipeline route, as shown in Figure 1-1. The information on which this appendix report is based was mainly gathered from these stations, (Eyubov, 1996) namely :

- Baku,
- Puta (near Guzdek),
- Alyat,
- Kazi-Magomed,
- Kurdamir,
- Yevlakh,
- Ganja,
- Shamkir,
- Kazakh and
- Akstafa.

Figure 1-1: Location of meteorological stations along the proposed pipeline



Standard techniques were used to collect data on the normal suite of meteorological variables, including hours of sunshine, solar radiation fluxes, air and soil temperature (at the surface and 200mm depth), atmospheric humidity, precipitation, and wind speed/direction. In addition, automatic rain gauges were used to gather data on rainstorm magnitudes and frequencies, factors that are very significant in with regard to the hydrological and geomorphological processes that may affect pipelines.

Many different climate types are represented in Azerbaijan. Eight of the 11 commonly classified climate types can be found in the Republic.

The climate of the eastern part of the proposed pipeline corridor, around Guzdek, can be classified as a subtropical, temperate semi-desert/dry steppe type, which is characterised by hot summers (air temperatures of up to 40°C), high evapotranspiration rates in summer, high wind speeds, low humidity and low rainfall (< 200mm p.a.).

To the west, the climate becomes slightly cooler, wetter and less windy, as altitudes rise to over 300 metres above mean sea level (mamsl – define the acronym and which sea it relates to) and distance from the Caspian Sea increases. The influence of the Caspian Sea moderates the climate along the eastern portion of the proposed pipeline route, and keeps winters warmer and summers cooler than might be expected for these latitudes (with an average of 40°N).

1.3 TEMPERATURE

1.3.1 Sunshine and solar radiation

The number of sunshine hours experienced along the proposed route is high by global standards. The Agroclimatic Atlas of Azerbaijan (Eyubov, 1993) shows that most regions receive approximately 2,200 hours of sunshine per annum, however this total decreases to around 2,100 hours for Kurdamir in the Shirvan Plain and rises to 2,320 hours for Ganja.

Around 60% of this total is incident between June and August when, for example, up to 11 hours of sunshine per day can be expected in Baku. This declines to an average of just three hours per day for Baku in winter.

Mean annual solar radiation fluxes alter little along the proposed pipeline corridor. They vary between 128 and 132kcal cm⁻² at the eastern end, and decline to a little less than 124kcal cm⁻² at the slightly cloudier western end, a region with one of the lowest annual solar radiation levels in Azerbaijan. In the winter period, between October and March, the whole route receives a solar radiation flux of only between 36 and 40kcal cm⁻².

1.3.2 Air temperature

The large inputs of solar energy noted above, combined with limited thermal moderation by cooling vegetation (especially around the eastern semi-desert part of the route) means that air (and soil) temperatures are high, particularly in the peak of summer. The mean annual temperature increases steadily eastwards from approximately 12°C at the Georgian border to 13.2°C at Ganja and 14.6°C at Alyat. Alyat is registered as one of the warmest places in Azerbaijan. It has been suggested by Hadiyev (1996) that mean air temperatures have risen significantly in the Trans-Caucasian region over the last 100 years.

Seasonal changes can be identified by studying the monthly averages given in Table 1-1. The coldest month is usually January; and the warmest are July and August. Mean January air temperatures at Puta, near the coast, and Ganja are 3.4°C and 1.1°C respectively, while in Akstafa the January mean drops to -0.1°C. In July the cooling effect of the Caspian means that average monthly temperatures are virtually the same at Puta and Ganja (25.8°C and 25.4°C respectively). The hottest parts of the proposed pipeline corridor in July are normally in the centre of the Republic, around Kurdamir and Yevlakh (both 27.3°C). These locations are far enough inland to be isolated from the moderating effects of the Caspian, yet not at a sufficiently high elevation to be affected by altitudinal cooling (see Table 1-1).

As regards temperature extremes, mean monthly minimum air temperature in January varies from 0.7°C at Puta to -2.4°C at Ganja. The lowest temperatures ever recorded at these two meteorological sites, however, are -17°C and -18°C respectively (and -24°C at Kurdamir). Mean monthly maximum air temperature in July varies from 30.4°C at Puta to 34.6°C at Kurdamir. The highest air temperatures ever recorded at Puta and Kurdamir are 41°C and 43°C respectively.

Table 1-1 Air temperature statistics for meteorological stations along the proposed pipeline (°C)

STATION	JANUARY					APRIL				
	MEAN	AVE MAX	AVE MIN	ABS MAX	ABS MIN	MEAN	AVE MAX	AVE MIN	ABS MAX	ABS MIN
Putu	3.4	6.6	0.7	21	-17	10.9	15.3	7.5	34	-2
Alyat	3.4	7.2	0.0	22	-16	11.7	16.7	7.5	36	-1
Kurdamir	1.4	6.2	-2.1	20	-24	12.6	19.2	7.1	34	-2
Yevlakh	1.7	6.9	-2.2	20	-18	13.5	20.2	7.4	35	-3
Ganja	1.1	5.5	-2.4	19	-18	12.0	18.2	6.7	33	-4
Kazakh	0.0	5.0	-4.0	18	-25	11.1	17.5	5.7	31	-5
STATION	JULY					OCTOBER				
	MEAN	AVE MAX	AVE MIN	ABS MAX	ABS MIN	MEAN	AVE MAX	AVE MIN	ABS MAX	ABS MIN
Putu	25.8	30.4	21.5	41	12	16.3	20.0	12.7	35	-2
Alyat	26.4	31.2	21.9	40	12	10.6	20.9	12.7	34	1
Kurdamir	27.3	34.6	20.6	43	14	15.9	22.3	11.2	35	-4
Yevlakh	27.3	34.0	20.4	42	11	15.6	21.9	10.2	36	-5
Ganja	25.4	31.8	19.0	40	10	14.3	19.9	9.6	34	-5
Kazakh	24.0	30.3	17.9	39	7	13.2	19.0	8.1	33	-6

1.3.3 Soil temperature

The temperature of the soil is dependent on the nature of the soil surface, but also on the amount of solar radiation incident on the area, and on energy balances found at the surface. The following issues are of relevance:

- Soil particle grain size and sorting, which influence thermal properties, such as conductivity (eg fine-grained materials conduct heat more efficiently to depth, moderating soil surface temperatures)
- Soil moisture content (wet soils conduct heat downwards more easily, minimising diurnal heating and nocturnal cooling of the surface)
- Vegetation cover, which tends to subdue the seasonal and diurnal temperature ranges, all other factors being equal

The mean annual soil surface temperature map for central Azerbaijan is presented in Figure 1-2. Mean daily soil surface temperatures are around 2°C-3°C higher than air temperatures. This is due to the following factors:

- Very strong heating of the soil surface as a result of incident solar radiation (especially in summer),
- The lack of a shading/transpiring vegetation cover
- A limited soil moisture supply that could be evaporated and therefore cause cooling

Mean annual soil surface temperatures are relatively constant along the route, varying between 16°C and 18°C. The highest temperatures, above 18°C, are reached in the Shirvan Plain, and towards the east of the route (see Figure 1-2). In summer, soil surface temperatures can be extreme, and maxima have exceeded 70°C at Akstafa in the west and at Sabirabad in the Shirvan Plain. Mean July temperatures along the whole route vary between 30°C and 35°C. In January, mean soil surface temperatures along the entirety of the route lie between 0°C and 3°C, except near Guzdek where average values tend to exceed 3°C.

Figure 1-2 Mean annual soil surface temperature along the proposed pipeline



1.4 ATMOSPHERIC MOISTURE

1.4.1 Evapotranspiration

Potential evapotranspiration (PE) is strongly linked to temperature regimes. PE is the maximum amount of evaporation and transpiration that can take place if an unlimited moisture supply is available. PE rates, at more than 800mm in eastern Azerbaijan and 600mm in the west in the April to October period, are very high. The summer evapotranspiration peak is controlled by the following factors:

- Large solar radiation receipts (up to approximately 130kcal cm^{-2})
- Substantial periods of unbroken sunshine
- High air temperatures (commonly up to between 30°C and 35°C)
- High wind speeds which enhance replacement of dry air supplies
- Low atmospheric humidity which, according to standard flux-gradient principles, allows near-surface air to accept large volumes of evaporating moisture from the surface materials

The fact that potential evapotranspiration losses exceed precipitation inputs by a significant margin is largely responsible (along with soil salinity and overgrazing problems) for the sparse vegetation cover in the eastern part of the route. Irrigation systems are extensive in the central parts of the proposed corridor, and replenish evaporated and transpired soil moisture to sustain agricultural activity (Wolfson and Daniell, 1995).

1.4.2 Humidity

Mean annual absolute humidity increases from around 11 gcm^{-3} in the west to around 13 gcm^{-3} in the eastern coastal areas. Strong seasonality exists, however, and in the Shirvan Plain lowlands, values range from 4.0 to 7.2 gcm^{-3} in January, and 14.3 to 22.2 gcm^{-3} in August. Mean annual relative humidity displays little spatial variability, increasing from 67% at

Shamkir to 72% at Kurdamir. Summers are hot and dry, and peak relative humidities are achieved in winter. The highest average humidity recorded is 87% in Kurdamir during the winter, a value that declines to 72% in July.

1.5 PRECIPITATION

1.5.1 Annual and seasonal precipitation

Average annual precipitation decreases steadily from around 350 to 400mm near the Georgian border to 104mm at Puta (see Table 1-2). Rainfall is the most strongly varying climatic parameter in the proposed corridor (see Figure 1-3). The arid desert plain in the Guzdek/Sangachal region is one of the driest areas in Azerbaijan. Variability from year to year is high, as is common with semi-arid and arid environments, and Puta has received as much as 390mm in one year (1968), and as little as 78mm in another (1925). Similarly, annual totals at Akstafa have ranged from 567 to 253mm (as shown in Table 1-2). It should be stressed, however, that it is the much greater precipitation (and snowmelt processes) in the vicinity of stations like Sheki in the Caucasus ranges (greater than 1,000mm in many areas) which controls the magnitude and seasonal variation of flows in the rivers crossed by the proposed pipeline, rather than rainfall over the proposed pipeline route itself (see Figure 1-4).

Table 1-2 Precipitation statistics for meteorological stations along the proposed (mm) (year given in brackets)

STATION	JANUARY			APRIL		
	MEAN	AVE. MAX.	AVE. MIN.	MEAN	AVE. MAX.	AVE. MIN.
Puta®	12	79 (1905)	1 (1898)	10	70 (1911)	0 (1957)
Alyat Why 3 entries?	16			20		
Kurdamir Why 3 entries?	22	68 (1937)	1 (1912)	32	88 (1923)	2 (1950)
Ganja Why 3 entries?	10	34 (1893)	0 (6 yrs)	27	64 (1895)	0 (1950)
Akstafa	13	43 (1957)	0 (6 yrs)	38	92 (1912)	0 (1943)
Puta®	2	48 (1922)	0 (19 yrs)	16	132 (1946)	1 (2 yrs)
Alyat	4					
Kurdamir	17	121 (1926)	0 (9 yrs)	33	134 (1951)	0 (1954)
Ganja	23	92 (1922)	0 (2 yrs)	22	95 (1951)	0 (1952)
Akstafa	32	139 (1906)	0 (4 yrs)	30	120 (1951)	2 (1932)
STATION	TOTAL FOR YEAR			® Because of a lack of reliable records extreme data are given for Baku, where average annual precipitation is 198 mm		
	MEAN	AVE. MAX.	AVE. MIN.			
Puta®	104	390 (1968)	78 (1925)			
Alyat	188					

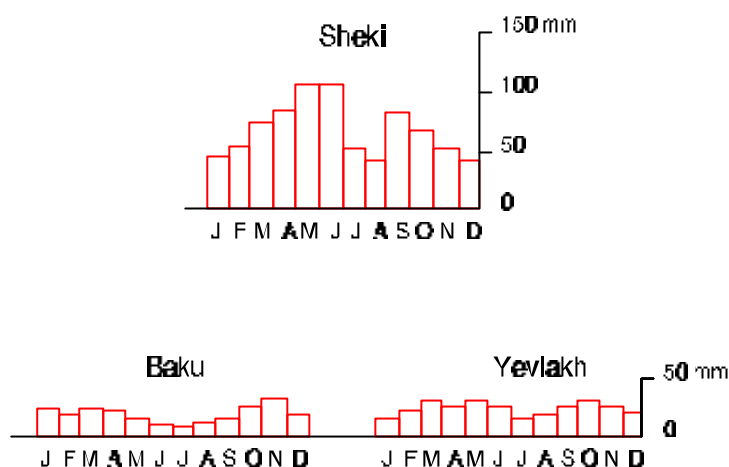
Table 1-2 Precipitation statistics for meteorological stations along the proposed (mm) (year given in brackets)

STATION	JANUARY			APRIL		
	MEAN	AVE. MAX.	AVE. MIN.	MEAN	AVE. MAX.	AVE. MIN.
Kurdamir	325	551 (1963)	195 (1947)			
Ganja	248	397 (1948)	150 (1932)			
Akstafa	359	567 (1915)	253 (1925)			

Figure 1-3 Mean annual precipitation map for Azerbaijan (Source: Agroclimate Atlas of Azerbaijan, 1993)



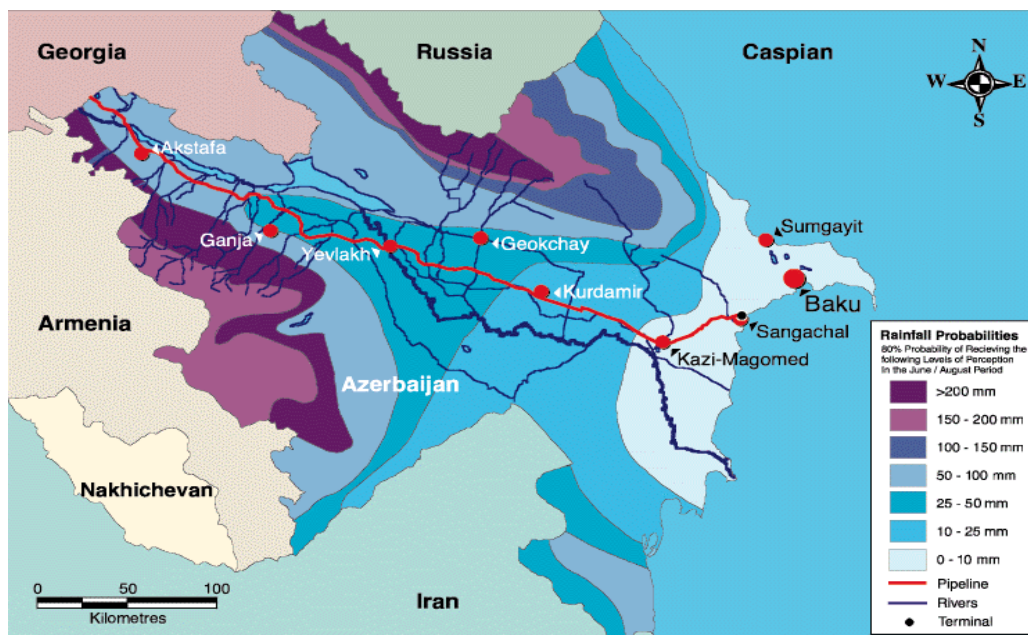
Figure 1-4 Monthly precipitation distribution for Baku, Yevlakh and Sheki



Hadiyev (1996) indicated that over the last 100 years, at selected sites in Trans-Caucasia, annual rainfall totals were decreasing, except over large cities. However, in a simple analysis of patterns over the last 60 years, done specifically for the EIA for the WREP, it has emerged that there has been a significant increase in annual rainfall in recent decades. The number of annual totals greater than 300mm tripled at both Baku and Ganja over the 28 year period between 1963 and 1990 compared with the previous 28 years. Similar precipitation increases have been found by Mumladze (1991) at Poti on the Georgian Black Sea coast.

Seasonal distribution of precipitation is not especially pronounced in the region, although there are subtle differences along the proposed pipeline corridor (see Table 1-2). Most of the precipitation falls between September and April. Figure 1-4 demonstrates that two seasonal peaks are evident, one in the March to May period, and a second in autumn/winter (October in Yevlakh, and December in Baku). The driest month is July throughout the proposed pipeline corridor, when the average rainfall is just 8mm in Baku (Darde, 1994), 2mm in Puta, and 32mm in Akstafa. Once again, however, year to year variability is high. For summer rainfall probabilities (June-August), there is a clear east/west gradient, west of Mingechaur, there is an 80% probability of receiving between 50 and 100mm precipitation, but this figure falls to less than 10mm in the Guzdek area (Figure 1-5). It is this relative security of summer rainfall supplies which helps to ensure the maintenance of the Karayazi wetland at the western end of the proposed pipeline corridor.

Figure 1-5 Rainfall probabilities in Azerbaijan for the June-August period



1.5.2 Rainfall event magnitudes and frequencies

Details of rainstorm frequencies are just as important as information on monthly averages, because large rainfalls can adversely affect pipeline construction working conditions. On average, rain falls on approximately 58 days a year in Baku, and 71 days in Kurdamir. The absolute maximum daily precipitation amounts received along the route vary from 65mm in Baku to 100mm in Kazi-Magomed, 97mm in Kurdamir, 77mm in Ganja, and 95mm in Akstafa. These extreme events occur mostly in summer, but they can also arrive in winter, especially near the coast. Eyubov (1996) states that such large daily rainfalls, in the 75 to 100mm range, may occur once every 100 years.

Precipitation is very often convective or frontal, when high-intensity rainfall results. While the local annual average numbers of daily rainfall events in excess of 30mm are not high (eg Alyat 0.3 per annum and Baku 0.2 per annum), they are probably more common in the mountains where flash floods are generated and transmitted downstream. Despite low annual precipitation receipts, intense rainstorms in such semi-arid environments have occurred, on average, every 24 years. Because of relatively large, steeply-sloping and poorly vegetated basins in the region, these events can lead to significant floods. These are associated with erosion and substantial sediment loads in the channel networks, which may be dry or at low flow for most of the year. This is especially true at the eastern end of the line. Mudflows may also be triggered by heavy rainstorms (see Volume 2, Part 7 in the Appendices check that this is still a valid cross-reference).

1.5.3 Snowfall and snowmelt

Precipitation occurs almost entirely as rain with only six days of snow per annum on average recorded at Baku and Kurdamir, increasing to 15-18 near the Georgian border. In Akstafa, for example, there is an 8% chance each winter of snow depth of between 60 and 200mm. However, heavy snow accumulations do occur in the Greater and Lesser Caucasus mountains every winter, which significantly affect the rivers crossed by the proposed pipeline route. The

snows melt under strong, thermally driven ablation conditions each spring, and snowmelt can be augmented by rainstorms. Considerable quantities of meltwater can generate significant flooding downstream in the proposed pipeline corridor. For example, Figure 1-6 shows the relationship between the seasonal rise in air temperatures through the 0°C threshold, rainfall inputs, and the subsequent, relatively sudden, production of large river flows.

Figure 1-6 Seasonal variation in discharge in the Ganjachay River near Zurnobad (Western Azerbaijan) in relation to mean daily air temperature and daily precipitation

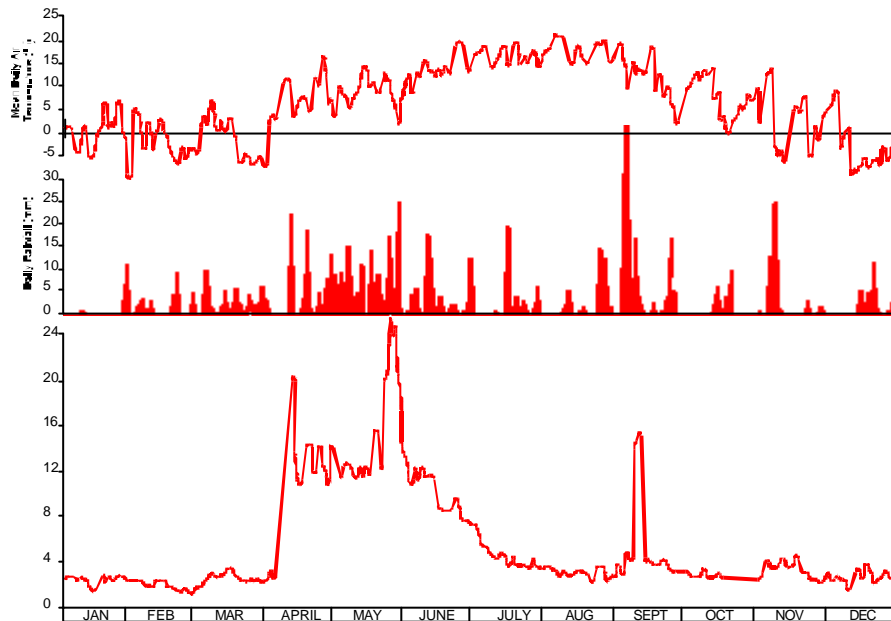


Figure 1-7 Average date of snow disappearance along the proposed pipeline

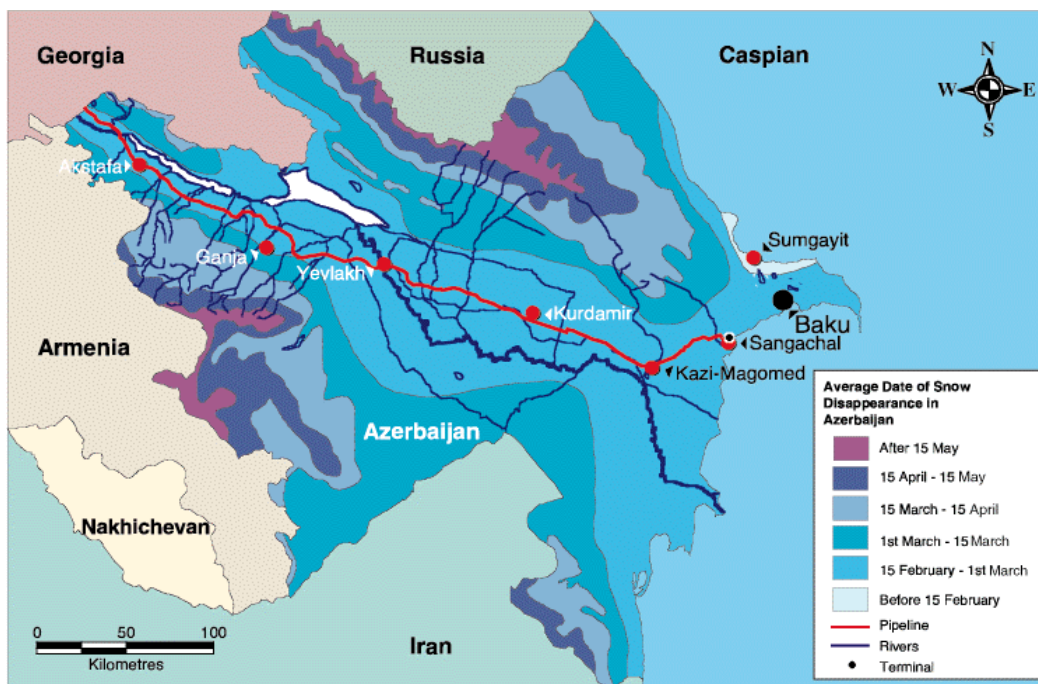


Figure 1-7 shows that snow has generally melted along the proposed pipeline corridor by the end of March. However, the isochrone map shows that snow usually persists in the mountain river source areas till the end of May/early June, and a risk of flooding downstream at proposed pipeline river crossings usually remains until late June. Most annual meltwater floods begin in March, peak in April or May, and are over by the end of June. Each specific basin has its own hydrometeorological controls and characteristics and it would be expected that snows on the south-facing slopes of the Greater Caucasus would melt slightly ahead of snowfields at the same altitude in the Lesser Caucasus, given the substantial aspect differences in net solar radiation receipts documented in the Caucasus by Borzenkova (1967, cited in Barry, 1992).

1.6 WIND SPEED AND DIRECTIONS

Mean annual wind speeds are very high near the eastern end of the proposed pipeline (6.7 m s^{-1} at Puta), decline toward the central part of the proposed corridor (2.3 m s^{-1} at Kurdamir), then rise again as the proposed pipeline begins to pass through the higher ground near the western end (3.3 m s^{-1} at Ganja). Guzdek is located in the windiest part of Azerbaijan (see Figure 1-8). The increase in wind velocities relate to the relief and protrusion of the Apsheron peninsula into the Caspian, and Guzdek's location at the southern end of a north to south aligned topographic channel which funnels near-ground air flows, especially northerly airstreams. Puta experiences 114 days each year on average when wind speeds exceed 15 m s^{-1} . This is more than seven times the number recorded at Kurdamir, and four times the frequency observed at Ganja. Stronger winds are especially common in August. Very high wind velocities (greater than 25 m s^{-1}) also occur regularly throughout the Apsheron region. With wind erosion of the local dry and fine surface materials likely dust-storm events should be expected in the Guzdek area.

Figure 1-8 Average number of days per annum when windspeeds exceed 15 m s^{-1} in Azerbaijan



At the eastern end of the line, northerly, north-westerly and north-easterly winds dominate the directional regime (55% of the time), especially the strong north wind known locally as the “Hazri”, which can, in winter, bring sudden reductions in temperature and occasionally snow. Southerly winds, called “Gilavar” may also be strong here. In central and western Azerbaijan, wind directions are dominated by easterly and westerly quadrants, reflecting the orientation of the enclosing Greater Caucasus and Lesser Caucasus mountain ranges. Westerly winds become increasingly common as one moves towards the Georgian border, especially in winter. Some katabatic winds from the mountains are also experienced (Eyubov, 1993b).

1.6.1 Dust storms

The eastern end of the proposed pipeline route is prone to much higher wind speeds than at the western end. This results in a high concentration of dust storms in this region. Typically, wind speeds of over 15 m s^{-1} are recorded for 100 days or more annually.

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1 HYDROLOGY AND WATER QUALITY

1.1 INTRODUCTION

The purpose of this report is to describe the baseline surface-water environments crossed or approached by the proposed pipeline route in Azerbaijan, and to identify key hydrological patterns, features, issues and areas. Water resources are especially valuable in this semi-arid part of Azerbaijan, and are intensively used for potable supplies, power generation, irrigation systems and livestock-watering. Water resources to be considered in the ESIA include major and minor river systems, reservoirs, wetlands and ecologically sensitive freshwater habitats.

The specific objectives of the report are to:

- Discuss the hydrological data-collection techniques employed in Azerbaijan and the quality and appropriateness of the information generated
- Identify the key hydrological and water resource features of the route
- Summarise the basic details and hydrological operation of the river systems in the vicinity of the pipeline corridor, including seasonality of processes
- Introduce information on river hydraulics and bank erosion problems
- Present information on water quality (both published and field data) for selected river systems
- Summarise details of known mudflows in this part of Azerbaijan

1.2 DATA SOURCES

This baseline report has been based on the following information sources:

- Literature Reviews by Azerbaijan scientists, including those of Professors Kashkay of the Institute of Geography at the Academy of Sciences in Baku and Professor Firdowsi Aliyev of the State Committee of Geology and Mineral Resources for the Azerbaijan Republic, produced in 1996, 1998 and 2000, and the State Committee of Geology (2001)
- Selected Azerbaijan Hydrometric Yearbooks
- Linewalk re-route information generated by AETC and ERM staff in 2000-2001
- Reconnaissance field data collected by D.M. Lawler on behalf of AIOC in November and December 1996
- Western Route Export Pipeline in Azerbaijan (WREPA) EIA, produced by AETC in April 1997
- Reports on Azerbaijan rivers, hazards, geomorphology and engineering and groundwater produced from 1998 - 2001, e.g. Fookes and Bettess (2000) and Banks (2001), made available by BP
- Published scientific papers on the hydrology of the Caucasus region (cited in References)

1.3 HYDROLOGICAL DATASETS AVAILABLE

A number of hydrological datasets exist in Azerbaijan, which are collected, maintained and processed by the State Committee for Hydrometeorology, the State Committee for Geology, and the Institutes of Geography and Geology at the Academy of Sciences in Baku. Hydrometric data have been collected for a number of the large river basins crossed by the pipeline route. Discharge

values have been mainly computed from current meter observations on cableway systems. The long term records/datasets are believed to give a reasonably robust indication of average values.

1.4 LIMITATIONS OF THE DATA

The following limitations of the hydrological and hydrogeological datasets should be noted, because they have significant implications for the confidence that can be placed in the data and hydrological baseline established:

- Limited current data. The hydrometric network in Azerbaijan was severely curtailed after 1991/92, so few datasets exist for the last ten years. As such, quantification of current conditions is highly challenging. Early hydrological data, though useful, will not reflect subsequent climate variations, basin landuse changes, channel cross-sectional geometry shifts, canalisation projects, local river channel interference (e.g. gravel mining), new surface-water and groundwater abstractions, water resource development schemes and, for coastal stations, fluctuations in the level of the Caspian Sea
- Limited information on techniques. Generally, little information is readily available on the hydrological and monitoring techniques adopted, including sampling conditions, constraints, timing and frequency, analytical methods, precision limits and data collection problems, so it is difficult to place confidence limits on the published datasets
- Lack of route specific data. Flow measurement sites (river gauging stations) tend to be located in, or near the foot of, the Caucasus Mountains, mainly because this is considered to be the limit of significant runoff generation in these rivers. Therefore they are sometimes considerable distances upstream (or occasionally downstream) of the route. Some caution is warranted, therefore, in extrapolating data from the point of flow measurement to the pipeline crossing itself. Some rivers, as in many semi-arid environments, actually *lose* discharge in a downstream direction, because transmission, irrigation and abstraction losses outweigh runoff generation in the lower reaches
- Few data on extremes. The available data tends to be in the form of averages (means) and, though useful, provides limited information with respect to hydrological extremes (e.g. flood and drought magnitude and intensity)
- Limited published, peer-reviewed analyses. Little hydrological or hydrogeological data or analyses has been published for Azerbaijan in the international scientific literature

1.5 KEY HYDROLOGICAL FEATURES ON THE ROUTE

1.5.1 Introduction

The key hydrological features which the route crosses or approaches include:

- the main stem of the Kura River system, which runs close by, and parallel to, the pipeline in the western half of the route, and is crossed twice by it;
- Large Kura tributary rivers draining the Great Caucasus and Lesser Caucasus mountains
- Mingechaur Reservoir and dam
- Shamkir Reservoir and reserve
- Karayazi Wetland near the Georgian border
- Jandari Lake which straddles the Azeri-Georgian border
- Canal and pipe networks supplying drinking or irrigation water to villages and fields
- The dry Gobustan area in the east, including the channel of the Djerankechmes River

Linewalk data and the crossings list provided by the pipeline design team indicates that the route crosses 20 significant water courses between the Sangachal Terminal on the Caspian and the Azerbaijan/Georgian border (Table 1). In addition to the significant river systems the route crosses, a number of minor streams, numerous wadis and a variety of man made watercourses (canals, drainage ditches and irrigation systems) which are in various states of repair.

Table 1 River systems crossed by the proposed pipeline route

River	Crossing Point (Approx KP)	Key Characteristics at Crossing Point
Djerankechmes	9.3	Wide river bed with narrow stream flowing at time of survey. Sensitivity relates to overall species diversity within river system rather than aquatic fauna; many burrows were observed in banks. Bank stability is an issue due to the erodable nature of the bank materials and the level of vegetation. River flows highly seasonal (flow increases considerably during spring). Typically exhibits high sediment load
Pisgarat	42.1	Narrow canalised river with slow flow. High sediment load. Dredged within last 12 months.
Agsu Canal	111.2	Wide canalised river. High sediment load. Low apparent ecological sensitivity but has the potential to transport contaminants to more sensitive areas.
Geokchay	171.3	Narrow canalised river in deep cutting. Vegetation indicates wide fluctuations in water level. High sediment load. Diverse bank flora and bird life.
Turianchay	193.5	Incomplete survey because dense scrub precluded adequate access. Possible habitat for water voles.
Kura (east crossing)	223.6	Wide fast flowing river with extensive fishing and wildlife value. Reedbed downstream from crossing point is particularly valuable for birds. Given the high flow rate, the river has the potential to transport contaminants downstream rapidly.
Karabach Canal	245.1	Canalised river with marginal vegetation. Abstraction point for irrigation immediately <u>upstream</u> of crossing point. Low apparent ecological sensitivity but has the potential to transport contaminants to more sensitive areas
Goranchay	257.8	Small and dry (at the time of the survey)
Kurekchay	276.5	Wide braided channel – only narrow channels flowing. Mud cliffs have abundant holes. River well used by villagers for washing etc. Also used widely for watering livestock.
Korchay	292	Braided river with narrow flowing channels within extensive areas of marshy reedbeds. Ecologically diverse (habitat for terrapins and a wide range of birdlife). Also used widely for watering livestock. In the event of a spill, contaminant migration might be partially impeded by the reeds but could have significant local effects. Believed to have greater flow in Spring.
Ganjachay	296	Channel of variable width but negligible flow. Many burrows in cliffs. Dammed c.300m downstream from pipeline crossing point. It is probable that contaminant migration would be limited by the presence of the dam in the event of a pollution incident upstream of it,
Sarysu	316.1	Small stream with good species diversity.
Gashgarachay	316.7	Fast flowing with good species diversity. Also used widely for watering livestock.

Table 1 River systems crossed by the proposed pipeline route

River	Crossing Point (Approx KP)	Key Characteristics at Crossing Point
Karasu	320.9	Narrow watercourse within a wide channel, mainly vegetated by reeds Valuable bird habitat. In the event of a spill, contaminant migration might be partially impeded by the reeds but could have significant local effects
Shamkirchay	332	Wide but dry channel. Very low ecological value or sensitivity. The dry river bed has been extensively exploited for gravel extraction .
Zayamchay	357	Very low ecological sensitivity and almost no flowing channel.
Tovuzchay	377.1	Wide cobble river bed with narrow flowing channel. Main channel eutrophic. Flow may increase in spring and therefore introduce the risk of any pollution incident impacting downstream receptors.
Hasansu	397.8	Fast flowing clear 'mountain' stream. Ecological diverse and valuable habitat. Smallholding immediately downstream with livestock drinking from the river. Locals informed us that they regularly catch large trout in the river – thought to spawn locally. A pollution incident at the crossing point could have serious adverse impacts and could be carried considerable distance downstream.
Kura (west crossing)	411	Fast flowing and wide. Extensive fishing. Diverse birdlife (including Kingfishers). Wetland & islands used by birds just downstream from proposed crossing. Pollution incidents at the crossing point could lead to rapid migration of contaminants downstream.
Kuradera	422.3	Narrow flowing channel c. 0.1m deep at the time of the survey with sand/silt substrate. Cobbles/sand throughout dry portions of river bed. Sand cliffs downstream provide potential nesting habitat. Fly tipping including chemical bottles on bank. Karyazi wetland downstream increases sensitivity.

1.5.2 The Kura River

The route is dominated by the large Kura River system. The route crosses the Kura River twice. The lower, easterly crossing (Kura East) is near Yevlakh to the south-east of Mingechaur Reservoir (URS/Dames & Moore, 2000). It should be noted here that there are important sturgeon breeding areas downstream (Alekperov, 1983; Efendiyeva, 2000; Luk'yanenko *et al.*, 1999). The westerly, crossing (Kura West) is at Polyu near the Georgian border, upstream of the important Shamkir and Mingechaur Reservoirs.

The Kura is the largest river system of the Caucasian region, originating in Turkey, then passing into Georgia before flowing into Azerbaijan near Polyu. Once in Azerbaijan, the Kura flows into Shamkir Reservoir and Mingechaur Reservoir, before crossing the Kura lowlands in the east and discharging into the Caspian. Its drainage basin area at Kurzan, near Polyu, is over 15000 km², and its mean annual discharge is 264 m³ s⁻¹ (Table 2). Like its tributaries, the Kura has a strongly seasonal regime, with the main flow period concentrated between March and June, with a peak around the end of April (see Figure 1). This relates to the seasonal melting of snowpacks high up in the mountain runoff source areas of the Kura drainage basin in Turkey, Georgia and Azerbaijan.

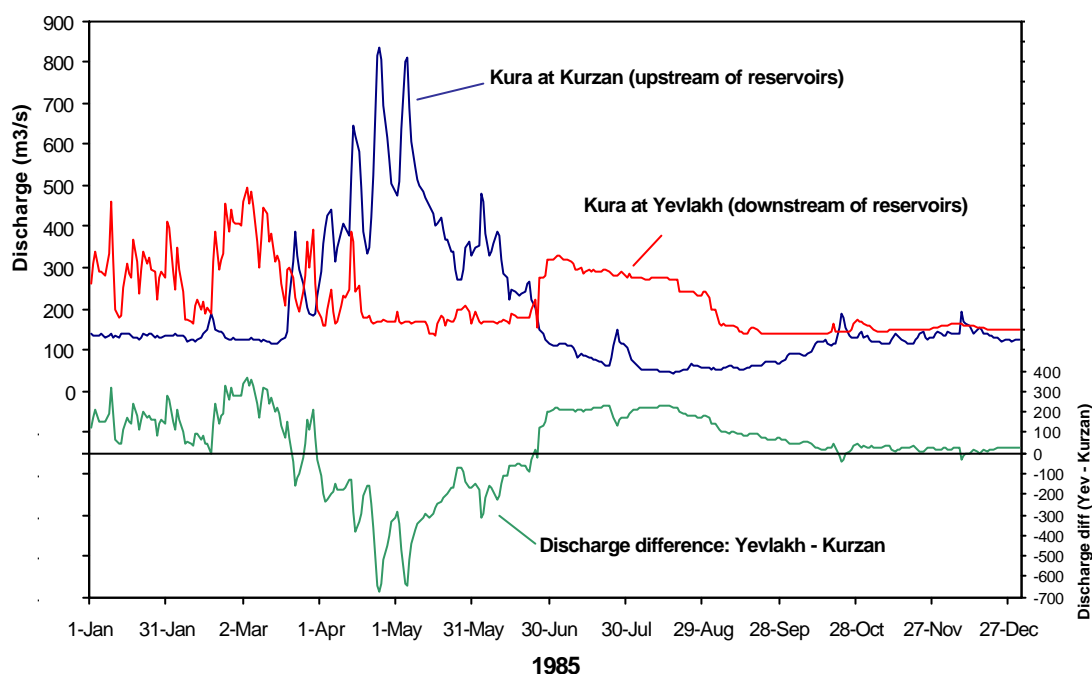
Table 1a Hydrological and Hydraulic Information for the Main Rivers Crossed by the Proposed Pipeline Route (Figures in Brackets are Estimates)

River	Station	Average slope (m/m)	Minimum slope (m/m)	River discharge (m ³ s ⁻¹)			Stream power(W/m)	Estimated mean velocity (m s ⁻¹)	Downstream Receptor	Receptor Distance from crossing (km)	Estimated average travel time (hours)	Estimated travel time in high flow** (hours)
				Mean annual	Maximum	Minimum						
Kura system in Azerbaijan												
Kura (u/s of Shamkir)	Kurzan	0.0034	0.000014	264	969	44.4	9.3	1.71	Shamkir Reservoir	7	1.1	1.0
Kura (d/s of Mingechaur)	Yevlakh	0.000831	N/A	313	1350	20	9.87	1.65	Sturgeon breeding grounds	200	33.7	27.8
Rivers of the Great Caucasus Southern Slopes												
Turianchay	Savalan	0.0205	0.00009	17.3	148	0.15	3497	0.28	Kura River	25	24.8	3.5
Geokchay	Geokchay	0.0175	0.00050	14.1	91	4.72	2433	0.55	Kura River	32.5	16.4	4.5
Girdemanchay	Garanour	0.0328	0.00200	7.7	(185)	1.36	2490	0.4	Karasu canal	1	0.7	0.1
Aksu	Aksu	0.0247	0.00170	1.96	(246)	(0.048)	477	0.4	Karasu canal	10	6.9	1.4
Pirsagat	Shosseyni y most	0.0682	0.01210	3.06	(287)	0.032	2058	0.29	Caspian Sea	32.5	31.1	4.5
Djeyrankechmes	Sangachal	0.0112	0.00371	0.16	(393)	0	18	N/A	Caspian Sea	16	N/A	2.2
Rivers of the Lesser Caucasus North-East slopes												
Akstafa	Krivoy Most	0.0210	0.00680	10.7	158	0.02	2216	N/A	N/A	N/A	N/A	N/A
Akhindjachay	Agdam	0.0236	0.01270	2.94	(47.6)	0.05	684	N/A	N/A	N/A	N/A	N/A
Tovuschay	Oysuzlu	0.0343	0.01410	0.91	31.4	0.01	308	0.3	Kura River	8.5	7.9	1.2
Dzegamchay	Yanihli	0.0210	0.01410	5.66	179	(0.090)	1172	1	Kura River	8	2.2	1.1
Shamkirchay	Barsum	0.0330	0.01400	8.56	(127)	0.95	2785	1.3	Kura River	10	2.1	1.4
Kushkarachay	Saritapa	0.0300	0.01390	1.35	(2.44)	0.49	399	0.63	Kura River	11	4.9	1.5
Ganjachay	Zurnabad	0.0277	0.01200	4.61	(95.5)	0.39	1259	0.8	Mingechaur	10	3.5	1.4
Kurakchay	Dozular	0.0245	0.00470	4.2	(168)	0.72	1015	0.66	Mingechaur	40	16.8	5.6
Goranchay	Agjakend	0.0380	0.00830	2.4	(45.2)	0.3	899	0.87	Mingechaur	27.5	8.8	3.8
** Assuming velocities in high-flow periods of 2 m s ⁻¹ (7.2 km hr ⁻¹)												

** Assuming velocities in high-flow periods of 2 m s⁻¹ (7.2 km hr⁻¹)

The impact of water storage in the Mingechaur and Shamkir Reservoirs on the Kura flow regime is substantial. Note from Figure 1 that, despite similar *average* annual flows upstream and downstream of the reservoirs, the natural highly-peaked annual hydrograph of the Kura at Kurzan, upstream of the reservoirs, is strongly reduced at the outflow at Yevlakh. This is common in reservoirized basins (e.g. Brandt, 2000). In contrast, low-flows in winter and summer are increased below the reservoirs (Figure 1). By smoothing out the strong seasonality in the Kura discharges, much more stable flows are achieved below the reservoir for irrigation purposes. Much river sediment is trapped in Mingechaur Reservoir also (Selivanov, 1996), and ERM (2000) have flagged up possible implications for dam failure due to loss of storage capacity and loading of the dam structure.

Figure 1 Impact of substantial flow regulation by the Mingechaur Reservoir on discharge peaks and seasonality of the Kura River: mean daily flow hydrographs for 1985 for Kurzan (upstream of Mingechaur and Shamkir reservoir) compared to Yevlakh (downstream of Mingechaur and Shamkir Reservoir)



1.5.3 Main Kura tributaries crossed by the route

Many of the Kura tributaries are high-energy mountain rivers, a number of which are laterally mobile within floodplain zones or incised into narrow gorges. The tributary rivers vary in mainstem length from the shortest, Tovuzchay (42km), to the longest, Turianchay (180km).

The rivers of the eastern half of the route flow south-west from the Great Caucasus. The Turianchay river is the most powerful. Most Great Caucasus rivers have floods generated both by snowmelt in spring/early summer and by rainstorms in the autumn. Rainstorm-generated floods can last up to 15 days.

In the west, the rivers generally flow in a north-easterly direction from the Lesser Caucasus mountains. Their regimes are dominated by the spring/early summer snowmelt flow period.

1.5.4 The Djeyrankechmes River

The Djeyrankechmes is a 20m wide wadi, which is often dry, incised into the Gobustan desert, flowing through the Gobustan Cultural Reserve for approximately 1km south of the pipeline crossing point. It is independent of the Kura River system and drains directly into the Caspian at Sangachal, approximately 9km downstream of the proposed pipeline crossing point. The river channel exhibits poor bank stability and is liable to flash flooding during periods of heavy rain. During periods of flow, it has a high sediment load.

1.5.5 Karayazi wetland

The route will pass close to the valuable Karayazi Wetland area between Polyu and the Georgian border. In this area at the western end of the corridor, there is an 80% probability of receiving between 50 and 100 mm precipitation during the summer months. It is this relative security of summer rainfall supplies which helps to ensure the viability of the wetland.

A site visit on 30 November 1996 confirmed that the groundwater table was at, or very near, the ground surface in the Karayazi Wetland, and standing water was visible. The wetland is, however, highly fragmented and heavily encroached upon by viticulture, drainage channels, pasture land and the main Baku-Tbilisi railway line.

Simple measurements of turbidity, pH and electrical conductivity on 30 November 1996 confirmed that Karayazi Wetland pool water was clear (turbidity 2.36 NTU), alkaline (pH 7.82) and not highly mineralised (electrical conductivity: 665 $\mu\text{S cm}^{-1}$). No contemporary hydrological or hydrogeological monitoring is thought to be going on in the area, but a 1:100,000 scale hydrogeological survey of the area was carried out in the late 1980s by the State Committee of Geology.

1.5.6 Canals

Numerous canals are crossed by the pipeline, particularly between Kurdamir and Yevlakh, where they are used extensively for irrigation purposes. Many of these are in disrepair. The main canal crossed by the pipeline is the Karabakh Canal (KP 245). The Karabakh Canal, which recharges from the Kura River at the Mingechevir Reservoir (Figure 2) carries significant amounts of water for many important uses including irrigation and industrial supply.

Figure 2 Karabakh canal



1.6 EAST-WEST HYDROLOGICAL DIFFERENCES ALONG THE ROUTE

Clear hydrological, fluvial and climatic differences can be identified along the pipeline route from east to west, from the Caspian Sea to the Georgian border, as follows:

- Average annual precipitation increases threefold from 150 to 500 mm per annum
- In the west, the climate becomes marginally cooler and less windy with lower potential evapotranspiration rates, as route altitudes rise to above 300 mamsl (metres above mean sea level)
- River flow seasonality becomes slightly more pronounced in the extreme west
- With one or two exceptions, there is a tendency for the seasonal flow peak to arrive earlier in the west (May rather than June)
- River suspended sediment concentration, turbidity, pH and TDS values tend to decrease towards the west

On the basis of these changes, four distinct regions along the route are identifiable:

- At its easterly end between Sangachal and Pirsagat, the route passes through very dry territory where average annual rainfall is less than 200 mm. The region is characterised by a number of semi-arid channel systems. These include two main rivers (the incised Djeirrankechmes and Pirsagat) and many ravines, gullies and wadis which carry flow for only a small part of the year but may experience flash floods. Transmission losses (through bed leakage and evaporation) are normally substantial in such rivers. The region is used as an over-wintering area for cattle, and small artificial reservoirs can also be found. These reservoirs and small, saline lakes contain water after rainstorms in autumn. Little intensive agriculture is practised. Water resources here are the scarcest in Azerbaijan, and the Djeirrankechmes basin delivers an average water yield of just $1.0\text{ls}^{-1}\text{km}^{-2}$, decreasing to zero near the coast
- Further inland, the line traverses the broad, flat, less arid Kura River lowland where the pipeline is largely isolated from the surrounding mountains (and their associated hazards) by a large alluvial plain. The route crosses four left-bank tributaries of the Kura River which are sourced in the Great Caucasus
- Further west still, after crossing the Kura near Yevlakh, the route passes through the Ganja-Kazakh Plain. It runs alongside the Shamkir reservoir, and crosses seven sizeable, high-energy, right-bank tributaries of the Kura River which originate from the north-east slopes of the Lesser Caucasus mountains
- Finally, the route re-crosses the Kura at Polyu and passes along the edge of the important Karayazi Wetland before crossing into Georgia

The Great Caucasus, left-bank, tributaries of the Kura tend to generate higher average, maximum and minimum river discharges at the gauging stations, despite lower precipitation totals on the pipeline route itself. The annual average and extreme flows for the easterly rivers Turianchay, Geokchay, Girdemanchay, Aksu and Pirsagat typically exceed the westerly, Lesser Caucasus, rivers (see Table 2). This is partly because the mountain source areas for the easterly rivers tend to receive slightly higher precipitation inputs. It should be noted that flow data are lacking for many pipeline crossing locations and it is likely that, on the route itself, the westerly, Lesser Caucasus, rivers are more powerful. This underscores the need to analyse river systems in their drainage basin contexts, as well as at site- or reach-specific locations near pipeline crossing points.

1.7 SURFACE-WATER RUNOFF SYSTEMS

1.7.1 Hydroclimatic conditions

The climate of central and western Azerbaijan varies from semi-desert at the eastern end of the pipeline corridor to more humid and continental conditions near the Georgian border (see Part 9 of the Baseline Reports). Average annual precipitation increases from approximately 150 mm near Guzdek in the east to around 500 mm in the Karayazi Wetland near the Georgian border. Mean annual potential evapotranspiration rates are very high all along the pipeline route: in the April - October period (the main evapotranspiration season), rates exceed 800 mm in eastern Azerbaijan and 600 mm in the west (Eyubov, 1993). These rates are far greater than rainfall inputs for the corresponding areas.

High evapotranspiration rates have several hydrological and geomorphological implications:

- Significant problems of soil salinisation in many places
- Creation of substantial water resource shortages and the need for irrigation systems to support intensive agriculture. Irrigation systems designed to replenish evaporated and transpired soil moisture to sustain agricultural activity are extensive in the central parts of the corridor (Wolfson and Daniell, 1995). Irrigation may be seasonal: for example, water is used to irrigate maize in August and September
- Generation of semi-arid hydrological systems and landscapes, with sparse vegetation cover and severe soil erosion and gulying problems related to intense rainstorms, fine erodible soils, little vegetative protection and flash flooding, especially in the eastern part of the route
- River runoff which decreases with distance from the mountain source areas. River discharges, after first increasing within the headwater zone, often then reduce downstream. This trend is exacerbated by increasing abstraction and irrigation in lowland agricultural areas and by transmission losses through permeable gravel river beds

Figure 3 Relief map of central Azerbaijan



River runoff is generated mainly by spring/early summer snowmelt in the Caucasus mountains and by rainstorms, especially in autumn. Many of the tributary rivers crossed by the route are sourced at high altitude (1900 - 3680 m) in either the Great Caucasus (Kura left-bank tributaries in the east) or the Lesser Caucasus (Kura right-bank tributaries in the west) (see Table 3 and Figure 3). Average annual precipitation totals rise to approximately 1000 mm per annum in the Great Caucasus and to around 800 mm per annum in the Lesser Caucasus. At high altitudes, much precipitation principally arrives in the form of snow.

Despite low annual precipitation receipts, intense rainstorms occur, on average, every two to four years. Because of relatively large, steeply-sloping and poorly vegetated basins in the region, these rainstorms can result in significant floods downstream. High flows tend to lead to bank erosion and increased sediment loads in the channel networks (which may be dry or at low flow for much of the year). This is especially true at the drier, eastern end of the line.

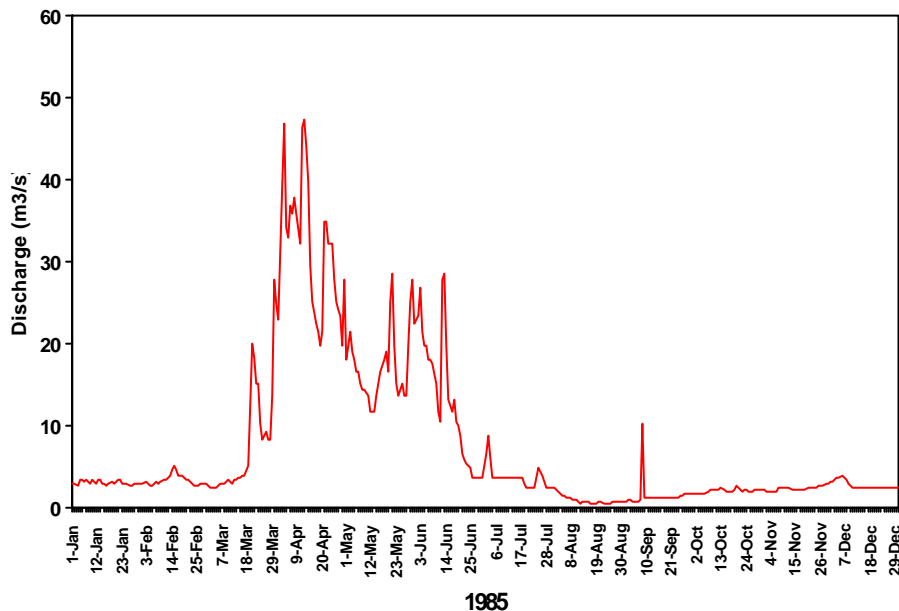
Table 2 Basic hydrological data for the main drainage basins crossed by the proposed pipeline route

River	Station	Length of record (years)	Station altitude (m)	Distance from confluence (km)	Length of river (km)	Source height (m)
Kura system in Azerbaijan						
Kura	Kurzan	20	149.3	739	1364	2,770
Kura	Yevlakh	42	5.23	566	1364	2,770
Rivers of the Great Caucasus Southern Slopes						
Turianchay	Savalan	53	118	106	180	3,680
Geokchay	Geokchay	47	89	37	115	1,980
Girdemanchay	Garanour	29	751.5	50	88	2,900
Aksu	Aksu	26	N/A	48	85	2,100
Pirsagat	Shosseyni y most	14	N/A	144	119	2,400
Djeýrankechmes	Sangachal	N/A	-28	1	88	N/A
Rivers of the Lesser Caucasus North-East slopes						
Akstafa	Krivoy Most	28	527.12	42	133	3,000
Akhindjachay	Agdam	33	529.6	30	76	1,950
Tovuschay	Oysuzlu	9	554.47	7	42	1,900
Dzegamchay	Yanihli	N/A	641.52	37	90	2,020
Shamkirchay	Barsum	53	688.73	42	95	3,220
Kushkarachay	Saritapa	25	N/A	32	76	2,360
Ganjachay	Zurnabad	60	872.48	58	99	2,814
Kurakchay	Dozular	49	617.64	87	126	3,100
Goranchay	Agjakend	51	1210.5	60	81	3,100

1.7.2 Snowmelt influence on river flows

Little snow falls on the pipeline route itself. There is an average of only 6 days of snow per annum at Baku and Kurdamir, for example, increasing to 15 - 18 near the Georgian border. However, heavy snowpacks do accumulate in the Great and Lesser Caucasus in winter which affect the rivers sourced in those zones and which are crossed by the pipeline. Ablation of the snowfields occurs in the spring as radiation receipts and air temperatures rise, and this is assisted by rainstorms. The considerable quantities of liberated meltwater can then generate significant flooding downstream. The clear dominance of the spring/early summer melt-season high-flow period can be seen for the Akstafachay River (which flows into the Kura River close to the Kura West crossing, but is not crossed by the pipeline route) in Figure 4. The striking relation between spring river flow peaks and the seasonal rise in air temperatures through the 0°C ablation threshold and sporadic rainfall inputs can be seen for the Ganjachay in Figure 5.

Figure 4 Annual river flow hydrograph for Akstafachay, 1985



Although any snow disappears from the pipeline corridor at the end of March, snowpacks persist in the mountain river source areas until the end of May/early June (see Figure 6). A risk of flooding at pipeline river crossings can remain until late June. The annual meltwater flow increase lasts 2-3 months, generally beginning in March, peaking in April or May, and finishing by the end of June. However, each specific basin has its own key hydrometeorological controls and characteristics, including slope aspect. Snow on the south-facing slopes of the Great Caucasus should melt slightly ahead of snowfields at the same altitude in the north-east facing slopes of the Lesser Caucasus, given the substantial differences slope aspects these cause in net radiation receipts in the region (Borzenkova, 1967; cited in Barry, 1992).

Figure 5 Annual hydrograph for the Ganjachay River. Note the relationship between the seasonal rise in air temperatures through the 0 °C threshold, rainfall inputs and the strongly seasonal generation of river flows

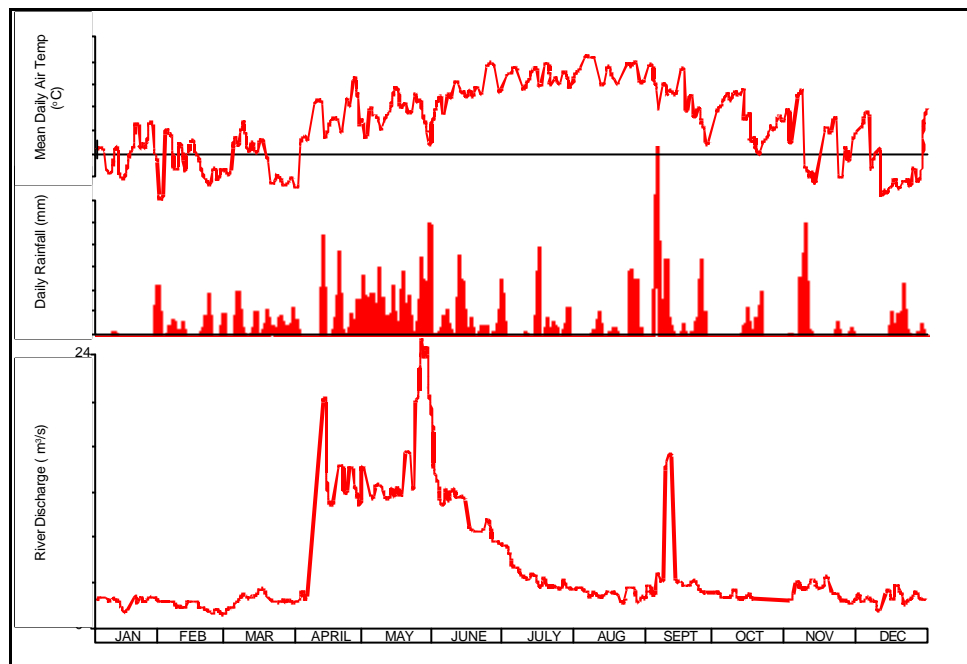
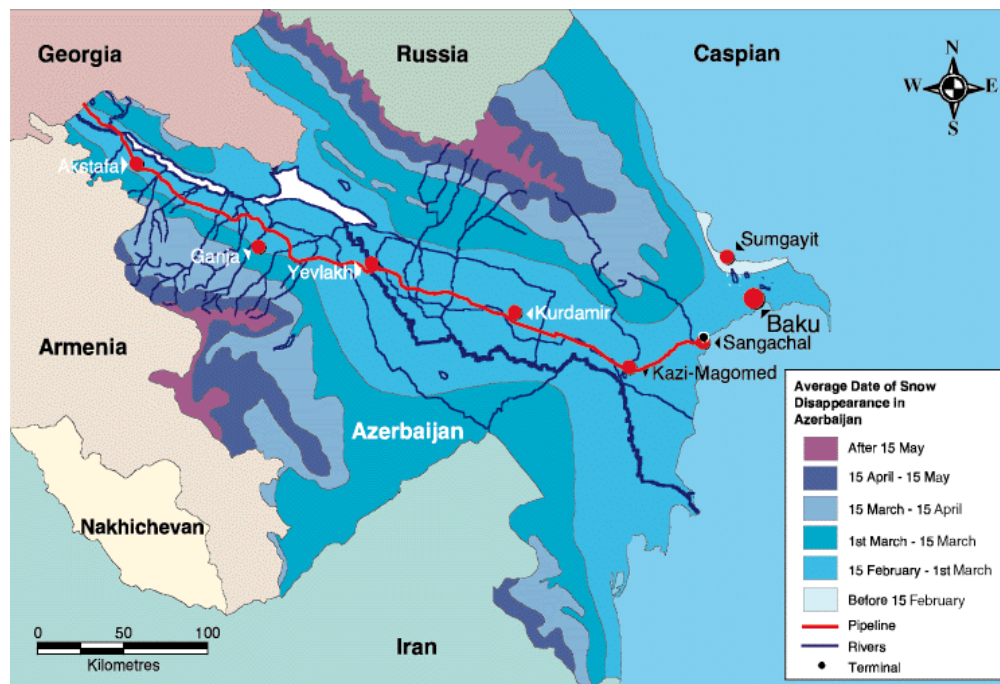


Figure 6 Map showing the average dates of snow disappearance across Azerbaijan (Eyubov, 1993)

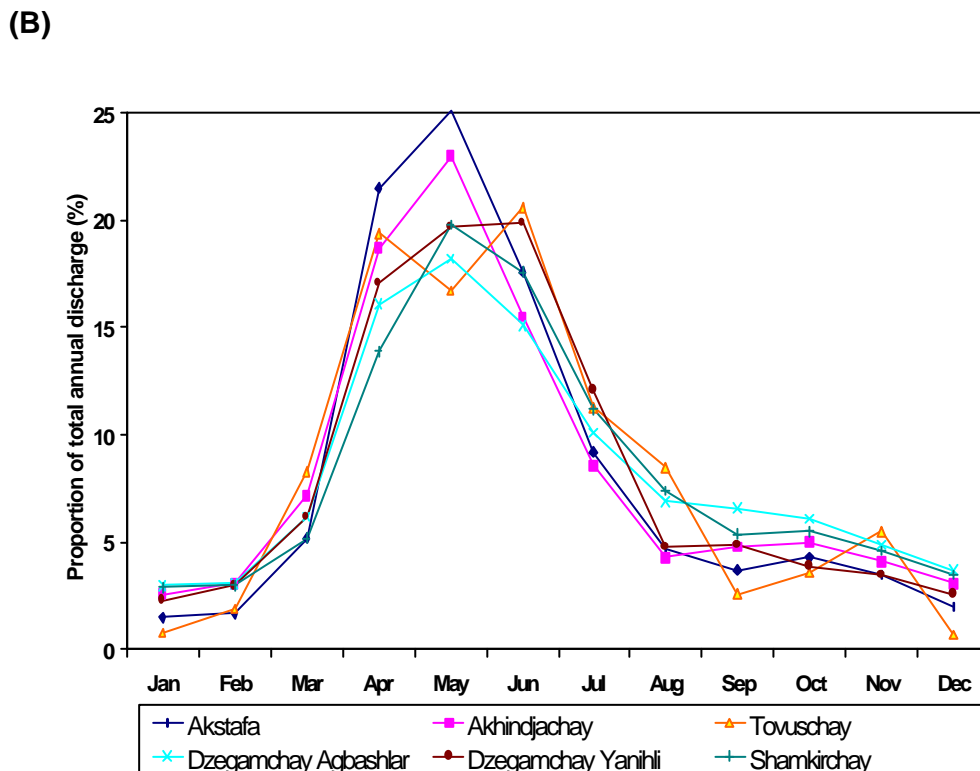
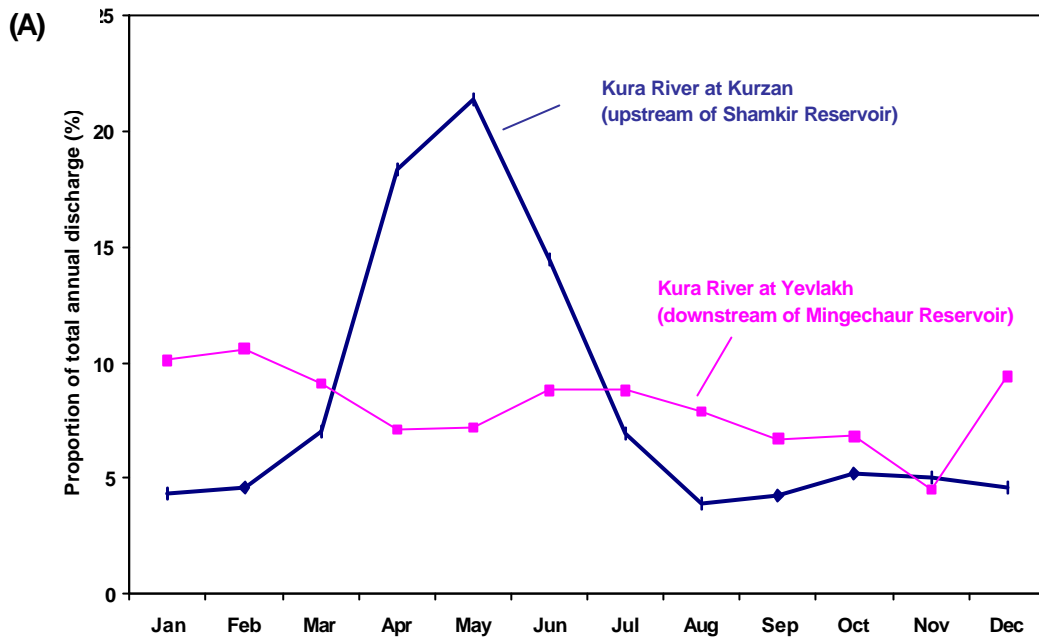


1.7.3 River flow seasonality

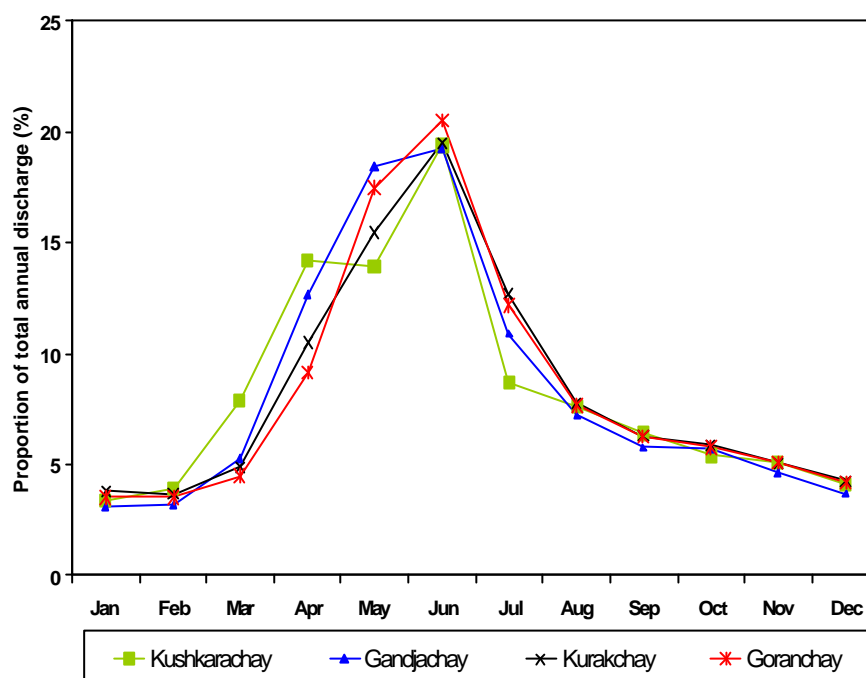
All rivers crossed by the route have highly seasonal regimes. Peak flows typically occur between April and June on average, with the low-flow period from September to February (see Figure 7). Around March and April, significant mountain snowmelt and rainfall begins to increase

discharges for most rivers, and peak flows are reached in May or June (see Figure 7). Around 15-25% of total annual flow takes place in May alone (see Table 4). For half of the rivers, more than 50% of total annual discharge occurs in a three-month period, April - June (see Table 4).

Apart from the Aksu and Girdemanchay rivers in the east (which peak in April), there is a tendency for the month of peak flow to shift from May to June as one moves east (see Figure 7). This is probably because most easterly rivers are sourced at higher altitudes in the Great Caucasus mountains, at around 3000 m (the Djeyrankechmes, at 800 m, is an exception). Snowmelt onset is delayed until May or June in these high altitude basins, in contrast to April/May for the Lesser Caucasus catchments in the west. The easterly rivers also tend to have a subsidiary flow peak in the September - October period, driven by autumn rainfall receipts.



(C)



(D)

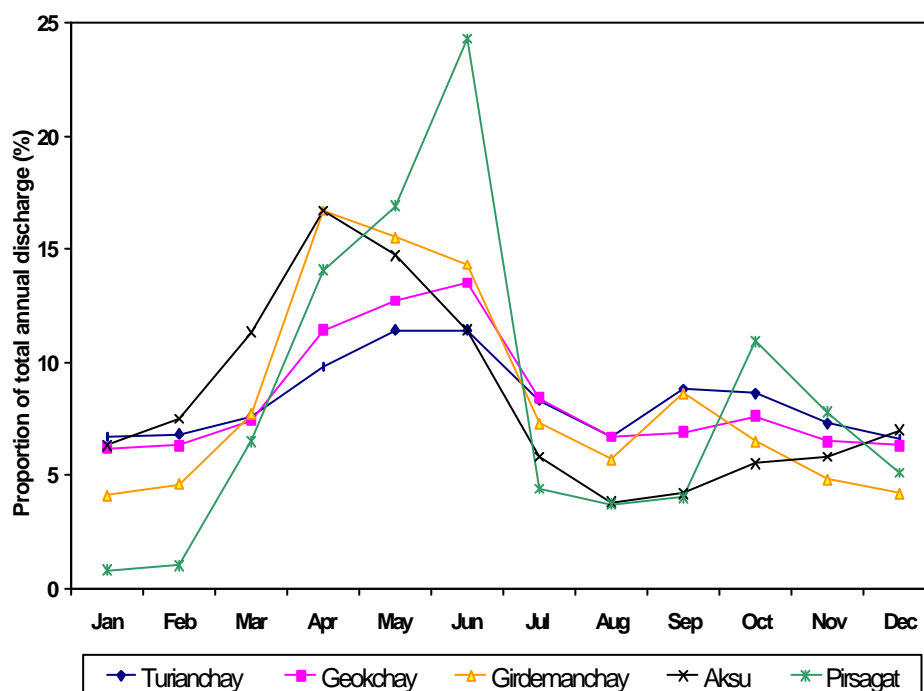


Figure 7 Seasonal distribution of flows for the main rivers crossed by the route: (A) Kura River at Kurzan and Yevlakh; (B) westerly Rivers of the Lesser Caucasus; (C) west-central Rivers of the Lesser Caucasus; (D) Rivers of the Great Caucasus.

Table 2 Average monthly distribution of river discharges (%), showing high flow seasonality

River	Station	Months												TOTAL	Proportion of flow in April – June (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Kura system in Azerbaijan															
Kura	Kurzan	4.3	4.6	7.0	18.4	21.4	14.5	6.9	3.9	4.2	5.2	5.0	4.6	100.0	54.3
Kura	Yevlakh	10.1	10.6	9.1	7.1	7.2	8.8	8.8	7.9	6.7	6.8	4.5	9.4	97.0	23.1
Rivers of the Great Caucasus Southern Slopes															
Turianchay	Savalan	6.7	6.8	7.6	9.8	11.4	11.4	8.3	6.7	8.8	8.6	7.3	6.6	100.0	32.6
Geokchay	Geokchay	6.2	6.3	7.4	11.4	12.7	13.5	8.4	6.7	6.9	7.6	6.5	6.3	99.9	37.6
Girdemanchay	Garanour	4.1	4.6	7.7	16.7	15.5	14.3	7.3	5.7	8.6	6.5	4.8	4.2	100.0	46.5
Aksu	Aksu	6.3	7.5	11.3	16.7	14.7	11.4	5.8	3.8	4.2	5.5	5.8	7.0	100.0	42.8
Pirsagat	Shosseyni y most	0.8	1.0	6.5	14.1	16.9	24.3	4.4	3.7	4.0	10.9	7.8	5.1	99.5	55.3
Rivers of the Lesser Caucasus North-East slopes															
Westerly rivers															
Akstafa	Krivoy Most	1.5	1.7	5.2	21.5	25.1	17.6	9.2	4.7	3.7	4.3	3.5	2.0	100.0	64.2
Akhindjachay	Agdam	2.6	3.1	7.2	18.7	23.0	15.5	8.6	4.3	4.8	5.0	4.1	3.1	100.0	57.2
Tovuschay	Oysuzlu	0.8	1.9	8.3	19.4	16.7	20.6	11.3	8.5	2.6	3.6	5.5	0.7	99.9	56.7
Dzegamchay	Agbashlar	3.0	3.1	6.2	16.1	18.2	15.1	10.1	6.9	6.6	6.1	4.9	3.7	100.0	49.4
Dzegamchay	Yanihli	2.3	3.0	6.2	17.1	19.7	19.9	12.1	4.8	4.9	3.9	3.5	2.6	100.0	56.7
Shamkirchay	Barsum	2.9	3.0	5.2	13.9	19.8	17.6	11.2	7.4	5.4	5.5	4.6	3.5	100.0	51.3
West-central rivers															
Kushkarachay	Saritapa	3.4	3.9	7.9	14.2	13.9	19.4	8.7	7.6	6.4	5.4	5.1	4.1	100.0	47.5
Gandjachay	Zurnabad	3.1	3.2	5.3	12.7	18.4	19.3	10.9	7.2	5.8	5.7	4.7	3.7	100.0	50.4
Kurakchay	Dozular	3.8	3.7	4.9	10.5	15.5	19.5	12.7	7.8	6.3	5.9	5.1	4.3	100.0	45.5
Goranchay	Agjakend	3.5	3.5	4.5	9.2	17.5	20.5	12.2	7.7	6.3	5.8	5.1	4.2	100.0	47.2

Table 3 Mean monthly suspended sediment concentration (SSC, mg l⁻¹), load (SSL, kg s⁻¹) and discharge (Q, m³s⁻¹) for selected rivers crossed by the route

River and Gauging Station	Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average annual
<i>Turianchay at Savalan</i>	SSL	0.1	0.5	3.5	85.5	147	133	61	17	79.5	79	6.8	2.5	51.3
	Q	12.3	12.6	13.9	18.5	23.8	22.6	13.4	12.5	18	19.9	15.2	13.4	16.4
	SSC	8	40	152	4629	6177	5850	3729	1365	4419	4404	447	186	3128
<i>Geokchay at Geokchay</i>	SSL	0.55	5.97	8	92.2	184	179	46.1	33.2	35.6	78.7	13.6	4.4	56.8
	Q	7.97	8.2	11	17	21.1	17.3	9.85	6.95	8.28	14.4	10.9	8.68	11.8
	SSC	70	729	726	5250	8730	10330	4670	4780	4300	5460	1246	507	4810
<i>Girdemanchay at Kululu</i>	SSL	0.12	0.55	1.76	11.7	70.4	37.3	0.78	1.82	0.6	1.76	0.042	0.068	10.6
	Q	0.84	0.9	1.31	3.75	8.03	4.99	1.08	0.6	0.3	1.69	0.32	0.48	2.03
	SSC	143	612	1312	3119	8760	7560	722	3036	2000	1041	131	142	5220
<i>Aksu at Aksu</i>	SSL	1.1	1.8	10	7.8	8.8	6.9	3.55	1.25	2.2	2.4	2.8	1.5	4.17
	Q	1.33	1.53	2.53	3.48	3.78	1.92	1.37	0.91	1.14	1.74	1.84	1.42	1.92
	SSC	827	11.76	3952	2241	2329	3594	2591	1365	1930	1380	1521	1056	2172
<i>Pirsagat</i>	SSL	0.1	0.9	2.46	2.18	5.51	0.66	0.6	0.004	0.6	0.2	0.057	0.03	1.11
	Q	0.62	1.42	2.99	2.8	2.62	1.66	0.85	0.18	0.53	1.45	1.35	0.57	1.42
	SSC	161	633	823	779	2100	397	705	22	1030	138	42	53	768
<i>Akstafachay at Krivoy Most (Crooked Bridge)</i>	SSL	0.05	0.1	0.85	13.8	18.8	7.8	2.1	0.8	0.35	0.55	0.38	0.12	3.82
	Q	2.12	2.51	6.03	23	26.2	17.3	9.28	5.92	4.13	5.03	4.26	2.7	9.04
	SSC	24	40	141	602	718	450	232	135	85	109	89	44	423
<i>Akhindjachay at Agdam</i>	SSL	0.005	0.012	0.24	0.46	0.65	1.95	0.14	0.008	0.004	0.012	0.002	0.002	0.3
	Q	1.29	1.95	4.22	7.92	10	8.92	2.86	0.62	0.7	0.93	0.7	0.28	3.36
	SSC	3.9	6.2	57	58	65	219	49	13	5.7	13	2.9	7.2	89
<i>Tovuschay at Oysuzlu</i>	SSL	0.002	0.017	0.027	0.02	0.038	0.095	0.09	0	0.001	0.003	0	0	0.024
	Q	0.21	0.7	0.84	1.45	1.54	1.2	0.64	0.091	0.89	0.19	0.16	0.084	0.6
	SSC	9.9	24	32	14	25	79	141	0	11	16	0	0	40
<i>Dzegamchay at Yanihli</i>	SSL	0.019	0.016	0.14	0.65	1.64	2.36	1.24	0.38	0.072	0.025	0.025	0.041	0.58
	Q	1.33	1.43	3.51	9.43	8.57	8.01	6.87	3.71	2.26	2.15	2.15	1.49	4.33
	SSC	14	11	40	69	191	295	180	102	32	12	12	27	134

Table 3 Mean monthly suspended sediment concentration (SSC, mg l⁻¹), load (SSL, kg s⁻¹) and discharge (Q, m³s⁻¹) for selected rivers crossed by the route

River and Gauging Station	Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average annual
<i>Shamkirchay at Barsum</i>	SSL	0.15	0.15	0.52	7.55	19	16.5	8.35	4.55	0.37	0.4	0.2	0.1	4.84
	Q	3.02	3.12	5.51	14.5	20.4	18.4	11.6	7.41	5.6	5.82	4.92	3.68	8.66
	SSC	50	48	58	521	932	897	720	614	66	69	41	27	560
<i>Koshkarchay at Dashkesan</i>	SSL	0.002	0.004	0.046	0.19	0.16	0.14	0.11	0.031	0.009	0.006	0.003	0.001	0.058
	Q	0.34	0.36	0.81	1.78	1.17	2	1.11	0.36	0.28	0.46	0.5	0.31	0.78
	SSC	5.9	11	57	107	137	70	99	86	32	13	6	3.2	75
<i>Ganjachay at Zurnabad</i>	SSL	0.01	0.01	0.05	0.6	1.55	1.19	0.48	0.34	0.23	0.33	0.05	0.02	0.4
	Q	1.49	1.6	2.4	6.49	9.39	9.82	5.77	3.58	2.84	3.53	2.34	1.78	4.25
	SSC	7	6	21	93	165	121	83	95	81	94	21	11	94
<i>Kurakchay at Dozular</i>	SSL	0.05	0.05	0.06	1.12	2.6	4.25	3.35	0.55	0.25	0.17	0.1	0.06	1.22
	Q	1.69	1.62	2.02	4.91	7.12	9.17	6.36	3.74	2.96	2.72	2.29	1.96	3.88
	SSC													
<i>Goranchay at Agdjakend</i>	SSL	0.01	0.02	0.01	0.08	0.23	0.3	0.16	0.06	0.04	0.04	0.03	0.02	0.08
	Q	0.86	1.12	0.98	2.15	4.2	5.01	3.34	1.96	1.57	1.49	1.28	1.04	2.08
	SSC	12	18	10	37	55	60	48	31	26	27	24	19	39

1.7.4 Hydrological extremes

Hydrological extremes (flood/drought intensity/frequency/duration) are probably more important than flow averages when assessing pipeline security and environmental impacts. Therefore, Values for flow minima and maxima are shown in Table 2. Substantial flows have been recorded at some time for most rivers. Once again, the data suggest that the easterly, Great Caucasus, rivers have produced the region's highest discharges. The extreme flow events of $246\text{m}^3\text{s}^{-1}$, $287\text{m}^3\text{s}^{-1}$ and $393\text{m}^3\text{s}^{-1}$ estimated respectively for Aksu, Pirsagat and Djeyrankechmes (Table 2) probably represent flash floods produced as a result of infrequent but intense rainstorms within the catchment area.

For flow minima there is no clear east-west spatial patterning, although the two rivers sourced at high altitude in the Great Caucasus (Geokchay and Girdemanchay) have reliable flows which have never dropped below $4.7\text{m}^3\text{s}^{-1}$ or $1.3\text{m}^3\text{s}^{-1}$ respectively (Table 2). Discharges of the Pirsagat and Djeyrankechmes rivers, in the dry easterly zone, can decrease to zero in summer.

1.8 RIVER HYDRAULICS

1.8.1 Introduction

Information on river hydraulic conditions, such as velocity, stream power, shear stress and energy slope information, is important in pipeline EIAs and subsequent pipeline construction, hydrotesting and operation. This is especially true in the following impact areas:

- River channel instability issues at river crossings, including bank erosion, bed scour, bedload transport and suspended sediment fluxes, which might threaten the integrity of pipeline or supporting structures, and influence location, design and management of river crossings (see Part 7 of the Baseline Reports)
- Direct fluid abrasion or corrosion effects on exposed pipelines, sleeving materials or supporting structures at river crossing sites
- Estimates of time-of-travel and dispersal patterns for contaminants introduced into rivers. Typical pollutants include fuel, lubrication oil or wastewater leakages from pipeline construction plant or pumping station operations, as well as crude oil spillages arising loss of integrity of pipelines
- Freshwater ecohydrology, especially hydraulic conditions vital to habitats and populations of invertebrates, fish and aquatic flora, via their influence on organism stress levels, dissolved oxygen concentrations, sediment-flushing processes, suspended sediment concentrations and light penetration in the water column
- Formulation of Emergency Response Plans and Oil Spill Response Plans, including boom design

1.8.2 Hydraulic data and pilot desk studies

For any rigorous channel stability analysis for the purposes of estimating setback distances or burial depths at pipeline crossings, strong, quantitative, datasets on river hydraulics, fluvial processes, sediment transport conditions and boundary material characteristics, collected at key sites during high-flow conditions, would be required.

Few meaningful hydraulic data of a suitable type, however, collected during key periods at appropriate river locations, are readily available in Azerbaijan. However, basic flow information is available for the gauging stations on the main rivers crossed by the route (see Table 2). Note

that these stations may be some distance upstream (and occasionally downstream) of pipeline crossings and they may not fully reflect conditions at the crossing points.

River gradients on the mountain rivers are steep, ranging up to 0.034 (Table 2). Table 2 shows that channel slopes in the vicinity of the pipeline are generally higher for the Lesser Caucasus rivers in the west. This means that, despite rough gravel beds and relatively shallow depths, flow velocities are generally likely to be substantial at higher flows. The achievable velocities are probably sufficient to mobilise the gravel bed material and to create potential channel instability. Gross stream power values have also been calculated in Table 2 according to the formula:

$$\Omega = \rho g Q S \quad (1)$$

where Ω is gross stream power per unit length of channel (Wm^{-1}), ρ is water density (1000kgm^{-3}), g is gravitational acceleration (9.81ms^{-2}), Q is discharge (m^3s^{-1}) and S is channel slope (mm^{-1}), normally the water-surface slope, but technically the energy slope. Stream power is an energy measure increasingly used as a more sensitive estimate of a river's ability to perform erosive work, and is often used to help estimate channel instability and sediment transport. Average stream powers here are high by global standards, reflecting the high discharges and slopes of their montane character.

1.8.3 Time-of-travel for contaminant releases in rivers

Accidental release of contaminants into a river or other water resource is a possibility during construction or operation of an oil pipeline. In the case of the proposed route, the potential release scenarios include:

- Spillages of construction or operation plant fuel, diesel, lubrication oil
- Discharge of oily effluent from cooling water blow-down, engine/parts wash-down
- Discharge of wastewater and rainwater from containment areas and AGIs
- Oil spillages during a pipeline breach

An important question, therefore, is how long after introduction into a river would a contaminant take to propagate downstream to other systems or sensitive sites such as public water supplies, reservoirs, ecologically valuable wetlands, coastal habitats or aquifers. Such information is useful as an input to an Environmental Management Plan or Oil Spill Response Plan. For the proposed pipeline route, the key potential downstream receptors for contaminants include the watercourses themselves, the Shamkir Reservoir, the Mingechaur Reservoir, the Karayazi Wetland, various aquifers, water abstraction points, agricultural lands and settlements.

The velocity data of Table 2 can be used to simply estimate approximate travel times for introduced crude, lubrication oil or fuel slugs (although they do not account for behavioural/density differences between fuel/oil and water, or seasonal changes in flow). It is clear that, especially under high-flow conditions in late spring/early summer (April-June), oil introduced at the upper Kura near Kurzan is likely to reach Shamkir Reservoir (7 km downstream) in around 1 hour (see Table 2). Similarly, any spillage directly into one of the right-bank, Lesser Caucasus tributaries would tend to reach the main Kura River in less than 6 hours. A spill into Ganjachay, 10 km from Mingechaur Reservoir, could reach the reservoir in less than 4 hours.

Clearly, plume migration times will vary with river flow conditions. In the early-summer flow peak, river discharges and velocities will be higher and plume migration speeds increased. Under low-flow conditions (September - February), however, velocities will be much lower and travel times much longer, but less dilution of the injected pollutant will take place and contaminant

concentrations may therefore be higher. This means that ecologically undesirable effects may also be highly significant at low flow conditions, though they are more likely to be more localised at these times.

The simple scenarios provided above may be useful when designing crossings, timetabling refurbishment tasks to avoid high-flow periods when velocities and dispersion potentials are maximised, planning protection measures, and establishing environmental management plans and emergency response plans.

1.9 RIVER CHANNEL INSTABILITY

1.9.1 Introduction

Many of the fluvial systems examined near or on the route are active, dynamic and meandering or braided, especially in the west where the pipeline approaches the foothills of the Lesser Caucasus (see Part 7 of the Baseline Reports). Such braided systems are normally characterised by large channel width-depth ratios, high energy flows, high bedload transport rates, a quickly-responding discharge regime (i.e. one prone to flash floods) and active lateral channel instability. Braided systems tend to occur on steeply-sloping valley floors, where large quantities of coarse sediment are frequently mobilised to build the braid bars, and copious but variable flows are available to reorganise the bed materials frequently and erode the banks relatively effectively. The steep slopes and seasonally concentrated meltwater regimes of the Azerbaijan rivers generate exactly these high-energy conditions. Necessary sediment supplies appear to be generated by mountain landslides, gullyng, bank erosion, deformation of upstream channels, and occasional mudflows and sheetwash events.

On field examination, river bed gravels appear fresh, with limited algal growth, and are likely to be mobile during parts of the high-flow season, March - June. Bank materials are relatively fine-grained in the lowland river reaches, but are coarser in the mountain rivers, especially in the west. Anthropogenic disturbance of bed fabrics through gravel extraction is important in some rivers (eg Shamkirchay), and may have the potential to impact pipelines in the area.

The timing at which highly seasonal river systems are inspected in the field is crucial. It is easy to form the impression of limited activity if these rivers are visited in the autumn and winter low-flow season, when only one or two small divided channels, if any, are occupied by water. The linewalk visits between September and October 1996, and the December 1996 and August 2000 water quality monitoring site visits, for example, found many watercourses to be dry or at low-flow. To appreciate fully the power of the rivers crossed by the route, it is necessary to visit during the March - June period when river flows are rising or peaking.

1.9.2 Indicators of channel dynamism along the route

Dynamic channels result from the interaction of high river energy levels with erodible boundary materials. Strong indicators of channel dynamism are apparent in the major Kura tributaries crossed by the pipeline, especially in the west. These indicators include:

- Velocities and stream power levels high enough to set typical bed materials in motion (see Table 2), especially during the early summer melt season
- The evidence of sparse vegetation on the braid bars, and an absence of algae on the gravel bed material (normally indicating recent particle transport);
- Extensive and severe bank erosion at many of the sites visited, including around existing pipelines and structures;

- Data over recent decades showing high suspended sediment concentrations and loads (see Table 5).

1.9.3 Bank and bed erosion

Bank erosion problems should always be viewed in a drainage basin context, because:

river flows responsible for erosion are generated by ablation of snowpacks or precipitation falls in upstream headwater zones;

- (a) coarse sediments derived from *upstream* alter *local* cross-section geometry, thereby changing velocity, shear stress fields, bed scour and bank erosion rates near pipelines; and
- (b) instability zones can migrate downstream over pipeline engineering design timescales.

Linewalks have revealed widespread lateral channel activity along the proposed pipeline route, indicating regional-scale instability. Bank erosion scars are quite numerous, and affect many crossings. The Azerbaijan authorities have already implemented bank protection schemes in some areas. These protection schemes indicate awareness by the authorities of previous problems. Some rivers (eg Aksu and Girdemanchay in the east) have been canalised for long stretches to stabilise flows and reduce erosion problems.

Little evidence of severe and widespread bed scour was found during the linewalk, but this is to be expected in braided rivers which are classically dominated by lateral, not vertical, activity.

1.10 RIVER WATER QUALITY

1.10.1 Introduction

Data on water quality of the rivers and other hydrological features crossed or approached is important in a pipeline EIA for the following reasons:

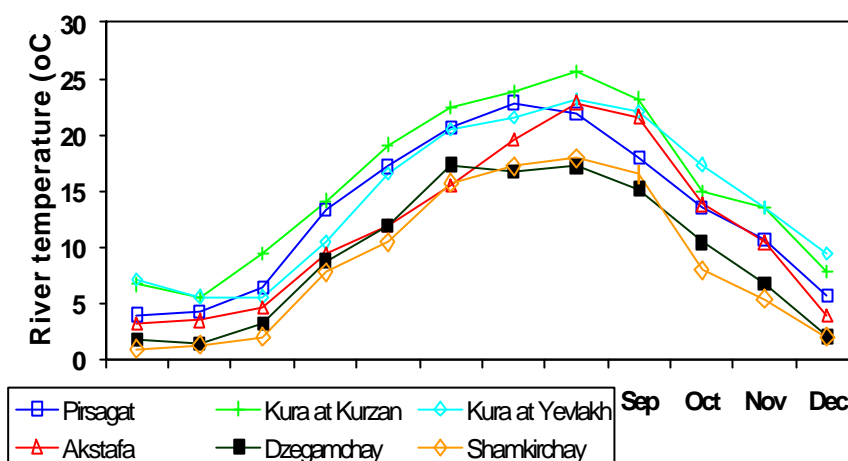
- High suspended sediment concentrations or bedload discharges can lead to problems of in-channel abrasion of pipelines, sleeves or other structures if positioned directly in the river
- High levels of suspended sediment transport can be indicative of more general problems of upstream soil erosion, land degradation, channel or hillslope instability. Such problems have the potential to propagate downstream and impact on pipeline stability;
- River water is often used for pipeline hydrotesting purposes, and there may be quality requirements involved;
- Water quality data provide baseline information when considering the disposal and behaviour of effluents arising during construction, hydrostatic testing or subsequent operation of the pipeline or AGIs. This includes complex binding of contaminants to suspended sediment (e.g. Horowitz, 1991) and changing behaviour of fuel or other pollutants in waters of different temperature, suspended sediment concentration, viscosity, chemistry or pH;
- Water quality influences habitat quality, especially freshwater species diversity and abundance and Azerbaijan water bodies have important freshwater biota.

1.10.2 Water temperatures

River temperatures vary seasonally from around 27°C in winter to 17-25°C in the summer months (see Figure 8). Warmest river temperatures are in August, except for Pirsagat which

peaks in July (see Figure 8). Lowest river water temperatures are attained between December and March, with minima in January or February (see Figure 8). The published mean early-winter values are consistent with direct field measurements of the temperature of selected river systems made in November and December 1996. River temperatures have strong freshwater ecological implications, and also affect behaviour of contaminant plumes.

Figure 8 Monthly river temperatures for selected rivers crossed by the route, 1985



1.10.3 Suspended sediment transport

1.10.3.1 Suspended sediment concentrations

Simple mean monthly water quality data for recent decades on suspended sediment concentration and total dissolved solids concentration (Kashkay 1996; 2000) for the rivers crossed by the proposed pipeline route are summarised in (Table 5). The longer-term mean datasets can underestimate total and mean loads, depending on the nature of sampling and calculation, but they can usefully augment data from hydrograph dynamics in such temporally variable systems. Average suspended sediment concentrations will vary considerably with river and season, and they will also fluctuate at the event timescale, but no data are available with respect to such conditions. It should, however, be noted that flood-peak suspended sediment concentrations can typically be many orders of magnitude higher than mean values.

Average concentrations and loads are high by world standards, and approximate those of other glacial/snowmelt rivers. Annual mean suspended sediment concentrations for the Great Caucasus rivers exceed by an order of magnitude those for the Lesser Caucasus systems. The rivers Girdemanchay (5,220 mg l⁻¹) and Geokchay (4,810 mg l⁻¹), both of which drain from the Great Caucasus, have the highest annual mean values (see Table 5). Girdemanchay (8,760 mg l⁻¹; May) and Geokchay (10,330 mg l⁻¹; June) also achieve the maximum monthly values of all rivers reported. Suspended sediment transport is highly seasonal, and for most rivers highest suspended sediment concentrations occur around the month of the highest flow between March and June, with a secondary peak in autumn (see Table 5).

1.10.3.2 Suspended sediment loads

The Great Caucasus rivers also boast the higher suspended sediment loads (i.e. mass flux per unit time). Geokchay again emerges with the highest sediment fluxes and, during May, it exports from its catchment an average of 184 kg s^{-1} of sediment (see Table 5). Turianchay, Geokchay and Girdemanchay are right at the heart of the region of dynamic left bank Kura tributaries which drain the vigorously eroding Great Caucasus Mountains.

High sediment transport rates relate to high soil erosion rates driven by steep slopes, intense rainstorms, highly seasonal snowmelt-driven flows, flash floods, likely freeze-thaw processes in the mountain zones, fine erodible soils and limited vegetation cover. In fact, the rivers of the Great Caucasus carry more suspended sediment than almost any other region in the FSU (Bobrovitskaya, 1996). Erodible soils are a particular issue. For example, Kuznetsov et al. (1998) found that for pre-mountain cinnamonic steppe-like soils, chestnut soils and light-chestnut soils on the surface of the south-eastern slope of the Great Caucasus, average scouring velocities required for a flow 2 cm deep varied from $0.20 - 0.24 \text{ m s}^{-1}$. Erosion scars are visible in many places on the existing WREPA ROW (URS/Dames & Moore, 2000), e.g. rivers Korchay and Shamkirchay. High soil erosion and sediment transport problems are likely to emerge as a key issue in pipeline engineering and integrity in Azerbaijan (URS/Dames & Moore, 2000). Soils are easily eroded once vegetation is removed and surface sediments disturbed (e.g. during pipeline or AGI construction).

Mingechaur Reservoir was built in 1953 but has rapidly silted up (capacity in 1953 = 16 km^3 ; 1982 = 14.5 km^3) with accumulation of suspended sediment. The reservoir removes around 70% of the sediment discharge from the Kura river (Selivanov, 1996).

1.10.4 Total dissolved solids (tds) concentrations

The few data from Kashkay (1996) on TDS levels in rivers crossed by the WREPA route are relevant to the proposed pipeline route and are presented in Table 6. Sampling, analytical and calculation methodologies are unknown, however. TDS values tend to be higher for the easterly, Great Caucasus, rivers, where average TDS concentrations range from $274 - 1812 \text{ mg l}^{-1}$ (see Table 6). This may reflect slower runoff in the lowland reaches and therefore greater solute acquisition opportunities (Trudgill, 1996), and contributions from solute-rich agricultural runoff. There is also a switch as one moves east from hydrocarbonate and carbonate river hydrochemistry in the west to a sulphate-dominated chemistry in easterly rivers. This may reflect increased geothermal contributions in the east (see Table 6). This is clearly shown for the Djeyrankechmes river, where the few analyses available indicate that SO_4^{2-} dominates the chemistry, accounting for between 40% and 56% of the total dissolved solids. Next dominant amongst the anions is HCO_3^- and, occasionally, Cl (Kashkay, 1996). The cationic proportions are reported as follows: $\text{Ca}^{2+} > \text{Na}^+ > \text{K}^+ > \text{Mg}^{2+}$.

Table 4 Total dissolved solids (TDS) concentrations in Azerbaijan Rivers (from Kashkay, 1996)

River	Average TDS Concentration mg L⁻¹	Minimum TDS Concentration mg L⁻¹	Maximum TDS Concentration mg L⁻¹	Hydro-chemical type	Dominant Cation
Lesser Caucasus Rivers	198 – 313	200	500	Hydrocarbonate	Ca or Na+K
Great Caucasus Rivers					
Turianchay	466	351	685	Carbonate	Ca
Geokchay	274			Hydrocarbonate	NA
Girdemanchay	563	510	1110	Sulphate	NA
Pirsagat	N/A	410	1278	Sulphate-Sodium	NA
Djeyrankechmes	1812			Sulphate	Ca

N/A = Data not available

1.10.5 Field reconnaissance survey data

A brief water quality measurement and sampling reconnaissance exercise was undertaken for selected rivers on the route on 30 November 1996 and 1 December 1996. This work was undertaken to obtain unique and/or up-to-date information on turbidity, water temperature, pH and electrical conductivity values for selected rivers and the key wetland zone crossed by the pipeline route at a time when almost all rivers were flowing (though at low flow). electrical conductivity (EC) can be used as a surrogate measure of total dissolved solids concentration. Seven sample sites were selected, in two spatial clusters. The first cluster included sites from Tovuschay westwards, and incorporated the upper Kura crossing and the Karayazi wetland (see Figure 9). The second cluster was a group of rivers east of the Mingechaur Reservoir, and included the lower Kura crossing near Yevlakh and the two river systems with the highest suspended sediment fluxes - the Geokchay and Turianchay.

Instruments used included a fully temperature-compensated RS Components Temperature and Conductivity Meter (RS 180-7127) and a temperature-compensated RS 610-540 pH meter, reading to an accuracy of 0.03 pH units. Turbidity values (in Nephelometric Turbidity Units, NTU) were determined in the field on 15-ml subsamples to an accuracy of +/- 2% using a Hach 2100P Turbidimeter. Samples were drawn from surface stream water at the channel edge. It is stressed that these values probably underestimate mean suspended sediment concentrations because concentrations tend to increase towards the bed in all but the most turbulent rivers. As is normal, all water quality measurements must be considered to be representative only of conditions at that time of sampling, especially in such highly temporally variable river systems as those crossed by the pipeline route.

Figure 9 Karayazi wetland region



Results for the 1996 survey are presented in Table 7. River temperatures were moderate, and varied from 9.7 to 12.7 °C. (cf. the published means plotted in Figure 8). All river waters were alkaline, with pH values between 7.82 and 8.20, and easterly rivers showed a tendency for higher pH values (see Table 7). These values are consistent with a limestone-dominated geology in the mountain source areas. Buffering ability for pollution is fairly good. Turbidity values were generally low (the Kura at Polyu was found to be very clear), consistent with the low-flow conditions sampled. However, turbidity increased towards the east and, confirming the average suspended sediment concentration data, the highest values were found for Turianchay, Geokchay and Girdemanchay.

A second water quality reconnaissance survey of river pH, electrical conductivity, nitrite and nitrate was undertaken by ERM (2000) in August 2000, and the pH and EC values have been added to Table 7. These later values are broadly consistent with the 1996 results of the reconnaissance survey.

1.10.6 River water contaminants

Only limited data is available with respect to baseline pollutant levels in the Azerbaijan water sources crossed or approached by the proposed pipeline route. However, many water bodies in neighbouring Caucasus and FSU republics suffer from significant problems with highly persistent pesticides (e.g. DDT; Richardson, 1998), nutrients and eutrophication (e.g. Hovhanissian and Gabrielyan, 2000), heavy metals, hydrocarbon contamination, and toxic defoliants used in the production of cotton. It is likely therefore that at least some water resources in Azerbaijan will be affected by measurable concentrations of these pollutants. Aliev (1995) considers the waters of the Kura River downstream of Mingechaur Reservoir to be polluted by heavy metals beyond the normal standards, and only usable for irrigation and industrial activities.

The results of water quality analyses conducted during the baseline assessment of the proposed pipeline route during 2001 are presented in Tables 8, 9 and 10 below.

Table 5 Results of reconnaissance water quality surveys of selected rivers and water bodies in Azerbaijan crossed by the route: (A) survey of 30 November and 1 December 1996; (B) survey of August 2000 by ERM (2000)

River/water body	Site location	Date	Local time	Temperature (°C)	Electrical Conductivity (us cm ⁻¹)	pH	Turbidity (NTU)
(A) Water quality survey: November/December 1996, west-east order							
Karayazay	Wetland pool	30-Nov-96	14:40	10.7	665	7.82	2.4
Kura	Polyu	30-Nov-96	16:40	10.9	646	7.98	5.8
Tovuzchay	Road bridge	30-Nov-96	17:49	10.8	1368	8.03	2.4
Kura	Yevlakh	1-Dec-96	10:33	12.7	630	8.12	14.7
Turianchay	Lyaki	1-Dec-96	11:45	10.0	660	8.16	72.1
Geokchay	Uzhary	1-Dec-96	12:30	10.5	609	8.20	62.7
Aksu	Karrar	1-Dec-96	16:50	12.0	4080	8.15	560.0
(B) Water quality survey, August 2000, west-east order							
Kura	Nr Akstafa	August 2000	N/A	N/A	750	8.4	N/A
Hassan Su	?	August 2000	N/A	N/A	800	8.4	N/A
Tauz	(main)?	August 2000	N/A	N/A	970	8.4	N/A
Karasu	?	August 2000	N/A	N/A	1960	8.2	N/A
Gushgara	?	August 2000	N/A	N/A	1300	8.2	N/A
Ganja	?	August 2000	N/A	N/A	1610	8.2	N/A
Karabach canal	?	August 2000	N/A	N/A	980	7.9	N/A
Kura	Nr Yevlakh	August 2000	N/A	N/A	740	8.6	N/A
Girdiman	?	August 2000	N/A	N/A	558	8.3	N/A
Pirsagat	?	August 2000	N/A	N/A	1710	8.1	N/A

Table 6 Results of 2001 Water Quality Survey of Selected Waterbodies Along the Pipeline Route - Metals

Water Source	Approximate KP	Date Sampled	Metals (mg/L)						
			Barium	Calcium	Chromium	Copper	Manganese	Nickel	Lead
NATURAL WATERBODIES									
Kura River	South of 82	20-Nov-01	0.046	140	0.009	0.020	0.310	0.025	0.030
Kura River	223	13-Nov-01	0.037	80	0.008	0.013	0.031	0.018	<0.01
Kura River	227	13-Nov-01	0.048	NA	0.005	0.008	0.028	0.010	0.012
Kura River	410	15-Nov-01	0.066	NA	0.007	0.078	0.081	< 0.005	0.019
Kura River	310	14-Nov-01	0.059	120	0.005	0.065	0.070	0.009	<0.01
River adjacent to former WREP camp	410	15-Nov-01	0.085	NA	0.005	0.009	0.017	0.008	0.025
Lake 4 km to NE of route	440	15-Nov-01	0.034	NA	< 0.005	0.007	0.021	0.005	<0.01
ARTIFICIAL WATERBODIES									
Irrigation canal 2 km S of Mugan	63	11-Nov-01	0.036	NA	0.012	0.013	0.120	0.028	0.025
Local irrigation canal	129	19-Nov-01	0.056	NA	0.005	0.011	0.049	< 0.005	<0.01
Local irrigation channel	176	19-Nov-01	0.064	NA	0.040	0.014	0.180	0.036	0.011
Irrigation canal	200	20-Nov-01	0.037	NA	0.005	0.010	0.100	0.018	0.020
Main canal in Yevlak	227	13-Nov-01	0.035	NA	0.006	0.005	0.036	0.056	0.012
Local irrigation canal	227	13-Nov-01	0.033	NA	0.006	0.006	0.071	0.010	<0.01
Irrigation canal to the north of Gandja	298	12-Nov-01	0.012	NA	0.005	0.015	0.019	< 0.005	0.013
Irrigation channels	298	14-Nov-01	0.039	NA	< 0.005	0.005	0.013	0.013	<0.01
Local irrigation channels	440	15-Nov-01	0.040	NA	< 0.005	0.006	0.029	0.011	0.017
Chohranli settlement (irrigation canal)	124	19-Nov-01	0.061	NA	0.005	0.010	0.010	0.014	<0.01
Agsu Canal	111	20-Nov-01	0.027	1900	0.010	0.021	0.040	0.007	0.031
Upper Karabakh Canal	244	13-Nov-01	0.047	100	0.006	0.055	0.013	0.006	0.085

Notes:

NA Not analysed

All samples were also analysed for Arsenic, Cadmium and Mercury, however these metals were not found to be present at concentrations in excess of the laboratory's detection limits (0.005mg/L, 0.001mg/L and 0/0002mg/L respectively)

Table 7 Results of 2001 Water Quality Survey of Selected Waterbodies Along the Pipeline Route - Bacteriological Parameters

Water Source	Approximate KP	Date Sampled	Coliforms (Yes/No)	E. Coli (Yes/No)	Sulphate-reducing bacteria (CFU/mL)	Anaerobic bacteria (MPN/mL)	Heterotrophic bacteria (MPN/mL)
NATURAL WATERBODIES							
Kura River	South of 82	20-Nov-01	Y	N	25	2.4E+06	2.7E+04
Kura River	223	13-Nov-01	Y	N	5.9	1.9E+06	9.4E+04
Kura River	227	13-Nov-01	Y	Y	NA	NA	NA
Kura River	410	15-Nov-01	Y	Y	NA	NA	NA
Kura River	310	14-Nov-01	Y	N	0.36	1.9E+06	5.2E+04
River adjacent to former WREP camp	410	15-Nov-01	Y	Y	NA	NA	NA
Lake 4 km to NE of route	440	15-Nov-01	Y	Y	NA	NA	NA
ARTIFICIAL WATERBODIES							
Irrigation canal 2 km S of Mugan	63	11-Nov-01	Y	N	NA	NA	NA
Local irrigation canal	129	19-Nov-01	Y	Y	NA	NA	NA
Local irrigation channel	176	19-Nov-01	Y	Y	NA	NA	NA
Irrigation canal	200	20-Nov-01	Y	Y	NA	NA	NA
Main canal in Yevlak	227	13-Nov-01	Y	Y	NA	NA	NA
Local irrigation canal	227	13-Nov-01	Y	Y	NA	NA	NA
Irrigation canal to the north of Gandja	298	12-Nov-01	Y	N	NA	NA	NA
Irrigation channels	298	14-Nov-01	Y	Y	NA	NA	NA
Local irrigation channels	440	15-Nov-01	Y	Y	NA	NA	NA
Chohranli settlement (irrigation canal)	124	19-Nov-01	Y	Y	NA	NA	NA
Agsu Canal	111	20-Nov-01	Y	Y	180	1.7E+06	2.4E+06
Upper Karabakh Canal	244	13-Nov-01	Y	N	6.9	2.4E+06	3.0E+05

Notes:

NA - Not analysed

Table 8 Table 1-2 Results of 2001 Water Quality Survey of Selected Waterbodies Along the Pipeline Route - Other Analytes and Parameters

Water Source	Approximate KP	Date Sampled	Chemical Oxygen Demand	Temperature	Electrical Conductivity	Dissolved oxygen	pH	Salinity	Turbidity	Chlorine demand	5 Day Biological Oxygen Demand (BOD-5) (max)	Sulphate	Chloride	Ammonia	Bicarbonate	Hardness (as Ca)
			mg/L	°C	mS/cm	mg/L	-	%	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NATURAL WATERBODIES																
Kura River	South of 82	20-Nov-01	110	12.1	0.09	9.6	7.3	0.04	139	1.8	0.63	190	51	0.4	220	110
Kura River	223	13-Nov-01	200	16.6	0.64	9.1	7.9	0.02	14	1.8	0.68	130	110	0.3	110	85
Kura River ⁽¹⁾	227	13-Nov-01	170	16.6	0.64	9.0	7.8	0.02	14	NA	NA	NA	NA	NA	NA	NA
Kura River ⁽¹⁾	410	15-Nov-01	230	12.8	0.67	10.3	7.7	0.02	24	NA	NA	NA	NA	NA	NA	NA
Kura River	310	14-Nov-01	50	12.8	0.67	10.3	7.7	0.02	24	2.0	1.1	140	110	< 0.2	135	85
River adjacent to former WREP camp ⁽¹⁾	410	15-Nov-01	130	14.1	0.12	13.4	7.9	0.05	1.4	NA	NA	NA	NA	NA	NA	NA
Lake 4 km to NE of route ⁽¹⁾	440	15-Nov-01	140	10.3	0.47	10.5	7.9	0.01	31	NA	NA	NA	NA	NA	NA	NA
ARTIFICIAL WATERBODIES																
Irrigation canal 2 km S of Mugan ⁽¹⁾	63	11-Nov-01	320	15.9	0.39	9.0	8.8	0.19	50	NA	NA	NA	NA	NA	NA	NA
Local irrigation canal ⁽¹⁾	129	19-Nov-01	170	10.8	0.83	10.0	7.7	0.03	71	NA	NA	NA	NA	NA	NA	NA
Local irrigation channel ⁽¹⁾	176	19-Nov-01	150	10.7	0.60	11.3	7.8	0.02	211	NA	NA	NA	NA	NA	NA	NA
Irrigation canal ⁽¹⁾	200	20-Nov-01	170	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Main canal in Yevlak ⁽¹⁾	227	13-Nov-01	60	15.0	0.30	8.4	8.0	0.14	51	NA	NA	NA	NA	NA	NA	NA
Local irrigation canal ⁽¹⁾	227	13-Nov-01	150	14.7	0.16	10.5	7.9	0.07	28	NA	NA	NA	NA	NA	NA	NA
Irrigation canal to the north of Gandja ⁽¹⁾	298	12-Nov-01	110	11.7	0.42	9.8	7.9	0.01	9.6	NA	NA	NA	NA	NA	NA	NA
Irrigation channels ⁽¹⁾	298	14-Nov-01	200	12.6	0.63	9.2	7.9	0.02	2.2	NA	NA	NA	NA	NA	NA	NA
Local irrigation channels ⁽¹⁾	440	15-Nov-01	200	11.0	0.46	9.2	7.9	0.01	5	NA	NA	NA	NA	NA	NA	NA
Chohranli settlement (irrigation canal) ⁽¹⁾	124	19-Nov-01	250	11.2	0.15	6.2	7.7		3.8	NA	NA	NA	NA	NA	NA	NA
Agsu Canal	111	20-Nov-01	130	7.9	0.32	11.2	7.2	0.15	7.6	2.8	0.67	1100	120	0.4	270	330
Upper Karabakh Canal	244	13-Nov-01	210	19.7	0.55	7.8	7.9	0.02	5.2	3.0	0.47	100	65	< 0.2	140	110

Notes:

NA - Not analysed

⁽¹⁾ - Samples also analysed for diesel range organic compounds, polynuclear aromatic hydrocarbons, polychlorinated biphenyls and a range of pesticides. None of these materials were detected at concentrations in excess of the laboratory's detection limits in any of the samples.

A more recent field water quality survey for the pipeline project was carried out by ERT Caspian (2001) between 9 and 20 November 2001 (see Tables 8, 9 and 10). In conjunction with a BP/Kvaerner team, sample sites were selected along the proposed route, and included irrigation canals and a selected rivers, including the Kura, with a view to assessing water quality. This was a 'one-off' survey, so could not take into account any seasonal variations in river water quality, which are known to be considerable (see above), but aimed to provide a snapshot background picture. Local residents were also interviewed for information on, for example, the reliability of their water supplies and recollections of any pollution incidents. The survey was not designed to determine sources of any contamination found in samples.

Samples were analysed for a range of metals, organics and coliforms used by water and health agencies to assess appropriateness of waters for drinking purposes. A small number of samples meet existing UK/EU water quality guidelines but would fail to meet the required standards due to be enforced in 2003 (ERT Caspian, 2001). Also, many samples pass water quality tests *individual* determinand, but would fail *overall* when assessed against a range of collectively-important water quality variables.

All samples fell within the international limits for PAH, Arsenic, Barium, Cadmium, Chromium, Copper, Mercury, pH, electrical conductivity (EC) and Ammonia. For lead, all sites passed except the upper Karabakh canal. A number of sites exceeded the manganese limits, especially the Kura River north of Mugan. In terms of nickel concentrations, several sites exceeded EU limits. Turbidity limits were exceeded in a number of rivers and canals, as would be expected. Allowable sulphate and calcium concentrations are exceeded in the Agsu canal.

One of the key determinands for human health, however, is coliform count. It is stressed that most waters sampled exceeded UK and EU limits, though a few samples were analysed after lengthy storage and results for these sites cannot be considered reliable (ERT Caspian, 2001).

Table 9 Recorded mudflow events in the basins crossed by the proposed pipeline route

River	Date	Mudflow duration (hrs)	Triggering factor		Altitude zone of Occurrence (m)	Results of mudflow occurrence						
			Snow melt	Rainstorm		Flood damage	Building damage	Road damage	Bridge damage	Railway damage	Canal damage	Fatalities
Turianchay	Aug 1905			✓	1800-2400	✓	✓					
Turianchay	01-Sep-30	8		✓	1800-2400	✓						
Turianchay	29-May-37	20	✓	✓	600-2600	✓					✓	
Turianchay	26-Jun-52	15		✓	1800-2400	✓	✓					
Turianchay	26-Jun-56	20	✓	✓	600-2600	✓	✓					
Turianchay	05-Sep-60	24			600-2600							
Turianchay	11-Jun-63	30	✓	✓	600-2600	✓					✓	
Turianchay	23-Jul-74	10		✓	1800-2400	✓	✓					
Bumchay (trib of Turianchay)	May 1927	3		✓	1000-2500	✓	✓	✓				
	13-Aug-45	8		✓	1000-2500	✓	✓					40
Bumchay	20-Jul-06	10		✓	600-1800	✓	✓			✓		
Bumchay	20-May-16	1		✓	600-1000	✓	✓	✓				
Bumchay	13-Jun-35	6		✓	600-1800	✓	✓					
Bumchay	30-May-49	2	✓	✓	1000-1800	✓						
Bumchay	30-Jul-55	2		✓	600-1800	✓						
Bumchay	02-Jul-57	6		✓	600-1800	✓					✓	
Bumchay	07-Jul-63	8		✓	1000-1800	✓					✓	
Bumchay	30-May-72	2		✓	1000-1800	✓	✓	✓	✓			
Bumchay	06-Jun-72	1.5		✓	1000-1800	✓						
Girdemanchay	27-Jul-15	2		✓	1500-2000	✓		✓				
Girdemanchay	18-Oct-51	2		✓	1500-3000			✓				
Girdemanchay	03-Jul-57	2-7		✓	1500-2000			✓				
Girdemanchay	07-Jul-57	2-7		✓	1500-2000			✓				
Girdemanchay	12-Jul-57	2-7		✓	1500-2000			✓				
Girdemanchay	19-Jul-57	2-7		✓	1500-2000			✓				
Girdemanchay	06-May-72	4		✓	1500-2000	✓		✓				
Girdemanchay	24-Jun-75	2		✓	1500-2000	✓		✓				

Table 9 Recorded mudflow events in the basins crossed by the proposed pipeline route

River	Date	Mudflow duration (hrs)	Triggering factor		Altitude zone of Occurrence (m)	Results of mudflow occurrence						
			Snow melt	Rainstorm		Flood damage	Building damage	Road damage	Bridge damage	Railway damage	Canal damage	Fatalities
Aksu	15-Jul-47	3		✓	1200-1500	✓			✓			
Aksu	09-Jun-62	2		✓	1200-1500	✓			✓			
Aksu	02-May-64	1		✓	1200-1500	✓						
Aksu	06-Jun-68	4		✓	1200-1500	✓		✓	✓			
Aksu	06-May-72	6		✓	1200-1500	✓		✓				
Aksu	24-Jun-75	5		✓	1200-1500	✓			✓			
Aksu	27-Jun-59	5		✓	1200-2000	✓		✓				
Aksu	16-May-66	4		✓	1400-2200	✓		✓				
Akhindjachay	25-Jun-52	3		✓	500-1500			✓				
Akhindjachay	08-Jul-72	5		✓	500-1500	✓		✓				
Tovuzchay	24-Jul-63	5		✓	500-1500	✓		✓				
Tovuzchay	08-Jul-72	3		✓	500-1500	✓						
Gandjachay	10-Jul-06	4		✓	1000-2500	✓		✓	✓		✓	
Gandjachay	26-Aug-31	3		✓	1000-1500	✓	✓	✓				
Gandjachay	11-Jul-65	6		✓	1000-1500	✓		✓				

1.11 MUDFLOWS

Mudflows are significant events that have affected at least seven of the rivers crossed by the pipeline (Kashkay 1996). Of the 41 documented events, 34 occurred in the four main Great Caucasus river basins (Turianchay, Geokchay, Girdemanchay and Aksu), where damage was also greatest. This is further evidence of the hydrogeomorphological dynamism of the region, though contemporary data is unfortunately lacking. Up to one million cubic metres of material can be moved down-catchment in a few hours during such events, causing infrastructural damage and fatalities (e.g. 40 people died in Upper Kamervan in the upper Turianchay basin on 13 August 1945). Damage to communications has been severe and frequent in the past, including near the pipeline route. Mudflows are highly seasonal events, typically taking place between April and October, but with a clear peak frequency in May, June and July. The most damaging recorded mudflow events are listed in Table 11.

Catastrophic 'mudflows' have affected the Djeyrankechmes basin, even as far downstream as Sangachal. Between 1941 and 1972 at least eight mudflows occurred on the Djeyrankechmes at an average interval of around 2-5 years. Most occurred in the May-July period and they were mainly generated at altitudes of 300-800 metres above mean sea level. Such events are likely to have been generated during intense rainstorms by the release of mobile materials as a result of slope erosion or failure. Eroded materials then develop into a thick sediment-water slurry which moves quickly downslope and into river channels. Boulders up to 0.4 - 0.7 m in diameter can be carried in the water-sediment mixture.

1.12 ENVIRONMENTAL CHANGE AND PIPELINE CORRIDOR HYDROLOGY

Significant environmental and hydrological changes (especially in temperature, precipitation, groundwater, land use, industrial activity and sea levels) have taken place throughout the Azerbaijan area in recent times. For example, Hadiyev (1996) has argued that mean air temperatures have risen significantly in the Transcaucasian region over the last 100 years. Furthermore, Hadiyev (1996) found that, at selected sites in the Transcaucasian region, annual rainfall totals *decreased* over the last 100 years, except over large cities. However, in a simple analysis of patterns over the last 60 years, Lawler (1997) discovered that there was a significant *increase* in annual rainfall totals in recent decades in Azerbaijan. At Baku and Ganja, Lawler (1997) found that the frequency of annual totals greater than 300 mm over the 28-year period, 1963-1990, was three times that of the 1935-1962 period. Mumladze (1991) described similar recent precipitation increases at Poti on the Black Sea coast of Georgia.

The level of the Caspian Sea has been rising since 1978 (Efendiyeva, 2000) at a rate of approximately 11cm per annum, leading to more than 2 m of sea-level rise between 1978 and 1996. This may have repercussions for groundwater levels, quality and flow directions in the coastal part of the proposed pipeline route.

Given these significant past changes over the last century in the Caucasus region, and predictions of future climates by General Circulation Models (GCMs), there exists the distinct possibility of future environmental changes along the proposed pipeline route. These include changes in climate (precipitation and temperature), land use and agricultural activities, groundwater levels and flow directions, and Caspian Sea level. These changes may alter hydrological regimes and water quality, and affect future flood intervals, river and soil erosion and contamination risks over the design life of the pipeline. In particular, future economic development in Azerbaijan may well generate significant agricultural land-use changes in the pipeline route that could alter river flows and surface-water and groundwater quality.

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SOCIO-ECONOMIC BASELINE

TABLE OF KNOWN PIPELINE AFFECTED COMMUNITIES AND CHARACTERISTICS

GARADAG						
	Settlement	Population	KP Ref	Community expectations & concerns	Infrastructure & Utilities	Requests / Possible Social Investment
	Sangachal also includes Azimkend	4010	KP 2	☺ - Local employment ☹ - Noise <ul style="list-style-type: none"> - Traffic - Roads deterioration 	Water: Always Electricity: Always Gas: Always Telephones: Always Roads: Fair	Use of BP's machinery Roads repair Basic sewage
HADGIQABUL						
	Randjbar	2850	KP 40	☺ - Local employment <ul style="list-style-type: none"> - Roads repair - Indirect employment ☹ - No compensation for land -Safety of the pipeline	Water: Shortage for irrigation (drinking in summer) Electricity: Often interruptions Gas: Partial supply (piped) Telephones: Some (communal point) Roads: Partially asphalted	Digging of a sewage ditch Roads repair Drilling the artesian well for water Inform on the commencement of construction
	Pirsagat	852	KP 45	*	Water: Always Electricity: Interrupted Gas: Permanent, canisters Telephones: At communal points Roads: Poor	*
	Kazi-Magomed	22279	KP 51-55	☺ - Local employment + indirect employment	Water: Enough for all purposes but low quality	Roads repair Sewage system cleanup

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				- Improvement of a gas supply ⊗ - Possible explosions	Electricity: Supplied with intervals Gas: Supplied with intervals (gas line) Telephones: Most households Roads: poor	Establish a micro credit program for SMEs
	Mugan	4000	KP 63	☺ - Local employment + indirect - Roads repair - School refurbishment ⊗ - Possible explosion - Gas leakage	Water: Always have water Electricity: Supplied with intervals Gas: Gas canisters Telephones: Mobile + most households Roads: poor	More information about pipeline Upgrade of the medical centre Refurbishment of a school building Digging sewage canals Roads repair Upgrade of a power transformer
	Qarasu	2266	KP 79	☺ - Local employment - Roads repair - Water channel repair ⊗ None	Water: Almost always Electricity: Supplied with intervals Gas: Gas line supply Telephones: Most have mobiles Roads: Poor	Digging of a sewage ditch Helping build a hospital Roads repair Building a village culture club
	Padar	752	KP 91	☺ - Local employment - Improved electricity supply - Gas supply ⊗ - None	Water: Buy from trucks Electricity: With long intervals Gas: Gas canisters (2 a month) Telephones: local and mobile Roads: Poor	Drilling of artesian well for water School building refurbishment Using the old pipe to delivery water from the nearby channel to the village Gas supply
Kurdemir						
	Kurdemir Town	17676	KP 128-132	☺ - Local employment - Improve infrastructure	Water: Some Electricity: Irregular	Receive information from BP Use of BP's machinery for

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				<ul style="list-style-type: none"> - Improve electricity and gas supply <p>⊕ - None</p>	<p>Gas: Some use gas canisters</p> <p>Telephones: Mobile + households</p> <p>Roads: Fair</p>	<p>improvement of a water supply network</p> <p>Investment in local dairy factory</p> <p>Support for carpet-weaving industry</p>
	Sigirly	5403	KP 105	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Gas supply <p>⊕ - In case of explosion damage to environment</p> <ul style="list-style-type: none"> - Misbehaviour of construction workers 	<p>Water: Irrigation comes from canal, drinking bought</p> <p>Electricity: 7 hours a day</p> <p>Gas: None</p> <p>Telephones: Some home lines + mobiles</p> <p>Roads: Very bad</p>	<p>More info on the project</p> <p>Roads repair</p> <p>Water source upgrade</p> <p>Digging of a sewage canals</p>
	Karrar	2196	KP 110	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Receive compensation - Gas supply - Road maintenance <p>⊕ - Pipeline might lay through good and fertile land</p> <ul style="list-style-type: none"> - Noise 	<p>Water: Not sufficient supply</p> <p>Electricity: With intervals and scheduled</p> <p>Gas: Containers</p> <p>Telephones: local and mobile</p> <p>Roads: Poor</p>	<p>Refurbishment of a school building</p> <p>Upgrade of a water system</p> <p>Roads repair</p>
	Karrar Station	1390	KP 119	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Gas supply - Receive compensation <p>⊕ - Damage to land</p> <ul style="list-style-type: none"> - Gas explosion - Damage to roads 	<p>Water: Canal water for drinking</p> <p>Electricity: Irregular</p> <p>Gas: Containers</p> <p>Telephones: Mobile and local</p> <p>Roads: Poor</p>	<p>Treatment of drinking water</p> <p>Establishment of medical facility</p> <p>Rehabilitation of wine factory</p>
	Chokhranly	1118	KP 123	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Use of BP's equipment - Trade links <p>⊕ - None</p>	<p>Water: Very little</p> <p>Electricity: 4-5 hours a day</p> <p>Gas: Containers</p> <p>Telephones: Mobile and local</p> <p>Roads: Fair</p>	<p>More information about pipeline</p> <p>Establishment of a medical care facility</p> <p>School building refurbishment</p> <p>Extension of a water pipe</p>

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	Yeni Shiximly	215		*	Water: No communal supply, canals Electricity: Interrupted Gas: No supply, canisters too expensive Telephones: No Roads: Fair	*
	Arshaly	652		*	Water: No communal supply, stored water Electricity: Interrupted Gas: No communal supply, canisters Telephones: Most households Roads: Poor	*
Ujar						
	Taza Shilyan	2800	KP 150	☺ - Local employment - Gas supply - Improvement of a water supply ☹ - Possible explosions - Environment - Damage to roads - Resettlement	Water: Insufficient especially for agro use Electricity: Interrupted Gas: Containers Telephones: Some local and mobile Roads: Poor	Roads repair Upgrade of the hospital Water system upgrade
	Chiyny	511	KP 159	☺ - Local employment - Credits allocations for business - Improve electricity supplies ☹ - Damage to water canals	Water: Bad quality, shortage in summer Gas: Some containers Electricity: Irregular Telephones: Some local and mobile Roads: Poor	New school building Establishment of medical facility Local water treatment Establishment of micro credit program
	Anver Memmedhanly	216	KP 163	☺ - Local employment - Roads improved ☹ - Environmental - Damage to roads and lands - Damage to canals	Water: Bad quality Gas: Containers Electricity: Seldom Telephones: Some local and mobile Roads: Poor	Potable water treatment New school building (or renovation of the old one) Establishment of a medical facility Refurbishment of a mosque
	Gulabend	1120	KP 170	☺ - Local employment	Water: Spring	More information about

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				<ul style="list-style-type: none"> - Receive compensation - Roads maintenance <p>⊗ - Disturb landuse</p>	Electricity: Scheduled Gas: Containers Telephones: Some local and mobile Roads: Poor	pipeline New school building Help in refurbishment of a water system Roads repair
	Garaberk	3500	KP 175	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Receive compensation <p>⊗ - Noise</p> <ul style="list-style-type: none"> - Damage to land, roads and water canals - Fire - Resettlement 	Water: Use canal water Gas: Containers Electricity: Permanent Telephones: Some local and mobile Roads: Poor	Upgrade of a medical centre Provision of a fishing gear
	Ujar Town	15483	KP 178	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Receive compensation in form of dug wells <p>⊗ - Roads deterioration</p> <ul style="list-style-type: none"> - Increased traffic 	Water: Not sufficient, have to carry from long distances Electricity: With often interruptions Gas: Some containers Telephones: Mobile and local Roads: Poor	Digging artesian wells for water More information about pipeline Improve electricity supplies Improve roads
	Alpout	3270	KP 180	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Piped gas available - Roads maintenance <p>⊗ - Damage to land</p> <ul style="list-style-type: none"> - Resettlement - Damage to roads 	Water: Canals Gas: Containers Electricity: Irregular Telephones: Some local and mobile Roads: Poor	School building refurbishment Roads repair More info from BP's reps
	Karadagly	2265	KP 182	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Gas supply - Receive compensation <p>⊗ - Damage to land</p> <ul style="list-style-type: none"> - No compensation for land - Gas leakage 	Water: Bad quality for drinking, not enough for irrigation Gas: Containers Electricity: With interruptions Telephones: Some local and mobile Roads: Poor	School upgrade Hospital upgrade Water system upgrade
	Alikend	700	KP 189	<p>☺ - Local employment</p>	Water: Canals	Treatment of a respiratory

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				- Improved electricity supplies ☹ -None	Gas: Containers Electricity: Irregular Telephones: Some local and mobile Roads: Poor	diseases School upgrade Help in revitalization of cotton production
	Ramal	720	KP 190	☺ - Local employment - Improve electricity supply ☹ - Possible explosion - Possible resettlement - Damage to roads - Damage to land	Water: Use water from canal, shortage in summer Electricity: Irregular Gas: Containers Telephones: Some local Roads: Poor	Potable water treatment facility Roads repair
	Shahliq	1400	KP 190	☺ - Local employment - Gas supply - Roads repaired ☹ - Noise - Possible resettlement - Land taken away - Possible explosion	Water: Almost always Electricity: Irregular Gas: Containers Telephones: Some local Roads: Poor	Improve electricity supplies Improve roads
Agdash						
	Asagy Leky	1454	KP 198	☺ - Local employment - Receive compensation - improve infrastructure ☹ - Possible explosion	Water: Problem especially in summer Electricity: Irregular Gas: Containers Telephones: Local lines and some mobile Roads: Poor	School repair + provision of basic supplies Help revitalize cotton production + live stock Cleaning of the water channels

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	Hanitlu	518	KP 198	☺ - Local employment - New wells - Indirect employment ☹ - Possible explosion - Damage to roads - Damage to water canals - Dust	Water: Little Electricity: 1-2 hours a day Gas: None Telephones: local and mobile Roads: Poor	Improve health centre facility Clean the potable water source Roads repair Digging artesian wells More information about pipeline
	Leki	3854	KP 205	☺ - Local employment - Use of BP's equipment ☹ - Damage to roads	Water: Insufficient Electricity: With interruptions Gas: Containers Telephones: local and mobile Roads: Poor	Digging basic sewerage gutters Use of BP's machinery for the village needs More info on the project
	Guvekend	1443	KP 205	☺ - Local employment - Use of BP's equipment ☹ - Damage to roads	Water: Insufficient Electricity: With interruptions Gas: Containers Telephones: local and mobile Roads: Poor	Digging basic sewerage gutters Use of BP's machinery for the village needs More info on the project
	Amirarh	1014	KP 205	☺ - Local employment - Improvement of social infrastructure - Water supply - Improved power supply ☹ - Unfair compensation for land	Water: Rare Electricity: 3 hours a day Gas: Some containers Telephones: local and mobile Roads: Poor	New school (no at present) Drill artesian wells
	Agdjaqovak	110	KP 217	☺ - Local employment - Sell products - Construction of school and a kindergarten - Receive compensation ☹ - Possible damage to water canals and roads	Water: Some Electricity: Very seldom Gas: Containers Telephones: local and mobile Roads: Poor	New school and kindergarten (none at present) Basic medical equipment to health centre Help develop cotton and wheat production

Yevlakh

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	Duzdak	446	KP 237	*	*	*
	Ashagy Garhun	1211	KP 220	☺ - Local employment - Gas supply ☹ - Damage to arable land	Water: Sufficient Electricity: 5-6 hours a day Gas: Some containers Telephones: Some local and mobile Roads: Fair	Medical centre upgrade School building renovation More info through meetings
	Yevlakh town	51952	KP 231	☺ - Local employment -Sewerage system fixed - Development of town's infrastructure ☹ - Dust - Noise	Water: Some Electricity: 8-10 hours a day Gas: Some Telephones: Local lines and mobile Roads: Fair	Digging of a basic sewage gutters
	Narimanabad	1573	KP 235	☺ - Local employment - Use of BP's equipment - Roads maintenance - School repair ☹ - Gas going to Turkey rather than for village use	Water: Little Electricity: 1-2 hours a day Gas: Some containers Telephones: Local and mobile Roads: Poor	Roads repair Establishment of a medical facility School building renovation More info through meetings
	Sametobad	1161	KP 237	☺ - Local employment - Gas supply ☹ - None	Water: Some (bad quality) Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Roads repair
	Neymatabad	1295	KP 238	☺ - Local employment - Gas supply ☹ - None	Water: Little Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Roads repair Micro credit program

SOCIAL BASELINE TABLE

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	Yaldily	1226	KP 242	☺ - Local employment - Gas supply ☹ - None	Water: Some (bad quality) Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Roads repair Upgrade of the medical centre Renovation of a school building
	Aran	6694	KP 242	☺ - Local employment - Gas supply - Trade links ☹ - Gas leakage - Accidents	Water: Little Electricity: 10 hours a day Gas: Some containers Telephones: Some local and mobile Roads: Poor	Drilling of artesian wells Roads repair Micro credit program More information about the project
Ganja						
	Ganja town	299000	KP 297-302	☺ - Local employment - Improved business ☹ - None	Water: Always Electricity: Almost always Gas: Almost always Telephones: Local and mobile Roads: Fair	

GERANBOY

Map Ref.	Settlement	Population	Attitude to Pipeline	Expectations	Specific Characteristics	Requests / Possible Social Investment
	Kazambulak	720	KP 272	*	*	*
	Yaharchi Gazahlar	850 e	KP 287	*	*	*
	Alpout	948	KP 291	*	*	*
	Eyvazlilar	509	KP 251	☺ - Local employment	Water: Very little	Drilling artesian wells for water

SOCIAL BASELINE TABLE

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				<ul style="list-style-type: none"> - Receive compensation - Gas supply ☹ - Damage to the land 	Electricity: 1-2 hours a day Gas: Containers Telephones: Few local lines Roads: Poor	Roads repair New school New medical center
	Jinli Boluslu	1230	KP 253	☺ - Local employment ☹ - None	Water: Some Electricity: With interruptions Gas: Containers Telephones: Local and mobile Roads: Poor	Roads repair Upgrade of medical centre School building renovation Drilling additional wells for water
	Erevanly	214	KP 256	☺ - Local employment <ul style="list-style-type: none"> - Gas supply - Trade links - Economic development ☹ - Damage to land <ul style="list-style-type: none"> - Damage to roads - Taking land away 	Water: Very little Electricity: 5-6 hours a day Gas: Firewood used instead Telephones: Few local Roads: Poor	More information about the project Roads repair Establishment of a medical centre Drilling artesian wells for water
	Nadirkend	1380	KP 256	☺ - Local employment <ul style="list-style-type: none"> - Receive compensation for land - Gas supply ☹ - None	Water: Some Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: More or less fair	Upgrade of a medical centre School building renovation
	Borsunlu	3460	KP 272	☺ - Local employment <ul style="list-style-type: none"> - Gas supply ☹ - None	Water: Little Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Roads repair School buildings renovation Upgrade of a medical centre
	Azizbeyov	690	KP 280	☺ - Local employment <ul style="list-style-type: none"> - Gas supply ☹ - None	Water: Little (bad quality) Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Building a new road Improve electricity supply Provide gas

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	Muzdurlar	1272	KP 281	☺ - Local employment - Gas supply ☹ - None	Water: Little Electricity: Irregular Gas: Containers Telephones: local and mobile Roads: Poor	Roads improvement School building renovation Medical centre upgrade
	Yolpak	590	KP 282	☺ - Local employment - Gas supply ☹ - Noise - Possible explosion - Possible removal of trees	Water: Little Electricity: With interruptions Gas: Some containers Telephones: Local and mobile Roads: Poor	Finish the school building Artesian wells upgrade More info on the project
	Bashirly	428	KP 283	☺ - Local employment - Increased state budget ☹ - Land loss - Damage to houses and water canals - Damage to roads	Water: Located in far distance Electricity: Irregular Gas: Some containers Telephones: Local and mobile Roads: Poor	Drilling artesian wells Medical centre upgrade More info about the project Improve electricity supply
	Sarov	850	KP 285	☺ - Local employment - Benefit to state budget - Gas supply - Improved power supply ☹ - Damage to land	Water: Some Electricity: Interrupted Gas: Piped gas Telephones: Local and mobile Roads: Poor	Establishment of medical centre Roads repair More information about the project
	Fahrly	2500	KP 288	☺ - Local employment - Gas supply - Economic development ☹ - None	Water: Some (bad quality) Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Digging artesian wells for water School refurbishment
	Gurbanzade	580	KP 289	☺ - Local employment - Gas supply ☹ - Safety	Water: Rare Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Drilling of artesian wells for water Upgrade of a medical centre Roads repair

SAMUKH

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Map Ref.	Settlement	Population	Attitude to Pipeline	Expectations	Specific Characteristics	Requests / Possible Social Investment
	Lyak	1096	KP 298	*	*	*
	Kadily	451	KP 316	*	*	*
	Ashagy Agasybeyli	447	KP 293	☺ - Local employment - Sell products - Gas supply ☹ - Damage to land - Land loss	Water: Some Electricity: With interruptions Gas: Some containers Telephones: local and mobile Roads: Poor	Roads repair Restoration of a medical centre New school More info on the project
	Aly Bayramly	816	KP 294	☺ - Local employment - Economic development ☹ - Damage to land - Damage to bridge	Water: None Electricity: 1-2 hours a day Gas: None (firewood instead) Telephones: local and mobile Roads: Poor	Transformer repair Drilling artesian wells Roads repair School building renovation Micro credit program More info on the project through meetings
	Hodjaly	1098	KP 302	☺ - Local employment - Receive compensation ☹ - None	Water: Almost always but not everywhere Electricity: Often Gas: Containers Telephones: Mobile Roads: Poor	Roads repair Medical centre upgrade School building repair Improvement of a water situation
	Seyidlyar	538	KP 316	☺ - Local employment - Gas supply - Receive compensation - Trade	Water: Always Electricity: 2 hours a day Gas: Some containers	Medical centre upgrade Improved power supply

SOCIAL BASELINE TABLE

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				<ul style="list-style-type: none"> - Improved power supply <p>⊗ - Safety - Damage to land</p>	Telephones: Local and mobile Roads: Fair	
	Garaarh	495	KP 320	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Trade - Accommodations lease - Gas supply <p>⊗ - Damage to land</p>	Water: Always Electricity: 2-3 hours a day Gas: Some containers Telephones: Mobile Roads: Poor	Roads repair School building repair Establishment of a medical centre Restoration of the irrigation canals More info about the project
SHAMKIR						
Map Ref.	Settlement	Population	Attitude to Pipeline	Expectations	Specific Characteristics	Requests / Possible Social Investment
	Chaparhy	1510	KP 336	*	*	*
	Talish	562	KP 318	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - New well - Gas supply - Power supply <p>⊗ - Safety - Damage to land</p>	Water: Always Electricity: 2-3 hours a day Gas: Some containers Telephones: Local Roads: Poor	Roads repair Medical centre upgrade New school building
	Garagemirly	5300	KP 326	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Gas supply - Lease of accommodation <p>⊗ - Safety</p>	Water: Some Electricity: Seldom Gas: Containers Telephones: Local and mobile Roads: More less fair	Schools renovation Repair of artesian wells
	Mahmudlu	3165	KP 330	<p>☺ - Local employment</p> <ul style="list-style-type: none"> - Gas supply - Lease of premises 	Water: Some (bad quality) Electricity: 8 hours a day Gas: Some containers Telephones: Local and mobile	Water system upgrade Kindergarten renovation More info about the project Improved power supply

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				☹ - Damage to land - Damage to road	Roads: Fair	
	Kechily	5600	KP 332	☺ - Local employment - Gas supply ☹ - None	Water: Some Electricity: Irregular Gas: Piped gas Telephones: Local and mobile Roads: Poor	Roads repair Medical centre upgrade Improvement of school conditions
	Dellercirdaxan	2540	KP 338	☺ - Local employment - Gas supply ☹ - None	Water: Almost always Electricity: With interruptions Gas: Containers Telephones: Local and mobile Roads: Poor	Roads repair School building renovation
	Deller	4169	KP 340	☺ - Local employment - Support for village schools ☹ - Damage to roads - Possible conflicts with workers	Water: Some Electricity: Rare Gas: Some containers Telephones: Local and mobile Roads: Poor	Basic school supplies to local school + its repair Improvement of a water supply Improvement in medical care Improvement of power lines Roads repair
	Dallyar Djeir	4857	KP 342	☺ - Local employment - Benefit to state budget - Receive compensation - Gas supply ☹ - Safety - Loss of land - Loss of houses	Water: Some Electricity: With interruptions Gas: Some containers Telephones: Local and mobile Roads: Poor	Medical centre upgrade School building renovation Roads repair
	Dallyar Dashbulak	2061	KP 343	☺ - Local employment - Receive compensation - Trade - Gas supply - Assistance in improvement of water and power supply	Water: Some Electricity: With interruptions Gas: Containers Telephones: Local and mobile Roads: Poor	Roads repair Medical centre upgrade School building renovation

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				☹ - Safety		
	Sary Tepe	510	KP 350	☺ - Local employment ☹ - Disturb land - Noise - Dust - Explosion	Water: Some Electricity: 3-4 hours a day Gas: Containers Telephones: Mobile Roads: Poor	More info about the project Vegetable processing workshop Digging of artesian wells Roads repair
	Bayramly	2670	KP 352	☺ - Local employment - Gas supply ☹ - None	Water: Some Electricity: With interruptions Gas: Some containers Telephones: Local and mobile Roads: Poor	Medical centre upgrade School building renovation
	Zeyem	7225	KP 354	☺ - Local employment - Improved water supply ☹ - Damage to roads	Water: Little Electricity: Irregular Gas: Containers Telephones: Local and mobile Roads: Poor	Drilling artesian wells for water Roads repair School building refurbishment Digging basic sewage gutters More info about the project
TOVUZ						
	Khatinly	2774	KP 382	☺ - Local employment - Gas supply - Provision of goods and services ☹ - Possible explosion - Damage to land	Water: Some Electricity: 5-6 hours a day Gas: Some containers Telephones: Local and mobile Roads: Poor	Roads repair School renovation School supplies Digging of artesian wells
	Ashagi Mulkulu	2200	KP 384	*	Water: No communal supply, stored water Electricity: Interrupted Gas: No communal supply, canisters Telephones: NA Roads: Poor	*
AKSTAF						

SOCIAL BASELINE TABLE

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	Ashagy Kesamanly	2560	KP 400	☺ - Local employment - Receive compensation ☹ - Loss of land - Damage to land - Damage to roads - Noise	Water: Some Electricity: 2-3 hours a day Gas: None Telephones: Local and mobile Roads: Poor	Roads repair Medical centre upgrade School renovation
	Zelimhan	1145	KP 401	☺ - Local employment - Gas supply ☹ - Safety - Land loss	Water: Some Electricity: Irregular Gas: Some containers Telephones: Local and mobile Roads: Poor	Roads repair Water system upgrade
	Poylu	1255	KP 410	☺ - Local employment ☹ - None	Water: Little Electricity: Sometimes Gas: Containers Telephones: Local and mobile Roads: Poor	Improvement of medical care services Textbooks supply for school needs Micro crediting program Use of construction machinery to improve water supply More info on about the project
	Saloglu	1300	KP 420	☺ - Local employment ☹ - Damage to the land	Water: Always Electricity: Often Gas: Containers Telephones: Local and mobile Roads: Poor	School repair
	Soyuk Bulak	640	KP 429	*	*	*
	Kechvely	1100	KP 432	*	*	*
	Boyuk Kesik	1300	KP 440	☺ - Local employment - Receive compensation	Water: Some Electricity: Irregular	Roads repair Water situation improvement

SOCIAL BASELINE TABLE

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				☹ - Damage to the land	Gas: None Telephones: Local and mobile Roads: Poor	(use of BP's equipment) More info about the project
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- Information not collected

COMMUNITIES SURVEYED FOR COMPILATION OF BASELINE

- | | | |
|---------------------|-------------------|-----------------|
| • Agdjaqovak | • Dellerdaxan | • Kirah Kesaman |
| • Alikend | • Erevanly | • Kurdemir |
| • Alpout | • Eyvazlilar | • Leki |
| • Aly Bayramly | • Fahrly | • Mahmudlu |
| • Amirarh | • Ganja | • Mugan |
| • Anver Memmedhanly | • Garaarh | • Muzdurlar |
| • Aran | • Garaberk | • Nadirkend |
| • Asagy Leky | • Garagemirly | • Narimanabad |
| • Ashagy Agasybeyli | • Gulabend | • Neymatabad |
| • Ashagy Garhun | • Gurbanzade | • Padar |
| • Ashagy Kesamanly | • Guvekend | • Poylu |
| • Azizbeyov | • Kazi-Magomed | • Qarasu |
| • Bashirly | • Hanitlu | • Ramal |
| • Bayramly | • Hodjaly | • Randjbar |
| • Borsunlu | • Jinli Boluslu | • Saloglu |
| • Boyuk Kesik | • Karadagly | • Sametobad |
| • Chiyny | • Karadjally | • Sangachal |
| • Chokhranly | • Karrar | • Sarov |
| • Dalimamedli | • Karrar .Station | • Sary Tepe |
| • Dallyar Dashbulak | • Kazyar | • Seyidlyar |
| • Dallyar Djeir | • Kechily | • Shahliq |
| • Deller | • Khatinly | • Sigirly |

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- Talish
- Taza Shilyan
- Ujar

- Yaldily
- Yevlakh
- Yolpak

- Zelimhan
- Zeyem

SOCIAL BASELINE TABLE