

# Imperial College

## Altiplano Expedition 2008

*A student expedition to carry out an engineering reconnaissance of the Bolivian Altiplano*



**29<sup>th</sup> June – 4<sup>th</sup> August 2008**

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**Published by: Imperial College London, South Kensington, London, SW7 2AZ. Jan 2009.**

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**Engineers Without Borders**

**City and Guilds College Association- Old  
Centralians' Trust**

**Imperial College Exploration Committee**

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**University of London Convocation Trust**

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# Introduction

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*The Imperial College Altiplano Expedition 2008 was a student expedition to the Bolivian Altiplano. The students worked with local authorities, communities and Non-Governmental Organisations to investigate the possibilities for improvements to standards of living through small-scale engineering projects.*

## 1.1: Aims and Objectives

### Primary Aim:

**To carry out an engineering reconnaissance of the Azanake area of the Bolivian Altiplano.**

Aim to complete feasibility studies on 2 - 4 possible engineering projects, focussing both on the need and desire for the project among community members, and on engineering issues.

### Objectives:

- To obtain accurate measurements and records including photographs, site survey and geotechnical information.
- To carry out the above with minimal technical equipment, due to the remote location. This will develop the team's ingenuity and engineering skills.
- To obtain accurate and detailed information on the sociological aspects of potential projects.
- To return home with details of at least one project suitable to be implemented by a team the following summer.
- To obtain relevant permissions to carry out the construction, and to obtain information on appropriate design standards.
- To trek safely between project sites, to experience the scale of the Altiplano and the challenges posed to the communities living there.
- To experience and gain an understanding of the indigenous culture of the Altiplano.
- To broaden the team members' understanding of engineering in developing countries.

## 1.2: Expedition Summary

A team of 6 students travelled to the Bolivian Altiplano to work with local authorities and Non-Governmental Organisations (NGO), carrying out feasibility studies on small-scale engineering projects in remote communities. Despite many challenges, the expedition was ultimately successful, and the team has formed useful relationships which can be built upon in future years.

The expedition was led by Harriet Kirk with Hilary Dyer acting as Treasurer. Andras Szollár took on the role of Health and Safety Officer, while Lorena Martínez was responsible for sociological work as well as translation. The team was completed by Sarah Clayton and David Blundell. The expedition worked with a local NGO called CEDPAN, and with a local government official named Cidar Cepeda.

The first problems began before even reaching Bolivia, as delayed flights and lost luggage meant that the team were stuck in northern Chile for a week before travelling on to Bolivia by

## Section 1: Introduction

bus. In order to minimise the disruption to the planned itinerary, the team decided to separate, one group staying in Chile to chase down the luggage while the other went on to La Paz to meet NGO contacts. Eventually all but one of the bags were found and the team reunited in La Paz, at 3,600m above sea level.

A very successful meeting with Trifón Choque Jimenez, director of CEDPAN (*Centro de Educacion y Desarrollo de los Pueblos Andean*, a local NGO) left the team confident that working with CEDPAN would be beneficial for both parties. Trifón has been working with Altiplano communities for many years and has an excellent understanding of their needs. He gave good advice on all aspects of the expedition, from how to interview people without causing offence, to practicalities like where to find water. The team left this meeting planning to visit only one or two communities, staying in each for up to 2 weeks to build up a good relationship.

The team then travelled on to Challapata, around 4 hours south of La Paz by bus, at an elevation of 3,700m. This town is the centre of CEDPAN's work in the region and also the seat of government (the *Mancomunidad*) for Azanake province. Following a meeting with the leader of the *Mancomunidad*, Cidar Cepeda, all plans were changed as the team were given a full schedule of communities to visit, staying between 2 and 5 nights in each.

The expedition visited 5 communities in the area around Challapata; Macallo, Quehuallani, Rio Blanco, Corta Viento and Calacala. The projects seen were extremely varied, ranging from a 200m-span vehicle bridge (clearly beyond the scope of student engineers) to simple improvements to roads and housing. The team spent 2-3 days in each community, talking to residents, taking measurements and considering the logistics of a possible construction project.

The first two communities visited were nominated by the *Mancomunidad*. Unfortunately these visits were not particularly successful, due to an apparent lack of understanding of the team's capabilities which led to being asked to take on large and complex projects. Although the time spent in these communities was perhaps not used efficiently, it did enable the team to learn something about the structure of development work in the region, and to appreciate the importance of the *Mancomunidad's* approval for any project.

This led the team to return to Challapata to speak to CEDPAN, to discuss concerns over the communities visited so far. CEDPAN then agreed that the remainder of the expedition should be spent in three indigenous communities in the Norte Condo district. The projects found in these communities were much more appropriate for a team of students.

The original aims of the expedition included trekking between communities, in order to experience the scale of the Altiplano first hand as well as introducing an element of physical challenge. It quickly became clear that it would be difficult to integrate this with the more important engineering aspects, partly because of geography but also because of cultural differences which left the Altiplano residents unable to understand why the team wanted to walk.

However, the team were able to undertake one day walk (climbing Cerro Sirpo, 4740m) and one 2-day hike at the end of the expedition. This last trek took in *Cerro Follo Khaina (5054m)* and involved camping overnight at 4800m, in temperatures as low as -15°C. This was a challenging but very rewarding part of the expedition.

## Section 1: Introduction

After leaving Challapata, the team spent 2 days in La Paz, sightseeing and relaxing, before travelling by bus to Arica and flying safely back to the UK.

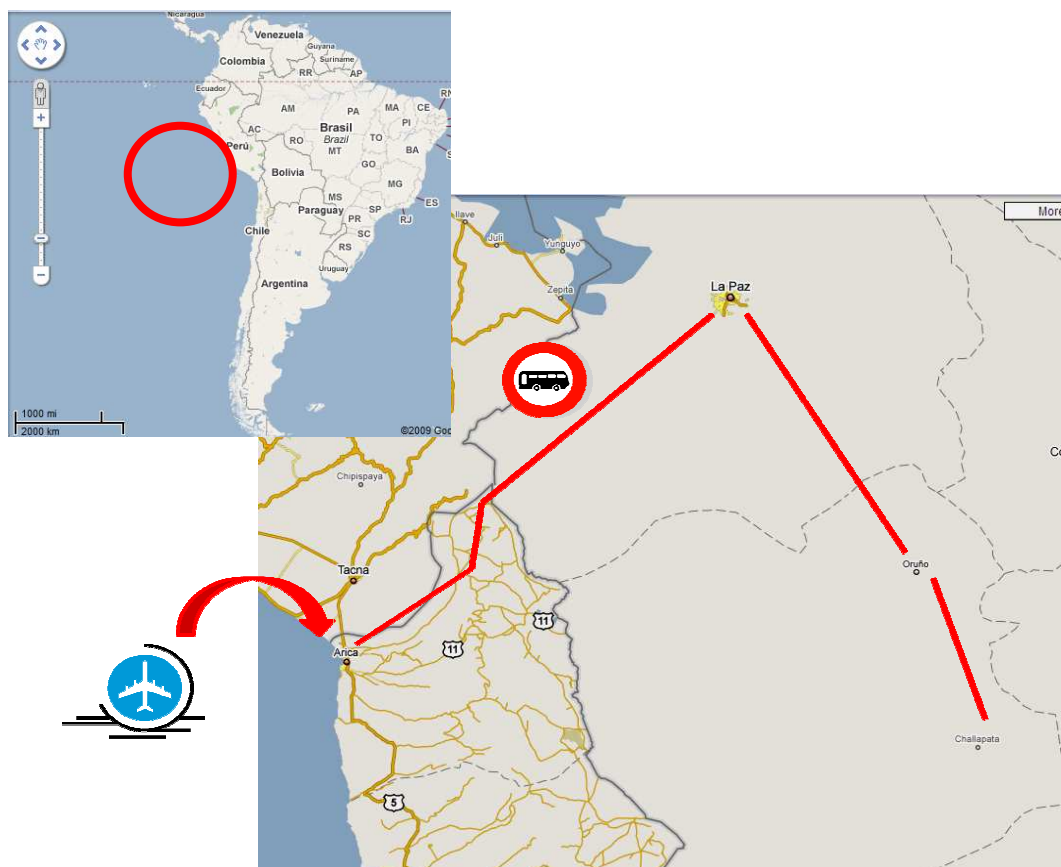
The expedition's progress was hampered by the initial delays, illness, and communication difficulties with the *Mancomunidad*. However, the team have now built a strong working relationship with CEDPAN which lays the groundwork for future expeditions. The team also has details of a number of potential projects which may be possible to build. These include pedestrian bridges and solar shower installation. The group also promised to send back information to the communities on simple improvements they can make themselves, for example to roads, houses and water sanitation.

Since returning to the UK, the team has spent time assessing all of the information gathered. A decision has been made that a return expedition to the village of Calacala is viable. This village requires 2 footbridges in order to allow children to travel to school during the rainy season, and to improve access to healthcare and markets. The process of planning this expedition has already begun.

### 1.3: Expedition Location

The Altiplano is a high, arid plain in the south west of Bolivia, at an altitude of 3500-4500m. Bolivia is divided into a number of administrative provinces, and the expedition took place in Oruro province, in the Azanake department.

As flying into La Paz is extremely expensive, the expedition flew to Arica in northern Chile and took a bus into Bolivia.



Maps taken from googlemaps ([www.google.co.uk](http://www.google.co.uk))

## 1.4: Expedition Diary

Day	Activities
1	Left London Heathrow
2	In transit
3	In transit
4	Arrived Arica (Chile) in the morning, checked in to hostel. Began chasing lost luggage.
5-6	Chasing lost luggage. Spare time spent planning studies. Made contact with NGO.
7	Team splits up. Harriet, Andras and Sarah go by bus to La Paz while the others stay in Arica to wait for luggage.
8	Acclimatisation to altitude in La Paz. Those in Arica take day trip to 3,500m to aid later acclimatisation.
9	Contacted Trifón Jimenez (CEDPAN) and arranged meeting. Investigated markets for supplies. In Arica, luggage finally arrived. 1 bag still missing
10	Meeting with Trifón and Germán (CEDPAN) in La Paz. Hilary, Dave and Lorena travel to La Paz bringing the luggage.
11	Acclimatisation to altitude for new arrivals. Shopping for food and replacement equipment.
12	Travelled to Challapata. Meeting in evening with German Ríos (CEDPAN).
13	Meeting with Cidar Cepeda (local government). Agreed on communities to visit and itinerary. Investigated Challapata and available facilities.
14	Further meetings with German, Cidar and community leaders. Shopped for final supplies and petrol for stoves.
15-16	Team in community 1- MACALLO
17	Returned to Challapata for regional fiesta.
18	Day walk to Cerro Sirpo.
19-23	Team in community 2- QUEHUALLANI
24	Returned to Challapata. Discussion of project so far.
25	Meeting with Germán (CEDPAN). Revised itinerary obtained. Meeting with community leaders of final 3 villages.
26	Team in community 3- RIO BLANCO
27	Team in community 4- CORTA VIENTO
28	Team in community 5- CALACALA
29-30	Trek back to Challapata. Final meeting with Cidar in evening.
31	Meeting with German. Some climb Cerro Sirpo while others arrange return to La Paz.
32	Return journey to La Paz.
33	Shopping and sightseeing. Arrangements for return to Arica and flights home.
34	Return journey to Arica.
35	Last day in South America. Swimming, sightseeing and shopping.
36	Left from Arica Chalacuta airport.
37	Arrived London Heathrow.



## 1.5: Team Members

### Harriet Kirk, 3<sup>rd</sup> year Civil Engineering Expedition Leader



#### Engineering Experience

- 2007- Imperial College Building Bridges Expedition to Malawi. Acted as Site Engineer, leading a team of two other undergraduate engineers, and helping to supervise a team of 30 unskilled workers. Completed a 37m footbridge, and learned a lot about low-technology construction.
- 2007- 8 week placement with Bachy Soletanche, a geotechnical contractor. Worked as Site Engineer, in charge of a site with two piling rigs and up to 15 labourers.
- 2006- Member of design team for Malawi Building Bridges project.
- 2006- One week spent working on a construction site in Liverpool with the charity Habitat for Humanity, building houses for low income families.

#### Outdoor and Travel Experience

- 2004- Three month's independent travel through Central America.
- 2003- 250km self-supported trek across northern Nicaragua.
- 2003- Raleigh International expedition to Costa Rica and Nicaragua. Environments included homestays in remote villages, and bivouacking in cloudforest at 3500m. Learned skills such as casualty evacuation and river crossing.
- 2002- present- Regular off-road runner, over distances up to marathon.
- Since childhood- Many walking, backpacking and skiing trips within the UK, both summer and winter, including wild camping.

Active member of Orienteering, Outdoor and Cross-Country & Athletics Clubs.

#### Other Relevant Skills and Experience

- Organisation: Currently Secretary (and previously Women's Captain) of IC Cross-Country & Athletics Club. Arrange teams, race entries, transport and accommodation.
- Assisted with fundraising for Building Bridges Expedition (2007), by contacting engineering companies, charities and trust funds. Also helped to organise tools and design documents.
- Leadership: Regularly take on a group leader position in projects at university. Play a strong leadership role within the Cross-Country Club, organising training and providing motivation to newer runners.
- Spanish: Spent 6 months in Central America, often in areas where little English was spoken. Currently studying Spanish level 4.
- First Aid: Completed St John's Ambulance 3 Cross Award (now expired). Attended several refresher courses covering CPR.

## **Hilary Dyer, 2<sup>nd</sup> Year Civil Engineering Treasurer**



### **Expedition and Outdoors Experience**

Participant in Inca Trail 5-day trek in Peru at high altitude (part of 3 weeks at altitude)

Several times a voluntary warden on RSPB Nature Reserves (mainly manual work), including 4 weeks at Haweswater Reserve, Lake District, winter 2005; 2 weeks at Arne Reserve, Dorset, 2004; and 2 weeks at Blacktoft Sands Reserve, Yorkshire, 2003.

Equivalent of a week's winter solo walking in Lake District, 2005

Solo walking weekends in remote areas of France and Spain, summer 2007 and spring 2006, carrying tent or survival bag for wild camping.

Regular participant in orienteering events since age 10, including multi-day events (Scottish 6-day 2003, Lakes 5-day 2006)

Secretary of Imperial College Union Orienteering Club

Active member of ICU Exploration, Cross Country and Athletics, and Fellwanderers Clubs

Currently training for Highlander Mountain Marathon, March 2008

### **Engineering Experience**

2007- Achieved a 1<sup>st</sup> in first year exams.

2007- 3-month placement, CMA-CGM Tower construction, GTM Construction (member of Vinci), Marseille, France. Work included drawings and logistics planning for unique slab formwork and shadow-gap column formwork in on-site offices, and 2 weeks working with surveyors on-site.

2007- 1-week practical surveying course as part of degree course

2006- 6-week placement, road construction, Sacer (member of Bouygues), Limoges, France

2006- 6-week placement, road construction working with surveyors, Eurovia (member of Vinci), 2006, Limoges, France

2005- 6 weeks office experience, Halcrow, Bristol

### **Relevant Skills**

Spanish: studied for 7 years at school, culminating in A-level (A), and Advanced Extension Award (Distinction, amongst top 10 highest scoring candidates) in 2005

Jan-Apr 2006: 3 month work placement in Spanish-speaking environment in Seville, Spain, during gap year. Currently studying Spanish level 4 as a Humanities subject.

Organisation and liaison: Managing Director of Young Enterprise Company while at school, demonstrating organisational and liaising skills. Company awarded West of England Company of the Year 2005.

First Aid: Intermediate Temporary Care First Aid certificate

## **András Szollár, 3rd Year Civil & Environmental Engineering Health and Safety Officer**

### **Engineering Experience**

- 2007- Half year industrial placement with Laing O'Rourke. Worked as a site engineer both with the structures and road works team, responsible for the construction of five bridges and two slip roads.
- 2006 and 2007- Imperial College 'Building Bridges' Expedition, Malawi 2006. Led the research and design phase, then the construction of a 37m span suspended type footbridge in rural Africa. Responsible for providing technical know-how and making amendments to the design on site, in addition to managing up to 45 labourers. Supported the 2007 team.
- 2006 - Led a week of voluntary construction work for students on a site in Liverpool with the charity Habitat for Humanity, building houses for low income families.
- 2006 - Three weeks design office training with Expedition Engineering. Worked as a student engineer involved in basic structural design.
- 2005 - El Salvador Reconstruction and Development Project. Construction of earthquake resistant houses and a retaining wall. Responsible for the engineering and quality assurance aspects of the project, in addition to being the Health & Safety Coordinator.
- 2004-present- Active member of Engineers Without Borders; committee member for 2 years.



### **Outdoor and Travel Experience**

- 2007- Health and Safety officer of the Imperial College Shimshal Expedition. This five-man student expedition successfully climbed the 6001m Yazgil Sar in the Karakorum Mountains of Pakistan.
- 2007 - Top third finish in Highlander Mountain Marathon (D category)
- 2005 - Two weeks individual backpacking in the Central Americas, including ascent of Volcan Acatenango (3976m) in Guatemala, numerous other volcanoes in El Salvador, and trekking and camping alone in the jungles of Honduras (after participation in the El Salvador project)
- 2004 – Present - Fortnightly weekend trips and weeklong tours in summer, spring and winter, climbing and mountaineering with ICU Outdoor Club around the UK and Europe. Traditional climbing up to HVS and winter mountaineering, up to Scottish Grade V-VI.
- 2004 - Leader of a six day Expedition to Yosemite National Park (in winter conditions, using snowshoes), including logistics and all preparations.
- 2003 - Five week trip to Ecuador; hiked up to 5000m on Vulcan Chimborazo.
- 2003 - Co-Leader of seven day expedition to the Grand Canyon, including logistics and all preparations.
- 2001 - Gained 'Leader for Hill Walking' certificate after eleven week training, including navigation, logistics, first aid, etc; Environmentalists' Association, Hungary.
- 1999-05 - Co-organizer of nomad, environmentalist camps for children, including construction of facilities in rural areas, logistics for a NGO and teaching Navigation, First Aid and Survival skills to youth groups.
- 1993- Present -1-3 weeks of skiing annually in Slovakia, Austria and the Italian and French Alps above 3300m.

### **First Aid**

- 2005 - Completed additional two day 'Outdoors' first aid course, including new CPR protocols.
- 2004/08 - First Aid at Work qualified St John Ambulance member. Attended many duties and treated numerous casualties. Presently site first aider for Laing O'Rourke.
- 2005 - Prepared a manual of 'First Aid for Rural Areas' to be used by Engineers Without Borders – Imperial Branch for use on expeditions and rural projects; and by El Salvador Project – 2005 and onwards.
- 2002/04 - Search & Rescue and Wilderness Leader trainee then core-team leader in New Mexico – Rocky Mountains 2-4000m, including several 3-4 day trips and training rescues (including winter conditions). Trained as an American Red Cross Emergency Responder, with Medical gasses and CPR for professionals and NOLS Wilderness First Responder.

### **Spanish**

- 2005 - to present - took non-credit evening course of Level 3 Spanish
- 2005 - spent 8 weeks in Central Americas on a volunteer construction project and individual backpacking.
- 2002/04 - 2 year Spanish course, ending with A/S level equivalent exam
- 2003 - 5 week trip to Ecuador.

**Lorena Martínez, University of Liverpool**  
**Erasmus student from the Institute of Education Sciences at**  
**University of Oviedo, Spain**  
**Sociology and Translation**



### **Relevant Skills & Experience**

- 2007- Translation and language skills (Spanish – English) course at Liverpool University; listening into lectures at the Institute of Latin American Studies
  - 2006 - present - Pedagogical skills course, University of Oviedo; including languages and cultural, sociological and philosophical aspects
  - 2006 - Read the Sociological report of the El Salvador Reconstruction and Development Project - written by Luz Gutierrez (Madrid). It was the first time that this annual Imperial College construction project, organised by civil engineering students, ran a sociological study on the effects of the project on the communities.
  - 2002/07 - Was trained in and later led workshops in cultural centre in Oviedo for adults and teenagers, discussing human rights, gender related issues, significance of language and culture in understanding society. This included preparing and doing basic surveys on focus groups.
  - 2000/02 - courses about Latin America, including linguistic, cultural and sociological aspects.
- Translation - Speaks fluent English and Spanish among other languages, and has significant experience in translation, including different dialects of Spanish as well.

### **Outdoor Experience**

- 2007/08 - Member of IC Union and the Outdoor Club, participating in weekend trips and Easter tour.
- 2008 - Currently training for Highlander Mountain Marathon, March 2008

1995 - to present - Regular trekking and camping in the Cantabrian Range, Northern Spain, up to ~2500m as a Member of the Corvera hiking club, including several multiday camping trips both in winter and summer conditions.  
Member of the regional mountain sports federation.  
Cycling, running, playing tennis and volleyball regularly.

## **Sarah Clayton, 2<sup>nd</sup> Year Civil & Environmental Engineering**

### **Relevant Skills & Experience**

I achieved a 1<sup>st</sup> last year so would like to put my learning into practice.

Engineers Without Borders - UK: Until the end of August I was the EWB-UK Appeal Coordinator. We managed to raise over £15,000 with many companies providing us with in-kind donations of administrative and IT support. This role required good communication skills as well as time management. I am also part of the National Fundraising team, which is currently organising the 'Big Event'; a dinner to raise awareness of what engineers can do to support development work.

I moved out of home for my gap year so am used to being independent and self-motivated.

I have been playing hockey for many years and am currently playing for Imperial Ladies 1<sup>st</sup> team. This continuously improves my team work skills.

Whilst at school I took part in the Duke of Edinburgh Bronze scheme and the Headmaster's 50-mile Challenge (walking 50 miles in 24 hours). I have experienced backpacking/camping and lots of outdoor trips.



## **David Blundell, 2<sup>nd</sup> Year Civil Engineering**

### **Relevant Skills & Experience**

2007- Achieved a 1<sup>st</sup> in Civil Engineering 1st year.

2007- Completed a three day trek in the High Atlas, Morocco, across 4 mountain passes (2800m)

2007- Came 2<sup>nd</sup> in Imperial College Night hike, navigating and running approximately 30km during the night

March 06 – August 07- Travelled independently around Thailand, New Zealand and Australia. Took part in an organised two day hike in the mountains of northern Thailand. Walked the Tongariro Alpine Crossing, and trekked the whole of the Abel Tasman national park in New Zealand on my own, carrying all my camping equipment.

August 05- cycled from Bristol to Trevoze Head, Cornwall, in three days carrying all equipment between the two of us.

Have been running for many years (annually running the Bristol half marathon) and am now the captain of the cross country club, organising training sessions as well as travel and accommodation for races.

I also go camping in Cornwall every summer, however would like something more active and adventurous that would allow me to put my engineering knowledge into practice.





## Planning and Preparation

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### 2.1: Initial contacts

The expedition needed to identify an appropriate partner NGO with which to work. Research began with internet searches to find UK academics or organisations who might have in-country contacts. Larger NGOs known to run programmes in Bolivia were also contacted; however this was found to be unsuccessful, as they already have access to the engineering expertise they require.

This research allowed the team to narrow down the field to a choice of two organisations; *Centro de Educación y Desarrollo de los Pueblos Andean* (CEDPAN) and *Suma Jayma*. The first of these was contacted with the help of Richard Beckett, a British man working in La Paz with an organisation called Khana Wayra.

Both of these organisations were contacted by phone and email in order to discuss the team's aims and capabilities, to see how these could aid the organisations' work in Bolivia. Both NGOs were keen to work with the expedition.

Eventually CEDPAN were selected as the most appropriate partner. The chief reasons for this were:

- A strong working relationship with the local authority, in particular the leader of the *Mancomunidad*.
- Current programmes focussing on education, youth development and agronomy, as well as technical assistance to communities.
- Excellent knowledge of local communities and their needs, and of Altiplano life.
- Experience of working with outside organisations and student groups, having been involved with a similar project with a Belgian group.



Initial meeting with CEDPAN officials in La Paz

Full details of organisations contacted and individuals who gave help or advice can be found in Appendix A.

### 2.2: Training

#### 2.2.1: Laing O'Rourke Training Days

The team were very lucky to be offered two training days run by Laing O'Rourke, an engineering contractor, which covered site safety, risk assessment, environmental hazards and group dynamics exercises. One day was spent in the Laing O'Rourke offices in Dartford, UK, and one onsite at a housing development practicing the skills

## Section 2: Planning and Preparation

learned the day before. The days were well-presented and interesting, and all the team felt they were extremely useful. In particular, experience of carrying out risk assessments onsite was very good practice and proved very useful while on expedition.

### 2.2.2: Wilderness Medical Training, “Far From Help”

Two team members attended this 2-day course at the Royal Geographical Society. It covered a variety of medical conditions, including altitude and cold-related illness, and taught a range of techniques to deal with medical emergencies in a remote area. Having attended this course, these two team members were able to act as support to the main Health and Safety Officer, who has considerable experience of wilderness medicine and first aid.

### 2.2.3: “Mini Expedition” to Dartmoor

In preparation for the expedition to Bolivia a five day backpacking trip was planned for the 14th-18th April 2008 on Dartmoor (UK), to try out various aspects of the expedition such as the food and surveying equipment, as well as allowing the team to bond while carrying out activities similar to those to be carried out in Bolivia. However, due to work commitments, it was eventually only possible for four members of the team; Harriet Kirk, Hilary Dyer, Sarah Clayton and David Blundell, to go on the trip.

The first and last day of the trip acted as a walk in and walk out, and while not adding any extra significant trekking or a chance to survey it did allow the members of the group extra an opportunity to practise pitching and striking the tents, as well as to use the stoves, and co-ordinate the different jobs so that they could settle down for the night as quickly as possible.



Camping on Dartmoor

After a morning of trekking, the afternoon of the 19<sup>th</sup> of April was spent practising surveying techniques with some of the equipment that was taken to Bolivia. It was the first time that Hilary, Sarah or David had been required to carry out surveying without the use of modern equipment, and it demonstrated the co-ordination between the team members that was needed to survey

using the equipment that was available. It also became apparent over the course of the afternoon, that these methods of surveying used could be quite time consuming compared to the modern methods that they had experienced before, and that the

## Section 2: Planning and Preparation

time management of the group when working in communities would be important to make the most of their time in each village.

The 20<sup>th</sup> and 21<sup>st</sup> were used as longer trekking days, and over the boggy and hilly terrain of Dartmoor the group were able to cover around 20 miles on each day, while also allowing time to strike and set up campsites and feed themselves before it was dark.

This trip also allowed the group to test the provisional meals that were to be eaten while in Bolivia. While the evening meals were considered to be good, the members of the trip felt that lunch, which consisted of a range of high calorie foods to be snacked on throughout the day, would be better if replaced with a single meal which could be eaten at a lunch time rest break. Another problem encountered was the extra time and fuel needed to cook traditional porridge for breakfast, with the alternative of instant porridge, or a cereal alongside a hot drink being raised. Both of these changes were made to the menu on the full expedition, due to feedback from the members of the trip to Dartmoor.

### 2.3: Fundraising

Fundraising was a major part of the preparation for expedition. It was calculated that the team need to raise in excess of £10,500. Two members were assigned the role of raising this money, namely Sarah Clayton and David Blundell. Firstly, in order to show commitment to the expedition, each of the team members was asked to contribute £500. There was the possibility of this amount being increased if other sources of funding couldn't be found. Applications were made to the Old Centralians' Trust and ULU Dunsheath Expedition Award in February 2008 both of which were successful. Through contacts with Imperial College's El Salvador Team, the Bolivia Team was able to secure funding from Laing O'Rourke.

The team's first attempt to apply for Engineers Without Borders (EWB) funding was unsuccessful, as EWB did not feel that their aims were fully met. After receiving feedback the application was rewritten to demonstrate that the expedition did meet EWB requirements and funding was awarded. This demonstrates the importance of tailoring an application carefully to the organisation, and bringing out the relevant aspects of the project.

The expedition also benefited from a generous donation from a source who has requested anonymity.

A full breakdown of all contributions and expenditure can be found in Appendix B.



## Logistics

### 3.1: Transport

The expedition did not start off well as far as transport was concerned. The flights were booked through Opodo which meant that there was very little flexibility with regards to flight times. This led to the team missing each pre-booked flight due to delays on every leg. So after much debate with various airline companies, as to who was to blame, the team stayed overnight in Madrid and Santiago, arriving two days late in Arica.



Waiting for yet another delayed flight

To add insult to injury, due to the fact that the team flew with several different companies our luggage did not arrive with us. In order to avoid these problems in the future it would be advised to make sure there is adequate time, at least 4hrs, in each stop-over location. Also it is advisable to fly with as few companies as possible so that if problems occur there are fewer people to deal with.

Within South America our main form of transport was by bus. For longer journeys such as that across the Chile-Bolivia border the team travelled by coach. Overall the standard and comfort of Bolivian coaches was high. Individual seats are assigned and luggage tags given. The only issue encountered by the team is that the timetabling often meant an early start.

Between Challapata and the individual villages the team took the local form of transport, mini-buses. These are privately owned and so there are no formal timetables. The team mainly had to use word-of-mouth to establish when & where the minibuses were going. Patience is needed as the mini-bus will generally only go once full and stops whenever anyone needs to get off.

Overall the team's experience of transport within Bolivia was positive with only one occurrence of a team member being 'ripped off'. This occurred due to the fact that the team member was not fluent in Spanish and travelling solo which was unavoidable but not recommended.



Travel by minibus in La Paz

## Section 3: Logistics

The team had been warned that there was a risk of delays caused by roadblocks due to political protests. In fact there was a roadblock between Challapata and La Paz on the day the team chose to travel back. However it was easily avoided by the driver taking an alternative route. This suggests that the threat of roadblocks may cause minor inconvenience but is not a serious problem.

### 3.2: Accommodation

While in towns and cities, the team stayed in a range of hostels.

#### 3.2.1: Arica (Chile)

##### Sunny Days Hostel

*Recommendation:* \*\*\*\*\*

*Prices:* US\$7 pppn

*Location:* ~30 minutes walk from centre of Arica, 5 min from main bus station

*Services:* unlimited breakfast included, communal kitchen, free internet and body boards and towels for beach, cycle hire (up to 4 bikes)

*Comments:* This place, with the indescribable friendliness of the owner, Ross, is a haven for all travellers. After a long struggle with missed flights and lost luggage, Ross became our guardian angel. It was not a problem at all that we were a few days late, he helped with hunting down our luggage and gave advice on where to go, what to see and what to be careful about in Arica. The place was tidy, welcoming and peaceful – apart from the school opposite preparing for a parade!



The team say goodbye to Ross- probably the best hostel owner in the world!

*Contacts:* Website: [www.sunny-days-arica.cl/](http://www.sunny-days-arica.cl/)  
Email: [sunnydaysarica@hotmail.com](mailto:sunnydaysarica@hotmail.com)

#### 3.2.2: La Paz (Bolivia)

##### Hotel Majestic

*Recommendation:* \*\*\*

*Prices:* US\$21 for a triple room

*Location:* right in centre ~20 minutes walk from main bus station

*Services:* minuscule breakfast included, no kitchen, en suite rooms

### Section 3: Logistics

*Comments:* Although this place was the quietest we found in La Paz, that was about as good as it got. Clean rooms and good showers were appreciated but staff steal cash from the rooms if they can find it (reception has a sign that they “do not take responsibility for any valuables left in the room” for a reason).

Contacts: Tel (00 591) 245 1628

#### **Loki Hostel**

*Recommendation:* \*\*

*Prices:* US\$6 pppn

*Location:* A bit further from the centre, ~40 minutes walk from main bus station

*Services:* all you can eat breakfast (tea and bread rolls), no kitchen, lockers in the room, shared bathrooms, TV/playstation room, oxygen-bar, and other touristy things

*Comments:* Warning: this is a party hostel. It might seem calm if you register during the day, but that is only because the guests are too stoned or have a bad hangover after the previous night's party. You cannot sleep, or rest, whatsoever. Would only recommend it if one wants to spend a few nights partying with a bunch of other young people from Europe and the US.

Contacts: Website <http://lokihostel.com/>

#### **Alojamiento El Solario**

*Recommendation:* \*\*\*\*

*Prices:* US\$4 pppn

*Location:* right in centre ~20 minutes walk from main bus station

*Services:* No kitchen, free internet, shared bathrooms

*Comments:* Probably the best place we stayed at in La Paz for a good price. Sufficiently calm for resting and has its own tour agency for biking and treks; in case you have some spare time for some touristy activities.

Contacts: Tel: (00 591) 236 7963

Email: [elsolariohotel@yahoo.com](mailto:elsolariohotel@yahoo.com)

### 3.2.3: Challapata (Bolivia):

#### Residencia Virgen del Carmen

*Recommendation:* \*\*\*

*Prices:* US\$3 pppn

*Location:* in centre, right next to main bus station

*Services:* no kitchen, toilets / showers which rarely work

*Comments:* This is pretty much the only option in Challapata. It is next to the main square. Avoid the rooms facing the street at all costs... buses leave for Oruro frequently from 4 am onwards and it is nearly impossible to sleep next to people shouting 'Orururururu' continuously. Running water is available only until 10am, and only on the lower floors due to low water pressure. The staff are friendly and there is an amazing roast chicken eating place right next door... but hurry or the chicken is gone!

*Contacts:* Tel (00 591) 2557 2538



## 3.3: Equipment

**Cold weather equipment:** Each member of the expedition took a Rab Neutrino Endurance down jacket and a Rab Ladakh 800 sleeping bag (except for Andras who took a down jacket and down sleeping bag made by PHD, both bought for a previous expedition). These proved invaluable while on the Altiplano and the jackets were worn morning and evening every day. While there were differences between the expedition members in the amount of clothing that needed to be worn inside the sleeping bag, everyone was able to sleep comfortably in them, with the exception of Hilary who was using a rented sleeping bag because her luggage had been lost (highlighting the quality of the ones we had brought with us).

**Tents:** While in communities, accommodation was always provided in adobe huts. Due to the hospitality of the communities and the small amount of trekking done, only one of the tents was used for one night only, with four members of the expedition using the North Face tent at 4800m near the summit of Cerro Follo Khaina. The tent performed very well in the



Warm jackets were appreciated on cold mornings



### Section 3: Logistics

conditions, and though quite a close fit, accommodated all four people and their trekking equipment.



Dave in his sleeping bag

**Stoves:** The stoves used by the expedition (the MSR Whisperlite International) again were very good. Particularly useful was their ability to run on a variety of fuels, as petrol turned out to be more difficult to buy than expected in Challapata, leading to the team having to buy some petrol away from official petrol stations. The only thing that might be an issue is that the stove is not very good at heating at a variety of temperatures, however the food on the expedition was very simple, so there were only a couple of meals where this became a problem.

### Survey equipment:

The following equipment was used for taking measurements on site:

- 30m steel tape measure
- 2x 5m tape measures
- String
- Plumb bob
- Spirit level
- 12m clear plastic hose
- Funnel



Getting bubbles out of the hosepipe before levelling

All of the surveying equipment that was taken proved to be useful. Using the plumb bob and a tape measure it was possible to level a cross section very quickly, in cases where the height difference on the cross section was not too large (under 2.5-3 metres). If the height difference was any larger, then the clear hose had to be used instead. Although it is slower to use than the plumb bob the larger height difference it could measure over proved to be very useful. The hose could also be tricky to fill with water before surveying, and in places away from a water source this had to be considered before hand, but with a little forward planning and the help of a small funnel this was not a large problem. The

30m measuring tape proved to be very useful despite of its weight, however the team found that it could be quite difficult to get the household string taut, and that fishing line would have been a better alternative, if it had been available.

## 3.4: Food

### 3.4.1: Food on 4 day Training Expedition, Dartmoor

On this training trip possible expedition meal plans were tried out. Research into food that would be available cheaply in Bolivia was carried out by asking contacts that had visited or lived in Bolivia, and taking advice from previous expeditions. The advice was that dried potato (*chuño*) and dried meat (*charqui*) that could be rehydrated before eating, would be readily available in markets. For the training trip to Dartmoor, the aim was to eat food as similar as possible to that planned for the expedition. However it was difficult, if not impossible, to find *charqui* and *chuño* in England, so we substituted salami sausage and mashed potato for the Bolivian equivalent. We were advised that the pasta available in Bolivia was suitable for soups but not for eating as a pasta dish, so we used noodles on Dartmoor. Quinoa is a corn crop grown on the Altiplano which we tried to imitate with couscous. The weight of food to be carried was also considered in planning for Dartmoor.

Dartmoor menus (per person per day)

<b>Breakfast</b>
50g porridge (with dried milk and sugar)
tea/coffee/hot chocolate
<b>Lunch/Snacks</b>
1 pack jelly
100g chocolate
1 pepperami stick
250g dried apricots/figs
<b>Dinner 1</b>
1.5 packs flavoured noodles
Dinner 2
1.5 packs flavoured noodles
Dinner 3
1 pack harissa-style couscous
25g chorizo-like salami stick

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Dinner 4
dried mashed potato
gravy
50g smoked pork sausage
<b>Desserts</b>
1/2 pack instant custard or chocolate dessert
soup packs for 3 meals were also taken

These menus were unsuitable for a long-term expedition due to the lack of fruit and vegetable content. It had been decided that quick-cook dried vegetables would be a good idea, but we had been unable to find them for this trip. Comments made by the team members were that the lunch was not substantial enough for a full day's walking and that savoury food at lunchtime would also be welcome. Crackers or biscuits were suggested. It was also noted that since a calorie calculation had not been carried out, not enough calories were being consumed for a long-term implementation of these menus. These comments were noted and it was decided efforts would be made to change these points for the actual expedition.

#### 3.4.2: Expedition Food taken from England

Some foods were taken from England (as advised by members of previous expeditions to Bolivia) as these would not be available in Bolivia and would be lighter or more suitable for camping than equivalents available in Bolivia.

	Weight	Units	Total
Dried milk packs	454g	6	2.7kg
Dried potato mash packs	250g	8	2kg
Soup packs	72g	3	216g
	104g	3	312g
	88g	3	264g

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Hot chocolate powder	400g	4	1.6kg
Coffee	100g	1	100g
Dried instant desserts	38g	14	532g
	49g	6	294g
	72g	20	1.44kg
Soya mince	200g	2	400g
Sauces	25g	2	50g
	35g	4	140g
	40g	10	400g
	43g	2	86g
Spices, pepper, salt			
Teabags		54 bags	

Dried mash was taken despite being advised that dried potatoes would be readily available as we were unsure whether these would weigh too much to carry whilst trekking. It was in fact possible to obtain this and all the other items taken from the UK (except dried milk, instant desserts and soya mince) in La Paz. Although the team tried to research the foods available to them in South America, it was found that the advice did differ slightly from those that they found in reality, as can be expected.

#### 3.4.3: Expedition Food: In towns (Arica, La Paz, Challapata)

Food during these times was either bought in a supermarket and cooked in the hostel (in the case of Arica as this was considerably cheaper) or the team ate in cheap restaurants. Restaurants in La Paz were chosen to be ones where many locals were eating, and these were cheap enough to come in under our £4 per person per day budget for food. Before leaving La Paz we bought food from a supermarket that would be suitable to take on a trek to a village and carry for a week at a time. In Challapata there was no provision for cooking in the hostel so the team ate in restaurants again; oddly the only ones available were more expensive than in La Paz. Due to the unexpected increase in the amount of time we spent in towns, especially Challapata, the food we had bought in La Paz was not eaten as it was not possible to cook it as would have happened had the team been camping. It was not possible to change the circumstances, so some of the supplies bought in La Paz were eventually surplus to requirements and were given to the porters at the *Mancomunidad* offices



## Section 3: Logistics

who had looked after our extra equipment while we had been visiting communities on the Altiplano.

### 3.4.4 Expedition Food: In rural communities

In several of the communities the villagers wanted to offer us their home-cooked food as a gesture of hospitality. This was often welcome as it was quinoa soup, so suitable for the Altiplano climate, but sometimes the team had to explain that some team members with upset stomachs were not able to eat a complete meal at that time. In general, the team cooked for themselves when visiting communities.



Eating local corn soup

The plan made for meals cooked by the team, based on the available food sources, was the following:

<b>Breakfast</b>			
Option 1	Granola	130g	550
	Soya drink powder	40g	100
	Dried milk powder	2tblsp	~30
	Nutmeg/cinnamon		
Option 2	Porridge oats	133g	500
	Soya drink powder	40g	100
	Dried milk powder	2tblsp	~30
	Nutmeg/cinnamon		
Drinks options:	Hot chocolate powder	4 tblsp	100
	Tea		
	Coffee		
	2 tsp sugar (in any drink)	8g	30

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<b>Lunch</b>			
	Chocolate	50g	200
	Savoury biscuits	50g	200
	Dried fruit	25g	100
	Pepperami	25g	100
	Drinks powder sachet	1/2 sachet	100
	Nuts/cheese	25g	100-125

<b>Dinner</b>			
Soup	Instant soup packs	1/3 pack	70
Carb options:	Dried mashed potato	280g	500
	Pasta	100g	500
	Semola		500
Protein options:	Foil tuna packs	1/3 pack	200
	Pepperami	25g	100
	Soya flour burgers	2 burgers	100
	Soya mince	50g	100
	Charquí (dried llama meat)		unknown
Flavouring options:	Sauce packs (7 meals)	1/3 pack	50
	Gravy granules (2 meals)	2tblsp	50
	Tomato sauce (2 meals)	1/6 tube	20
	Soups as flavourings	1/3 pack	70
	Spices		
Desserts options:	Instant custard	1/3 pack	100
	Instant chocolate dessert	1/3 pack	100
	Instant other flavour dessert	1/3 pack	100

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Dessert addition	Sugar	2tsp	~30
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Average total calories per day	2500
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### 3.4.5: Evaluation of suitability of team diet



Sarah refuses to eat a lovely bowl of semola

Quinoa was found in the supermarket in La Paz but it was decided that the cooking time was too much for our calculation of petrol for cooking. (In reality this was not a concern because we had ample petrol due to the shortened number of days the team cooked using MSR stoves.) Semola flour was bought to replace this. This was eaten for one meal but it was decided this was not a long-term solution to quick-cook meals as it was unappetising. It was fortunate in this case that the reduced number of days visiting

communities meant that the team had other options they were able to use. Couscous could have been brought from the UK to replace this. Charqui was purchased but was not tried because the reduced number of days the team cooked for meant that enough other protein options remained. However, the team did try charqui that had been cooked by villagers and found it very tasty. It was decided that the lunch content was an improvement on that eaten on Dartmoor. Emphasis had been placed on incorporating variety where possible into the team's planned diet to combat the effects of altitude on the appetite. However, it was felt that sometimes further variety was needed for those who also had lower appetites than normal due to illness. It is evident that fruit and vegetables were lacking from the meal plans. This was due to concerns about weight to carry and conservation of food. Dried vegetables that required short cooking times to rehydrate had still not been sourced in the UK and would greatly improve the diet. Whilst in towns, the team ate fruit and vegetables so it is thought that within the short amount of time they were using the expedition meal plans this deficiency would have had little effect on them. The above meal plan fulfilled the estimated calorie requirement (as calculated according to expectations of physical activity) and was bought within budget of £3 per person per day.

### 3.4.5: Fuel consumption

The original target of only using stoves at breakfast and dinner was achieved. All breakfast options only required bringing water to boiling point so used the minimum amount of fuel whilst offering a hot and hydrating meal to help the team cope with the high altitude.

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With regard to evening meals, dried potato mash, soya mince, and soup was the most conservative combination of meal components as it only required bringing water to boiling point and did not require sustained boiling. All desserts again only required boiling water to boiling point so were fuel-economic.

#### 3.4.6: Cooking methods

Great efforts were made to keep the preparation and consumption of food as hygienic as possible. Based on experience of previous expeditions, the team was issued with labelled bowls, spoons and cups, and separate utensils were used for preparing food in communal pans. Each team member was responsible for keeping their own equipment clean. It is unknown how effective this was in preventing the spread of stomach illness between team members because each team member exhibited slightly different symptoms of illness when they became ill, and there were many other ways in which illness could be spread.



Eating out in Arica

## First Aid, Health and Safety

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The team took Health and Safety measures very seriously, in order to ensure safety of all members and minimum hindrance to the expedition. Two members had completed the Wilderness Medical Course offered by the Royal Geographical Society prior to the expedition. The team's main first aider and Health and Safety coordinator was Search and Rescue trained and was responsible for medical care on a number of prior expeditions. In this respect the expedition has built on previous Imperial College expeditions, including the 'Imperial College 2005 El Salvador Reconstruction and Development Project' and the 'Imperial College 2007 Shimshal Expedition'. None the less, there was a relatively high incidence of diarrheal health problems, which should be addressed. A detailed report on precautions taken and lessons learned follows.

### 4.1: Preparations

#### 4.1.1: Risk Assessment

The team carried out a full risk assessment prior to the expedition, including additional risks due to high altitude. The full risk assessment can be seen in Appendix C.

#### 4.1.2: First Aid kits

The Team carefully organized and separated supplies into 2 bags; one mainly for musculoskeletal injuries and another for prolonged treatment, including most of the general medications and antibiotics. For a full list of contents please refer to Appendix D.

#### 4.1.3: Vaccinations

It was strongly suggested that team members take the following vaccinations prior to departure:

- Typhoid,
- Yellow fever
- Hepatitis A
- Hepatitis B
- Polio
- Tetanus
- Diphtheria
- Tuberculosis
- Rabies
- Meningococcal meningitis

## Section 4: First Aid, Health and Safety

Personal decisions were taken into account in some cases; for example Rabies was not taken by some members. This did not cause any problems, although the very high number of dogs strolling in almost all parts of Bolivia should encourage anyone going to take the vaccination.

Malaria prophylaxis was not taken by the group due to the almost non-existent exposure to the risk (since the team did not intend to travel to areas of Bolivia below 2000m). Instead, precautions were taken to prevent mosquito bites (50%DEET repellent spray used in Chile); Doxycycline as effective prophylaxis was taken in case some members decided to travel to lower areas after the expedition (this did not happen due to time constraints).

### **4.1.4: Emergencies**

The team was prepared to deal with most not immediately life threatening conditions, including high altitude sickness and common serious illnesses which require antibiotic treatment. For extreme cases a satellite phone was carried to make emergency phone calls. Medical facilities were available in Challapata, Oruro and La Paz. Each team member filled out a Heath form (Appendix E) prior to departure, which could be used to provide details on any previous medical history or contact details for relatives.

## **4.2: Problems encountered**

Although the team was well prepared and educated about possible health issues, there were none the less some cases of sickness, most which were related to bowel problems. Some minor issues had to be dealt with, with regards to high altitude and eyecare.

### **4.2.1: Bowel problems**

#### **Precautions**

Personal hygiene: Team members followed strict rules with regards to personal hygiene, enforced throughout the expedition. Antibacterial hand gels were used before food preparations and eating as well as after going to the bathroom.

Water purification: In inhabited areas only bottled purified water was consumed by the team, and precautions were taken to avoid eating anything susceptible to contamination by non-purified water.

During trekking and staying in villages, iodine solution was used for purification. To minimize the iodine used (less effect on taste and better economy) only 2 drops /litre were added to reasonably clean water, and 3-4 drops /litre were added to susceptible water; i.e. from a well or water pipe in village. (Note: not all iodine solutions for

## Section 4: First Aid, Health and Safety

purification of water have the same concentration; therefore these numbers are only indicative. A minimum of 15 minutes need to lapse before treated water can be consumed).

Despite these precautions, by the end of the expedition each member had suffered from some sort of digestion system related problem, the two most serious cases being bacterial bowel infections.

Case 1: One member fell ill during the stay in La Paz, probably due to some food containing egg white that was not kept appropriately refrigerated. This member developed rapid temperature increase (up to 38.5°C), and significant abdominal cramps and some bowel movements. General stomach poisoning was suspected and initial treatment focused on decreasing temperature and pain from cramps by Paracetamol and letting the body clear itself. The patient felt much better by the end of the day (no cramps or high temperature) and insisted on eating normally and assisting the team in doing shopping the next day. The following day the patient had a high temperature again, felt bad and had increased bowel movements, which did not seem to diminish. As more than 24 hours had passed since the onset of first signs, simple stomach poisoning was out ruled and antibacterial treatment (Ciprofloxacin) with some antimotility agents to aid hydration (charcoal tablets) was started. The symptoms slowly decreased and after 5 days of treatment the patient was fit enough to join the group in the field studies.

Case 2: Another member fell ill in the field, after 2 days of field studies, with high temperature (39 °C) and weakness. Paracetamol was administered, however, showing no significant bowel movements confused the first aider significantly about the possible reasons behind the illness, and due to the proximity of health care it was decided to take vehicular transport to Challapata, so that medical care was available if needed. By the end of the day bowel movements increased significantly suggesting stomach poisoning, which was treated accordingly by attempts at rehydration. These, however, increased throughout the following day and hydrating the patient proved very difficult, even with hydration sachets, as any intake would induce vomiting. By this point the first aider was reasonably convinced that this must be a strong bacterial originated infection and should be treated by antibiotics immediately, with the addition of antimotility agents. However, as hydration of the patient was highly unsuccessful during the day, it was decided that medical advice should be sought first, as it was readily available.

A local medical professional suspected viral infection (still after 36 hours of onset) and would not administer antibiotics, but put the patient on drips to replace lost liquids and administered some stronger antimotility agents. The following morning temperature was high again (39°C) and bowel movements did not decrease (up to 15-20 /day); therefore, hospital was visited again, where finally another doctor admitted that it must be bacterial infection, and prescribed a strong antibacterial agent. It took the patient a full week afterwards to recover to a functional state.

All other members appeared to get sick from locally prepared food consumed in Challapata and the villages or La Paz sooner or later. One stomach poisoning self-improved after 24 hours, and one extended case was treated by antibiotics.

Ciprofloxacin proved to be sufficient to eradicate the problem after 3-6 days of treatment.

### **Recommendations for future expeditions**

Although everyone returned in one piece, the continuous struggling with stomach related problems for some expedition members suggests that certain improvements could be made in the future. Stricter protocols might be beneficial, for example not allowing anyone to eat off the street and experiment with questionably sourced food. At least 3 members got ill most probably because of that.

The most frustrating mistake, however, was to rely on unknown local doctors and nurses as the team was living in a populated area, as opposed to relying on the first aider's extensive knowledge and experience of diarrheal problems in developing countries. Not following instincts immediately, and not administering antibiotics when they were first thought appropriate, but instead consulting local practitioners, delayed the appropriate treatment of one member by 2 days, and hence her recovery by 3-5 days at least, causing her unnecessary struggles and weakness lasting for the rest of the expedition.

It has to be mentioned that the health care in general was very professional even in remote places, such as Challapata. It is likely that the treatment would not have been much if any better in Europe either, as medical personnel often prefer to wait for a few days before willing to administer strong medications. Unfortunately this does not fit very well with the tight timescale of an expedition!

From an expedition point of view, where tight schedules need to be kept, this prolonged waiting is not acceptable, and it is recommended to follow the following guidelines for bowel problems:

1. Symptoms appear: headache, abdominal cramps, diarrhoea and possible vomiting, temperature:
  - a. if symptoms are of rapid onset and bowel movements are non-productive after 12-24 hours, than it is highly likely that it is a stomach poisoning (due to toxins, viruses, etc)
  - b. if symptoms persist after 24 hours; i.e. still not able to intake fluids, diarrhoea does not diminish, fever may also persist and generally patient does not feel any significant improvement, than it will be due to bacterial infections which require antibacterial treatment
2. Treatment:
  - a. For first 24 hours: do not administer anything that restricts bowel movements to give the patient's body a chance to clear its system.
    - i. When onset is very rapid, i.e. symptoms develop in 1-4 hours into serious diarrhoea and nausea, it is best to encourage the patient to empty his/her system until nothing else can possibly come out.
    - ii. If there is any question whether it is indeed stomach poisoning, than avoid the above drastic actions.
    - iii. Either case: hydration of patient is of utmost importance. Rehydration drinks and water should be sipped frequently,



- even if this makes patient nauseous. No food should be given. If patient feels dramatically improved than easy to digest food can be given in small amounts (biscuits, bread, etc. NO fruit).
- b. If symptoms have not improved after 24 hours:
    - i. Start administering antibiotics. Ciprofloxacin was found to be the most effective general antibiotic. Follow dosage listed on prescription (usually double dose to start with than normal dose for the rest of the treatment).
    - ii. Aid hydration by giving anti-diarrhoeal agent to patient (Charcoal tablets, Loperamide, etc, effectiveness depends on patient).
    - iii. Hydration hydration hydration... and a bit of food to preserve strength of patient; this will depend on how much the patient feels able to eat. In worse cases sugary water can be sipped as an alternative energy source.
    - iv. Do not let patient stop antibacterial course early. Do not let patient exert him/herself or consume complex food (fruits, locally prepared dishes, etc) until symptoms have been absent for at least one full day. These are necessary to avoid fallback into infection.

General: Believe in your instincts built on previous experience, and treat members accordingly, with efficiency, even if in populated areas. Local doctors are not usually accustomed to treating westerners and will not promote the fastest recovery possible.

#### **4.2.2: High Altitude**

The expedition took place on the Bolivian Altiplano at an average altitude of 3500-4000m. Therefore, caution had to be taken with regards to risk due to high altitude (see Appendix C for detailed Risk Assessment). This section of the report discusses the team's preparations to minimise these risks.

#### **Preparations**

All team members were briefed about symptoms of altitude-related disorders to aid early recognition. In addition to general precautions, such as resting well before travelling to high altitude, the team carried medications to treat all major types of high altitude sickness, as a rapid ascent from sea level was expected.

#### **Acclimatisation**

Although the Team wanted to acclimatise by a step by step increase in sleeping altitude, due to the geography and organization of the region this was not possible. Therefore the Team was forced to increase sleeping height by 3500m in one day, which is well above the recommended values above 2000m. The team was also forced to split into two groups due to logistical issues. These two groups had the following experiences during travel from Arica (sea level) to La Paz (3,600m).

## Section 4: First Aid, Health and Safety

Team 1: travelled up to La Paz in one day, without any previous opportunity to be exposed to altitude. At the border crossing (~4100m) all members developed Mild Altitude Sickness: throbbing headache, weakness, lack of appetite, etc. These did not improve as members got into La Paz. Having to carry backpacks to accommodation caused further worsening. A strong dosage (600mg) of Ibuprofen helped to decrease headaches and allowed members to sleep relatively well. By next day symptoms had eased and, although feeling weak, members could deal with most tasks in town.

Team 2: took a day trip to ~3500m 2 days before travelling on same route to La Paz. Border crossing was without major problems, and most felt healthy and able to carry backpacks on arrival to La Paz. One member, who had low blood iron levels and was still exhausted from previous health issues, felt slight headaches and weakness. For this member it took a few days to get accustomed to the altitude.

Altitude medications did not have to be used for any team member.

### **Treks at high altitude**

Although most members noticed a significant decrease in physical abilities, most seemed to acclimatize well and were able to carry loaded backpacks through long distances. Working in the communities did not cause any major physical difficulties.

A day trip to a nearby peak (4742m) was completed by almost all members.

A two day trip to the second largest peak in the area (5048m) was completed by 4 members, who spent prolonged times above 4500m and slept above 4700m without any problems other than easier exhaustion.

### **Recommendations**

Although the ascent to 3500m from sea level did not cause any major illness, even a single day trip to elevated areas seemed to aid acclimatization prior to such an ascent. Therefore, if possible, it is strongly recommended to do such trips prior to large increases in sleeping elevation, even if sleeping altitude itself cannot be increased incrementally. La Paz was equipped with health facilities to treat the most severe cases of altitude sickness, in case someone did end up developing them. In order to ensure successful acclimatization of all members, Diamox might be worth carrying as a preventative medication, which aids oxygen intake, for the benefit of members who know that they might be more susceptible to altitude sickness. In this case allergy advice should be checked prior to departure.

## Section 4: First Aid, Health and Safety

### 4.2.3: Eye care

One member had a minor eye injury prior to departure. This was successfully treated by antibiotic ointment prescribed in the UK.

Two members used contact lenses during the trip. They used prescription glasses whenever possible. Otherwise they used daily disposable lenses to avoid infections due to limited hygiene, and no problems were noted.



Andras learning to play the Churrango (a traditional instrument normally made from an armadillo shell, although this one is wooden!)

## Engineering Report

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This section gives details of the team's work in the 5 communities visited: Macallo, Quehuallani, Rio Blanco, Corta Viento and Calacala.

Further details on the social and economic circumstances of each community are given in the Sociology Report in Section 6.

### 5.1: Macallo

Macallo was the first village visited by the expedition, and was a community recommended by the *Mancomunidad*. It is situated about 10km north-west of Challapata, off the road to Potosi. It is home to ten families, who farm the community-owned fields during the wet season, and tend their cattle and sheep during the dry season. The team were sent to look at a borehole that had been drilled in the community by a Japanese NGO, but had never been used for extracting water. The community had a few small wells for water, and electricity, however there were no sanitation facilities.

**Stated need:** Making a previously drilled borehole into a functional well, to provide cleaner drinking water and allow the villagers to water crops during the dry season.

**Current provision:** At present there is a shallow well (around 5m deep and 2m wide), which provides the village with drinking water. A borehole approximately 33m deep was drilled 5 years ago, by a Japanese organisation; however, there was no pump provided and the borehole was left sealed.



Well currently used by the village. Note uncovered openings.

#### Site walkover and initial discussions



Investigating the borehole

**Current well:** Although the well seemed to contain relatively clean water, the team noticed a high likelihood of contamination due to uncovered openings and proximity of animal and human waste. The well was clearly designed to have a lockable access-cover for maintenance and a manual pump to supply the water, neither of which was present at the team's visit. It is also located next to the main road, where large numbers of animals pass daily and defecate nearby or right onto the outside of the well, as is the case with the local dogs. The villagers noted that sometimes they find dead rats and other

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animals fallen into the well. It was also noted that during the dry season the water level drops significantly and that the well is just about sufficient to provide drinking and cooking water but not enough for animals or for agricultural use.

**Bore hole:** The borehole is located only a few meters away from the well and was measured to be 25m deep at present, with water level being initially 2.9m then 3.9m from ground level, as water was extracted manually by the team. The water was first cloudy, but as extraction continued (to about 40liters) it was only slightly soiled. The team was told that the Japanese group gave them no pump to run the borehole and that they did not have enough money to invest in their own. The villagers hoped that if working, the borehole would provide sufficient water to do agriculture during the dry season, including growing tomatoes, potatoes and other vegetables which the locals could sell at the Challapata market. Currently they rely on selling animal products during the rainy season.

**Alternative water supply, channel from reservoir:** There is a concreted water channel that runs from the nearby reservoir, however, this only provides water 2 – 3 times for a couple of days each time during the dry season, for unknown reasons. Villagers claim that ‘there should be enough water in the reservoir to irrigate throughout the dry season’. This water is used for irrigation rather than for drinking.

### **Outcomes**

**Current well:** It was considered most important to first improve the hygiene of the well currently in use. Cover the openings to avoid pests and other contaminants from entering the well. Surround the well with a fence to avoid passing animals defecating near the well. The team tried to educate the locals about the connection between these contaminants and related human diseases.

**Borehole:** It was found out from Cidar Cepeda that the Japanese organisation originally wanted to drill to a depth of 50-60m to avoid contamination from animals, however they stopped at 33m as they hit rock. They were only meant to drill the well and the town council was supposed to provide the pump, however they never did due to “lack of time and money”. The team could not gain any contact details of the Japanese organisation. The decreased depth measurements suggested that the borehole must have become silted up since installation, and thus a specialist cleaning pump would need to be used to make the borehole functional. Any normal pump that would be lowered would most probably break shortly due to the dirt. Such a borehole activating procedure should be done by a specialist and was therefore deemed inappropriate for the team. It was also noted that the villagers’ expectations with regards to agricultural use and animal feeding are probably beyond the capabilities of such a borehole.

**Irrigation channels:** The team visited the reservoir, which seemed to be almost full (only ~1m drop was observable even at the middle of August) which suggests that a re-evaluation of the present reservoir handling scheme might be worthwhile, however, this is on a higher governmental level.

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**Stated need:** A bridge to cross one of the canals coming from the reservoir. During 4-5 months of the rainy season, the canal is full and animals cannot cross to feeding grounds, nor can trucks to collect the harvested crops.

**Current provision:** At present there is a section of the canal without concreted sides, where the path leads across. Vehicles can cross here when the water is low. There is also a small concrete plank without handrails next to a weir with a large step in the

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canal, where animals can cross during the dry season, however, they are too afraid to cross when there is rapid water making loud noises at the falls.

### Site walkover and initial discussions

Talks to some of the other villagers revealed that the importance of this crossing is nowhere near as high as the water issues. A crossing of similar dimensions was found further upstream, leading to another section of the lands; the dimensions of this could be used for future design of such crossings. The concrete planks were made by the locals as well, who have said that if they were given some drawings and plans, they could probably construct the bridge themselves.



Looking at the current bridge across the irrigation canal

### Outcomes

It was perceived that the construction of a new crossing is not the most urgent priority for the village and therefore first the possibility of improving the crossing at the weir should be considered. This could be done by simply filling the downstream part of the weir with some boulders to soften the noise from the passing water so that animals would not be afraid to cross. Widening and providing some rails to this could also enhance the safety of the crossing. Alternatively, engineering drawings for such a small scale bridge could easily be provided by the students.

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**Stated need:** Road improvements between Macallo and nearby junction, which joins the road towards Peñas, Quehuallani and Apanake.

**Current provision:** At present the road is made from hard packed silty sand; an old gravel layer can also be seen in some places. It takes a winding path between the fields and the steep clay-formations of the next higher section of the plateau. The surface is very uneven in places and appropriate drainage is rarely present. The community stated that their vehicles keep breaking down due to the bad quality of the road and during the rainy season it can become impassable by vehicles altogether. All maintenance is carried out by the village residents, and consists of filling in the potholes with whatever material is found nearby.

### Site walkover and initial discussions

The team walked through the section of the road with two village representatives, who pointed out some of the problems. It was discovered that the road leading to Peñas will probably receive asphalt cover in the coming years; however, improvements will not take place on the section leading to Macallo. The villagers expressed desire to have their bit covered with asphalt too.

### Outcomes

It was discussed with the villagers that an asphalt cover would need to be provided by the government due to the expense and machinery required. That is something our team would not be able to provide help with. However, dirt road improvements which can be done by manual labour only were discussed with the representatives as the team walked along the road. These included: alignment, surface and levelling corrections; manual methods for better compaction, materials to be used; and



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establishing an effective drainage system along the road and across junctions and other complicated sections. These have been summarized on site and translated into Spanish so that a simple manual with easy to understand images can be prepared and used in Macallo, but one that could also be used in other communities for similar problems (see Appendix G).

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**Stated need:** Housing improvements and building of new houses.

**Current provision:** At the time of the team's visit there was a wide range of different quality houses present. From discussions with the locals, the team perceived that once a house is not in a good state, it is simply abandoned and a new one is built.

### Site walkover and initial discussions

The most common houses were built directly onto the ground (no foundations) using adobe bricks for the walls and thatch or tin sheets on timber structure as roofing. Windows were small and often only partially covered; doors were made of timber planks. A few houses had reinforced foundations, using stones or even some cementious mortar.

The main reasons for deterioration were found to be rainwater related damage to the roof structure and the bases of the walls. Non-existence of guttering with a combination of short eaves – barely going over the top of the walls – led to erosion of the bottom of the walls, due to splashing from ground. Poorly-maintained roofs allow water to leak onto walls and erode it from top down.

Another problem was the lack of thermal insulation and high noise levels under tin roofed houses. Villagers claimed that although they are aware of the benefits of the older ways of constructions (thick walls, thatched roof), it is also more expensive and takes more effort and time to build and is more difficult to maintain, therefore they now build mostly in the newer way, using thin walls and tin roofs.

### Outcomes

The following recommendations were thought to be appropriate and relatively easy for the community to implement.

**Strengthening existing buildings:** it was thought that even simple measures, such as placing some rocks next to the bottom of the walls and extending the eaves of the roofs could significantly reduce erosion by rain.

**Rainwater retention:** collecting the rainwater runoff from roofs by installing gutters would protect walls and if collected, could provide good quality water for drinking or other usage.

**Insulation / Noise:** Some houses already filled in the gaps between roof timbers with hay and noted significant reduction of noise and better thermal properties. The walls



A typical adobe house in need of repair



Erosion of base of wall

could also be thickened – older, thicker-walled buildings were known to be thermally better – even if only by addition of old bricks from unused / half destroyed houses. It was noted that due to poor maintenance, walls have often cavities in them. These should be filled in. Application of additional ‘plaster’ finishing layer could also enhance this. Windows and doors should be fitted without gaps and could be covered by hay-pads/blocks during the night for better insulation.

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**Stated need:** Although it was not stated by the community itself, the team perceived that sanitation issues should also be addressed as a matter of urgency. It was however mentioned that locals would like to have bathrooms in their houses with running tap water.

**Current provision:** There were absolutely no provisions for defecation, keeping to a ‘go anywhere’ principle. Water resources were not tended appropriately, as seen in the example of the well.

#### **Site walkover and initial discussions**

Although the village had access to electricity and basic means of transportation, the locals appeared to be particularly uneducated about and/or unwilling to address sanitation issues appropriately. None of the houses had latrines, wash basins or any similar facilities. The villagers claimed that they do not like the idea of latrines, because they would smell. They would rather keep defecating outside than have to smell anything. It was also noticed that connections between such contaminant sources and related human diseases are not understood. For example, it was stated that on average the villagers need to go to hospital due to serious illness – mostly bowel related – twice a year, and the doctor’s explanation would be ‘greasy food’. The team understood that this is more likely due to the issue of sanitation being a taboo rather than a lack of quality of the medical system.

#### **Outcome**

The team believes that there is an urgent need to provide basic education on sanitation issues to the people of Macallo, and probably many other communities in a similar situation. Without understanding of the importance of such measures, the people will not alter their behaviour, no matter what facilities are provided. Such a programme is to be suggested to CEDPAN, and is already in part under way in some of the areas.

Then, as a first step, designated toilet areas could be established, separate from animals and safe from rain water runoff. Later, simple pit latrines should be implemented, taking into considerations of implications to ground water – relatively high ground water levels can be a problem – and a relatively ‘smell proof’ requirement. A fact sheet on sanitation issues has been prepared which CEDPAN can use to aid their education programme.

Improvements to the water supplies have already been discussed.

## **5.2: Quehuallani**

Quehuallani was the second community that the team were sent to by the local authority. It is large village, with around 200 residents, and is situated along the side of a valley over about 2km in length. The village economy consists mostly of pastoral farming of cows and sheep. The village has a good community set-up with regular council meetings. The majority of houses have access to running water, latrines and



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limited electricity. The team headed there having been told that a bridge was needed. It soon became clear that what was needed, a 200m span vehicle bridge, the team were unable to provide.



**Stated need:** A bridge to carry vehicles across the river during the rainy season, allowing access to the road at Apanake, which is soon to be paved. This would give easier access to the market in Challapata.

**Current provision:** At present there are two fords which allow vehicles to cross the river when the water is low. It is only possible to drive to Challapata by this route for 7 months of the year.

There is a dirt road running through Quehuallani, by which it is possible to access Challapata year round- however this is a very long way round and is not generally used. There is a school in Quehuallani, and year-round access to healthcare.

### **Site walkover and initial discussions**

The river lies in a wide flat valley, bounded by raised land. From information given by locals, it is clear that the river changes its course dramatically on a regular basis, and can vary by as much as 20m to either side of the average channel. Initial estimates of the span of any bridge were between 50 and 200m.

The village had previously been visited by another group of engineers who had informed the residents that a bridge would be possible if the river could be confined to a narrower concrete channel, and it transpired that this was what the residents were expecting. The team was unable to obtain any details of this group of engineers, and the village had had no further contact since their departure.

Ground conditions were very poor, with the raised land either side of the river being highly eroded by the water flow.

The residents were very keen for the bridge to be built in a particular location matching up to the existing road, rather than to divert the road to a section where the river was narrower.

### **Outcomes**

It was clear from the first discussion that this project was way beyond the capabilities and resources of a group of student engineers. It was explained to the village leaders that this is a major project and that therefore it would not be possible to collaborate on it. However, the team did give some suggestions to the village on preparing a submission to the local government on their need for a bridge. This included advice on how to quantify the river flow and the rate of bank erosion.

**Stated need: Improvements to the dirt road linking Quehuallani to Apanake.**

**Current provision:** The road is made from hard packed silty sand. It currently takes a winding path around fields, and the surface is very uneven in places. There is no drainage. The community state that during the rainy season the road can be unusable. All maintenance is carried out by the village residents, and consists of filling in the potholes with sand from the river on an annual basis.

#### **Site walkover and initial discussions**

In general the road surface was found to be concave rather than convex, preventing drainage. There are no drainage channels and in some places the road is at a lower level than the surrounding ground, and so becomes a sink for rainwater runoff.

In several places the two sides of the road surface are at different levels, particularly on corners. The material which has been used to fill potholes is often poorly compacted and so is easily washed out or eroded by vehicles. The road is made of very fine material, which has poor resistance to the wear and tear placed on it.

The community stated that around 30 vehicles per day use this stretch of road. The team counted an average of 15 vehicles per day, plus animals.

#### **Outcomes**

The team took the village leader to the road to explain simple improvements which could be made by the community. The need for drainage channels was stressed. However, the situation of the road, the flat land surrounding it and the volume of water present in the rainy season means that installing adequate drainage is likely to be challenging. The need for a harder road surface was also explained, and it was suggested that the finer fill could be covered with larger stones from the river. Simple compaction techniques were outlined to improve the fill. It was agreed that, as in Macallo, the team would leave a document giving details of these improvements.

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**Stated need: Improvements to the town square**, to give a better communal space and improve facilities for the annual festival which attracts people from all over the region.

#### **Current provision**

The square has a small central pagoda, and a church and community centre on one side. It is not widely used for socialising as the town is quite spread out. The ground is quite steeply sloping, and river channels run down either side. These carry rainwater runoff from the mountains, and sometimes flood over the square.

#### **Site walkover and initial discussions**

The team first talked to the town leaders about what improvements they would like to see to the square. The following suggestions were made:

- Control of water flow in streams to prevent flooding over the square and into adjacent houses
- Hard covering (perhaps concrete) of the square
- Level the ground
- Tree-planting
- Seats or benches



The square, church and community building

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The channels next to the square were examined and found to be blocked with soil, rubbish and both animal and human waste. In several areas the channel is essentially at the same level as the surrounding ground, causing flooding. At the east side of the square (downhill side), the channels widen out and disappear as they approach the road. Clearly in the rainy season all the water which comes down these channels just flows over the main street.

The team also talked to some other members of the community about what improvements they would like to the square. In general, the question was not seen as important, as residents seemed only to be interested in the bridge. This led the team to question how useful improvements to the square would be.

### Survey

The team carried out a basic survey of the square, from which rough maps and sections were drawn. The river channels were also surveyed.

### Outcomes

It was felt that the major issues with the square concern the river channels and general water management. The town were advised that they could improve the situation themselves by keeping the channels free from rubbish and debris to allow the water to flow freely. The public health implications of using the channel as a toilet were highlighted.

The team felt unable to offer much advice on how best to channel the water as the town was only seen in the dry season, when the channels were completely dry. This project would require a longer-term approach, perhaps with the help of a group such as Engineers Without Borders, who run placement schemes. This option was discussed with the village leader. He seemed sceptical about the use of such a project; however this is something that will be discussed further with the authorities when the team return to Bolivia in 2009.

The team considered that covering the square in an impermeable material such as concrete would make the situation worse. The other suggestions such as planting trees and installing seating are largely cosmetic. While they would improve the look of the town centre, it did not seem that there was much enthusiasm for this project among the residents.

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**Stated need: Improvements to irrigation channels** in fields next to river, to improve crop yields and reduce maintenance required.

**Current provision:** There is a good network of unlined irrigation channels serving all the fields. As these channels are dug straight out of the earth, it is simple to redirect the water to where it is needed. One small section, around 15m long, has been concreted.

### Site walkover and initial discussions

The village leader stated that the channels could be improved by lining them all with concrete and providing gates to allow the water to flow down the correct channels as needed. This would be a similar system to that seen in Macallo. However, the length of channels in Quehuallani would be much greater; the team estimated it roughly as 5-6km.



Concreted irrigation channel



In general the channels seemed to be in good condition. However it would be expected that they might require more maintenance in the rainy season.

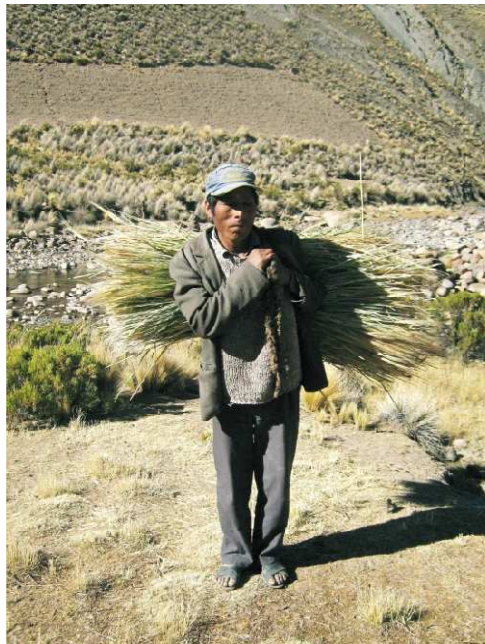
### Outcomes

The team felt that this issue is part of the larger problem of water management in Quehuallani, and as such should be treated holistically with the problem of water draining down from the hills. It would be appropriate for this to form part of the EWB placement. This will be discussed further with the authorities.

## 5.3: Rio Blanco

Rio Blanco was the first community which the team visited at the request of CEDPAN.

Rio Blanco is situated in a narrow steep-sided valley that also contains the tarmac access road from Challapata to Potosi. The elevation is approximately 2-300m higher than Challapata, so 4000m altitude. The houses making up the community are located on the south side of the valley, meaning that they occupy a north-facing slope and so receive very little sun, or in some places, no sun at all in the winter. The farmland used by the villagers for grazing animals and growing crops is on both sides of the valley. A small school was situated in the base of the valley near to the road. Whilst the team were there, a second school building that was intended as a second classroom was being built in the yard of the existing school house. On the north side of the road was a river, which was in this location a single flow, but forked upstream of the Rio Blanco community. In the rainy season this flow is uncrossable.



A farmer in Rio Blanco

There are approximately 20 families, with 12 children of primary school age. The community is split into two sets of houses, one slightly higher up the slope than the other. Transport to the village consists of micro buses stopping at the roadside near to the school, it seemed that this happened on the basis of word-of-mouth communication with Challapata and the bus drivers. The economic activity is llama and alpaca farming, and growing crops to feed these animals. There is a high rate of migration away from the village due to the difficulty of farming in such harsh conditions, and there are now few young adults resident.

Due to the short amount of time available, the team only managed to look at one project in Rio Blanco.

**Stated need:** A pedestrian bridge across the river, so that during the rainy season the village can farm and graze their animals on the north side of the river. Also would allow five children from another village that attend the school during the dry season to come during the wet season, rather than attending an alternative school.

**Current provision:** Currently there is no provision for crossing the river, except for a shallow section next to the village, which can be crossed on foot during the dry season, however during the wet season it is uncrossable as the water can be up to chest high.



#### **Site walkover and initial discussions**

The river lies between the road from Challapata to Potosi, and some hills rising to the east. There was only a small stretch of river near the current fording point which seemed a possible position for a bridge, as downstream of this point the road came very close to the river, and upstream of the fording point the bank on the East side of the river became very steep (up to 60/70°) before turning into cliffs. Just

above the ford, there was a smaller stream/river entering from the west side of the river, and a smaller dry gully on the East, which probably became a stream during the wet season. Because of this the team felt that if a bridge was built it would probably have to be placed upstream of the ford and the joining stream. A cross section was taken.

The west bank was steep up to about 8m above river level when it became flat, while the east side had a gentler slope that carries on into the main hill. The soil to the west is fine clay, and there are coarser sands and boulders by the edge of the river. The east side is made up of alluvial deposits.

#### **Outcomes**

While the project in itself did seem a reasonable task, the team has several concerns about it. Firstly during both meetings with the community, the discussion was dominated by the teacher at the school, who then turned it to the need of creating another new classroom with internet access to allow the children to use computers. Overall it was felt that there was considerable division within the community over prioritising needs, and it was not clear that everyone felt they would benefit from a bridge.

The team also felt that the number of beneficiaries from the bridge being built would not be as great as for some of the other projects that were visited by the team. There was concern as to whether the community would be able to provide enough man hours to allow the construction of the project.

### **5.4: Corta Viento**

Corta Viento lies on pampa to the east of Challapata, on the edge of mountains coming down from the south. It consists of about 10 families who live by grazing llamas, sheep and alpacas. They are already linked with CEDPAN and take part in their educational programmes on agriculture and animal husbandry.

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The village is connected to the asphalt road towards Challapata by a dirt track which passes through the meandering channels of the river running across the flatland. They use this to walk or bike to the nearby villages and sell their animal products. The children attend school in Catavicollo, a nearby village on the dirt track.



Local children play naughts and crosses in Corta Viento

The village has a small well, which provides relatively good drinking water and is covered consistently to avoid it being spoiled by animals and other sources of contaminants. However there are no latrines. The people were very friendly and welcoming, and showed a lot of willingness to work to improve their situation. Prior to the team's arrival, the community had prioritised the construction of bridges across two rivers. The community mentioned that they would like to build some latrines and possibly solar showers if it was possible; in addition to establishing a community building.



**Stated need:** The rainy season reported by the community members lasts from November to March (sometimes May). During this season two rivers which must be crossed for access to the community are sometimes too high and dangerous to be crossed. The result is that the children sometimes cannot get to school, the villagers cannot get to Challapata on a reliable basis so their access to market is restricted, and the access to medical attention is cut off. The duration of the time when the rivers cannot be crossed is several days at a time until the water level subsides again. There are 10 children in Corta Viento who are affected, and 2 others from settlements further away from the school. When the community members fall ill (particularly children) from cold-like illnesses or stomach problems, they sometimes die due to the difficulties of reaching the doctor in the next village. The community also stated that they would like to take their animals across the bridge to access better grazing land.



One of the river crossings on the way to school

**Current provision:** In February and March the children do not go to school often because they cannot cross the river. Villagers have therefore been moving to the other side of the rivers (away from Corta Viento) so that their children can go to school regularly in the wet season. There is no current solution to the problem for the community members.

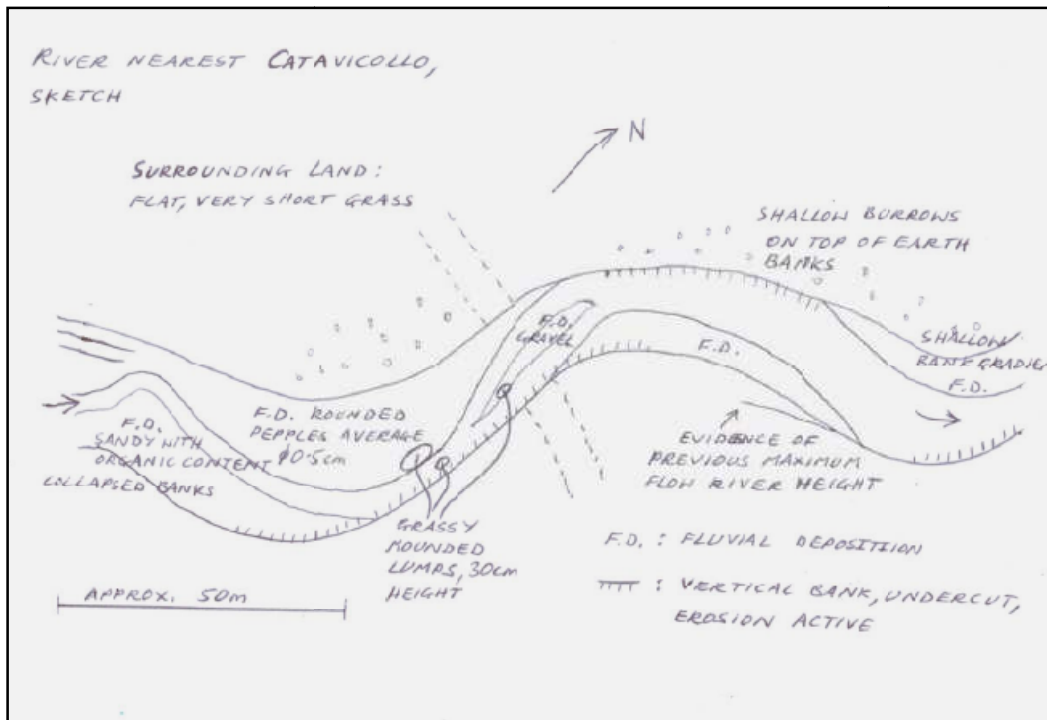
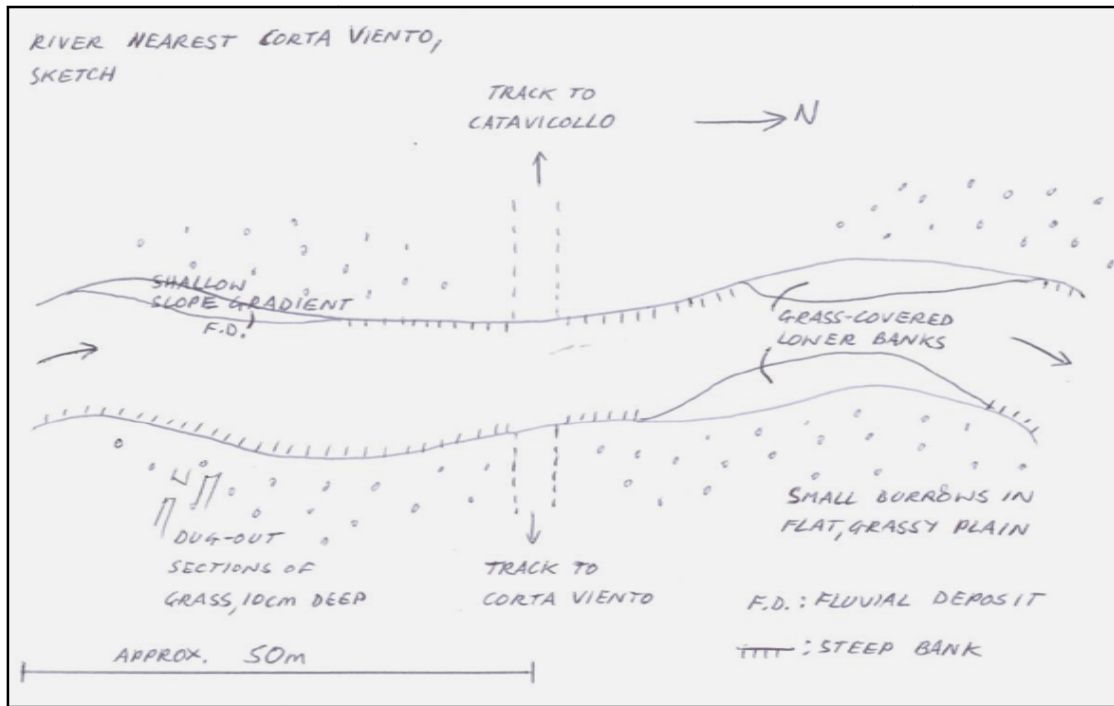
#### **Site walkover and initial discussions**

The community's priority was the bridge, due to concerns for the education of their children. The community members built their own houses, so had basic adobe brick skills. We were told two other communities could help with the building of the bridge, comprising 10 families in total. Therefore the workforce from this area would be coming from 20 families in total. The land on the plain through which the rivers flow is owned by the community.

Site visits to the two rivers were carried out. Sketch maps of both sites are included here. Optimal bridge locations were chosen in areas where the river span was small and the river channel was straighter so that minimal erosion of the banks would affect the bridge. The main geological processes at work are deposition and erosion by the river. Medium sand containing some small pebbles (slate or sandstone, 5mm size) is found on the level of the plain, i.e. the banks of the river. The river bed itself is sand with an overlay of silt. Erosion of the clay banks by the river has caused undercutting, and resulted in tension cracks appearing at the top of the banks. Salt deposits can be seen along the banks. A very short layer of grass covers the tops of the banks (at the level of the plain) and many inhabited small rodent burrows exist all along the tops of

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the banks, making the top 10cm very soft in certain places. The grass is grazed by these rodents and the llamas and alpacas owned by both Corta Viento villagers and neighbouring communities.





## Outcomes

At the meeting held by the expedition team on return to the UK it was decided that building two bridges at Corta Viento would be a feasible idea. The small workforce that was available was a problem that could be solved by possibly paying villagers from other communities to work to build the bridges. The team was satisfied that the need for the bridges was real and that it was the priority issue to allow for improvements to be made to the lives of the community members. The bridge locations surveyed produced no construction problems that could not be solved, although erosion and the presence of salt in the ground would present problems. A location for the bridge could be selected so that the span was not greater than was feasible to build, including margins allowing for the effects of erosion.

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**Stated need:** Sanitation and potable water

**Current provision:** There were no latrines in the community. The water supply was a well that was covered with loose rocks and a rock lid for protection. The height of this protection above the ground was approximately 10cm.

### Site walkover and initial discussions

In a meeting held with the community we were told that a bridge was a priority but that they would like to have all of the above as they would improve their daily standards of living. The stomach problems that the children sometimes suffer during the rainy season may be due to the water that the villagers have already available to them from a well. When the groundwater level is high, there will be a shorter distance of filtration of the water through the soil before it reaches the well water level, so the water extracted from the well may contain more harmful particles and bacteria. The protection at the entrance to the well may also be insufficient if water is lying on the ground surface.



The well with its cover weighted down by stones

## Outcomes

The team discussed sanitation with CEDPAN on their return to Challapata, and were told that in many areas where efforts had been made to provide latrines in communities, these were not used by the community members. The team felt they were not able to do enough research into the groundwater levels and drainage systems during the dry season to gather enough information to make definitive changes to the potable water supply that already existed through the well. However,

it was recognised that a solution to water management problems could remove some of the health issues that became life-threatening due to the lack of access to the community during the wet season.

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**Stated need:** Solar showers and solar panels

**Current provision:** No exploitation of solar energy sources exists in Corta Viento. Washing facilities are from the available water sources only, which are extremely cold due to the low temperatures at night.

**Outcome**

The installation of solar showers would be a feasible project due to the high intensity of ultraviolet rays that reach the Altiplano at 4000m altitude, but it is not a priority issue for the community.

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**Stated need:** Introduction of improved agricultural practices and advice on current agricultural practices

**Current provision:** No advice was being given to the community on agriculture.

**Outcome**

CEDPAN was told by the expedition about the need for advice on agricultural practices. This is work that CEDPAN carries out in other communities, so they have expertise that the expedition team could not provide.

## 5.5: Calacala

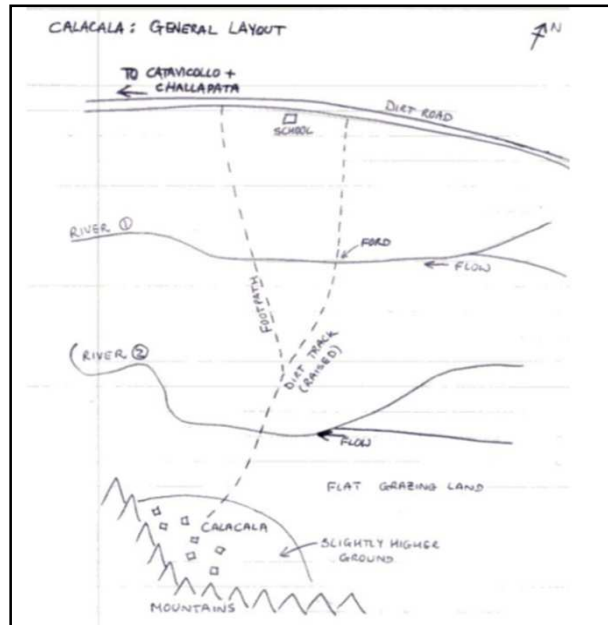


Houses built around a courtyard; tap in foreground

The final village visited by the expedition was Calacala, situated around 4.5 km north-east of Corta Viento. The village is home to 40 families, who farm sheep, alpacas and llamas. The community has a tap for water, and communal latrines, however does not have electricity. The community atmosphere appears to be vibrant and active. The residents have constructed their own dirt track leading out to the dirt road at Japo, and were in the process of fencing an area for their animals. The team felt very welcome and were well provided for.

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The main request from the community was for the team to look at building bridges to allow the children to get to school during the wet season, as there are currently rivers which are uncrossable for several days after heavy rain. The expedition was also asked about the possibility of solar showers for the community.



Sketch showing general layout of Calacala and surrounding pampa

**Stated need:** Two footbridges to enable children to walk to school during the rainy season, and to give access to markets and healthcare. The villagers also thought this access might also help bring tourists to their area.

**Current provision:** At present there are many rivers through which the children have to wade to access their school. This is only possible when the water is low, for around 7 months of the year. During the rainy season, two of these crossings are particularly bad. There are periods of up to a week when children cannot attend school and adults cannot reach the market.

At present a bus visits Calacala once a week on market day. It is possible to access Challapata all year round on foot, even when the rivers are flooded- however, this is a very long route and so is not generally used except in emergencies.

### Site walkover and initial discussions

The rivers lie in a wide flat plain, bounded by raised land. From inspection and information given by locals, it appears that the river does not change its course dramatically or flood over its banks onto the surrounding fields. Initial estimates of the span of any bridge were between 10 and 30m. The river channels were surveyed and



Talking to locals at a possible bridge site

## Section 5: Engineering Report

photos taken for future reference.

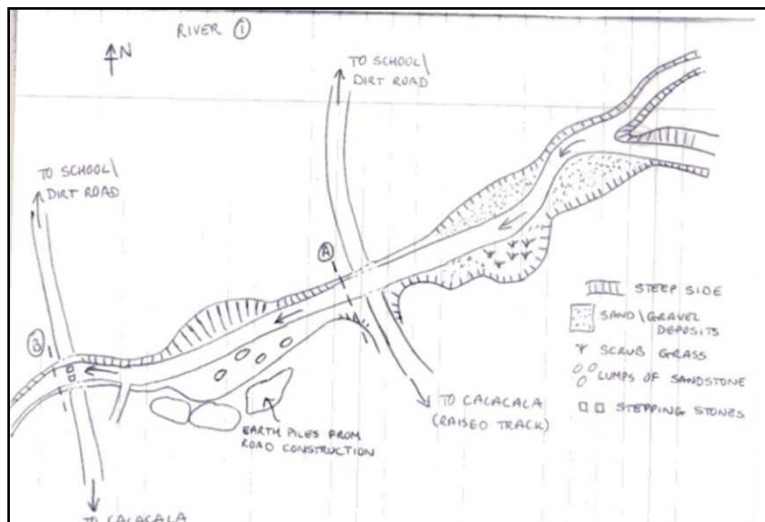
After bank inspections and soil samples had been taken the soil conditions were found to be reasonable though the villagers reported up to 30cm of bank erosion each rainy season.

The residents were keen for the bridges to be built as close as possible to the existing track as this is the most direct route.

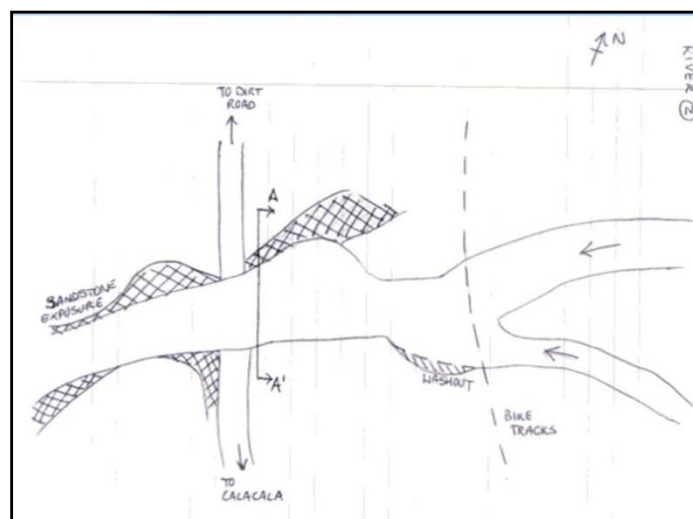
### Outcomes

It was felt that the community were united in their strong desire for these bridges, and were well prepared to work on the construction. They had some construction experience, having built their own houses and the road leading to the village. They also seemed to be very sure of their priorities as a community.

It was thought that the engineering aspects were of a suitable level for a group of student engineers. Potential sites were identified on both rivers, and workforce and material availability were discussed. Therefore, Calacala has been chosen as the location for a return expedition in 2009.



Sketch map, river 1, showing potential bridge sites A and B



Sketch map, river 2



**Stated need:** Solar showers to make washing easier. This was mentioned particularly in relation to young children. In the community's eyes, this need was very much secondary to the bridges in importance.

**Current provision:** There are a few taps scattered throughout the village which provide water throughout the day. Unfortunately in the evenings these freeze and are not usable again until around 11am. At present, water for washing must be used cold or heated over a fire, which uses up scarce fuel supplies.

### Outcomes

It will be a secondary aim of the return expedition to provide information, possibly in the form of a workshop and working prototype, on affordable, easily made solar showers. This should allow the benefits to be spread to other communities, as CEDPAN will be able to pass on the information.



The new bridges will allow children to access the school in all weathers



Saying goodbye to new friends in Calacala

# Sociology Report

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## 6.1: Introduction and Objectives

The objective of the sociological project within the Altiplano expedition was to assess the relevance of potential engineering projects in the area, and to estimate their impact on the local population. The motivation for this project was the awareness that an engineering project cannot be dissociated from sociological factors, such as:

- who needs it and why
- who will benefit and in what ways
- whether it is relevant to build something, or whether an alternative solution would be preferable
- any religious, cultural or political constraints on the project
- who is ready to actually work during the construction
- what difference will the project make in the long run
- what chances of maintenance and continuity the project has, and many other factors of this kind.

The conclusions reached while bearing in mind these sociological factors will decisively affect the main decision on the engineering project and will help to decide what solution is best for the benefit of its potential users.

This sociological report details not only the findings of our field work, but also the preparations for the expedition, the methods employed for the research, the process of negotiations with local organisations and the experiences of the expeditioners as a team and as individuals, in the hope that all this information may be of use to future expeditions to the area.

## 6.2: Methodology

### 6.2.1: Team preparation

Prior to arrival in Bolivia, the expeditioners met to discuss the sociological aspects of the expedition. These previous meetings served to raise awareness in all members of the expedition about the sociological objectives and the methods that would be employed, in particular those to conduct interviews.

During these meetings, emphasis was put on:

- Who to interview? The general agreement was that we should interview all stakeholders, local authorities, local NGO, village chiefs and community residents. Within community residents, discrimination of age groups, gender, ethnic groups and social classes should be made to ensure that everyone's voice is heard.



## Section 6: Sociology Report

- In all cases, the expeditioners would make clear that this was a student expedition and therefore its scope and budget were limited. This was stressed as essential to avoid raising unrealistic expectations in the communities.
- A classification of the basic needs of a society into topic areas for organised research: health, food, housing, education, culture, transport and communication.
- Interviews should be conducted in a certain manner, and interviewers should be aware of their role in them.

All these points were registered, and expanded, in a handout sheet that was passed on to each expedition member. (See Appendix H).

### 6.2.2: Interview methods and observation

The method chosen to find out the information needed was that of qualitative interviewing and, to a lesser extent, direct observation.

#### a) Qualitative interviewing

- main theme of research: the local peoples' way of life and the difficulties they encounter that might have an engineering solution
- Open-ended conversations leave the way open for every interviewee to tell his or her personal experience freely.

Open-ended conversations need to be guided towards some basic goals. To achieve the purpose of these conversations, a guide of topics to tackle or *aide-de-memoire* was written down for the use of interviewers. Yes / no questions or questionnaires were avoided, to exclude any limitations in the choice of answers, and most importantly, not restricting the interviewee's intervention to the topics chosen by the interviewer. A guide for interviews including a bilingual sample of the team's *aide-de-memoire* is included in this report (see Appendix I).

#### b) Direct observation

- CEDPAN advised that native Andean people are often weary of western sociologists coming to find out about their society and then seeing them leave without having made any positive contribution for them.
- Observation minimizes the intrusion of interviewers in the locals' daily life, reducing alteration in their normal routines. Facts like what they use for fuel, where they get water from or what they cook for lunch or who is in charge of tasks could be easily noted without asking.



Killing a sheep to take to market

## Section 6: Sociology Report

For the recording of the information, taking notes and recording conversations were the methods chosen. The team took with them a voice recorder and notebooks. The advantages and disadvantages of both methods were evaluated. The recording is faster and more accurate, but it is subject to consent and may also inhibit the interviewees, with a consequent loss of information. The conversations need to be transcribed at the end of the day, which adds extra work for the researcher. Taking notes is slower but does not require further transcriptions, and gives the interviewee a confident feeling of being listened to. The team managed a good combination of both methods according to the circumstances in which they found themselves. A more detailed account of the methods and a evaluation is included in the conclusions of this section.

### 6.2.3: Group discussions



At the end of the day the team would have a discussion about the findings of the day. The outcome of the interviews and sociological findings were shared with all the members of the team. The feasibility of the potential engineering projects was discussed. Then, this was put in coordination with the sociological aspects in order to find a balanced decision on what projects would be optimal. These discussions aimed mainly to integrate both

the engineering and the sociological aspects in just one common view about the possible projects. They allowed each member of the expedition to contribute their opinions regardless of their personal speciality, and to learn what the other members were doing and thinking.

Another aim of these discussions was to let the expeditioners have the opportunity at least once a day to express themselves freely about any issue they might be feeling uncomfortable with, regarding the team work or any other personal matter, so that the other team members became aware and a solution could be negotiated.

### 6.2.4: Methodology: conclusions

The methods chosen proved to be adequate and the team was able to gather a good amount of information from the communities visited. The taking of notes was more practical during the visits in the villages, especially in outdoor environments, and it did not slow down the interviews or the engineering survey. During the indoor meetings with the authorities, the NGO representatives and the village leaders, a voice recorder was used with their consent, which proved to have no negative effect on their willingness to speak. Notes were also taken. The atmosphere was relaxed and the team not only asked questions, but was also asked about their ability, objectives, provenance of their members, financial support and duration of the expedition. The

## Section 6: Sociology Report

team was always welcomed and invited to be taken to and guided through the communities by some of their local authorities. During the visit to the particular communities, the team tried to address other people apart from the guide(s). A number of other community members were interviewed, but one of the main difficulties the team found was to do individual interviews in a systematic way, covering people of all ages, gender and occupations. This could not be done entirely as planned at any of the communities. The main reason for it was the fact that, after the re-arrangement of schedule, the expedition members had only one night to spend at each community, which left them with little time to interact with locals and do observation. Villagers are rarely together all at one place at the same time, many of them are found travelling to town for the market, for work, or for partying several days during the *fiesta*; or attending their cattle or duties in the field.



Meeting with villagers from Rio Blanco

It is important to note that the communities in the Norte Condo district organised themselves to hold at least one general meeting at the arrival of the expeditioners, in which a significant representation of the villagers was present. These were successful meetings, and allowed a good exchange of questions, information and comments. They gave the team a general view of the community's social composition, the different needs of their members and their initial commitment with a potential community project. More detailed information about each particular community is given in section 6.4, *Findings*.

The success of these meetings rested greatly on the fact that communities had been told beforehand the goal of the expedition was to design and implement a project in the area, not just do a research. Their interest could be felt in repeated questions like "*this is to implement a project in the end, isn't it?*" made in different situations by different community members. Some of them even came up to the team to find out by themselves, so the initial suspicion that the NGO had predicted was not felt at all.

End of day discussions were a good moment for reflection within the team. They allowed time to reconsider more critically the opinions gathered during the interaction with the locals. At this time, contribution of all members of the team is essential. Unfortunately, discussions were not held systematically every night, often due to tiredness, lack of time late at night or illness of the expeditioners.

To conclude, for future research it would be advantageous to follow the NGO advice to spend several nights within each community (especially if it happens on a weekend, when most villagers are away at market), allowing more time for the research, and for locals and expeditioners to develop bonds of mutual confidence.

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The following facts should also be taken into account: relevant habits of the villagers of the area researched around Challapata include waking up at dawn to start working by 8am. Then, at around 10am they take the cattle out to graze, so from that time onwards they are more likely to be found in the fields. Lunch time is from 1pm to 2 pm approximately, and dinner is right after dusk. On Sundays villagers go down to the main market in Challapata where they spend the day. Authorities cannot be contacted at the villages during the weekends either. July 16<sup>th</sup> is the festivity of the patron saint of Challapata, *la Virgen del Carmen*. All villagers come to town the previous day and celebrate for 48 hours. Habits include heavy drinking by the men, so it is possible that some of them are not ready to work properly again until July 18<sup>th</sup>. On the Saturday after July 16<sup>th</sup>, there is another smaller celebration of Cristo del Calvario during the day, including a pilgrimage up to the Christ chapel on the hill of Challapata.

Timings are relaxed; it is recommended to be on time for arranged meetings, but not to expect locals to be equally punctual. Allow spare time at the end of meetings in case they get delayed or extended.

### 6.3: Working with local organisations

#### 6.3.1: Getting in touch

From Europe, the team got in touch with two different organisations in Bolivia, CEDPAN (a Bolivian NGO) and the Mancomunidad Azanake, to find out about possible communities to visit and the logistic needs for the expedition. Contact was kept via email, but we have to note that it was not as efficient as the team would have liked. The two organisations responded differently as well. While CEDPAN answered relatively quickly and more to the point of the team's questions, the Mancomunidad manager was often busy or away on work trips; did not reply to the team's emails for weeks and when he did, he offered general, vague information, referring the team for a future meeting in person. His argument was that the Mancomunidad was still "evaluating the projects and communities". This slowed down, to a very considerable extent, the logistic preparations in Europe on key issues such as food, itinerary and calendar.



First meeting with the *Mancomunidad*

It was the general feel that Bolivians are not keen on making arrangements with other people at a distance, or far in advance. Basic details such as the final itinerary could not be set until the team met the Mancomunidad manager in person at his office. CEDPAN's cooperation was more helpful during the preparation time, but still, not fully up to the team's expectations. We can draw the conclusion that, for expeditions in this



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area in Bolivia, discussions in person are preferred, and that final decisions can only be taken after a personal meeting has taken place.

It is also relevant to note here that phone calls can also be made. Office times are flexible, but they include a morning and an evening shift, from approximately 9am to 10pm with a lunch break. Phone calls did not prove to be more reliable than emails for two main reasons: the phone lines in Bolivia were not good, and most of the times the person required was not in the office when the team phoned. The Mancomunidad manager was virtually unreachable, while the offices at CEDPAN did answer the phone, but just to let the team know that they would be happy to discuss details once the expeditioners had arrived at their offices.

### 6.3.2: Language

Some of the managers of the organisations mentioned above understand a little English, but would not be able to communicate in it on a normal basis. All other staff and community members would communicate with the team only in Spanish. Therefore, it is convenient for the expedition to count on a fluent speaker of Spanish from the beginning. All the meetings, phone calls and interviews were conducted in Spanish. All the communities visited were bilingual, speaking Bolivian Spanish and one or two indigenous languages. Indigenous languages from the communities visited were Aymara and Quechua. There was a high rate of literacy in the communities visited, where the leaders that guided the expeditioners could all read and write skilfully. It is sufficient for communication in the area to have a good knowledge of standard peninsular Spanish, but for the ease of future expeditioners, a little vocabulary guide with local terms has been included (See Appendix J)

### 6.3.3: Local organisations: structure and alliances

#### 6.3.3.1: Introduction

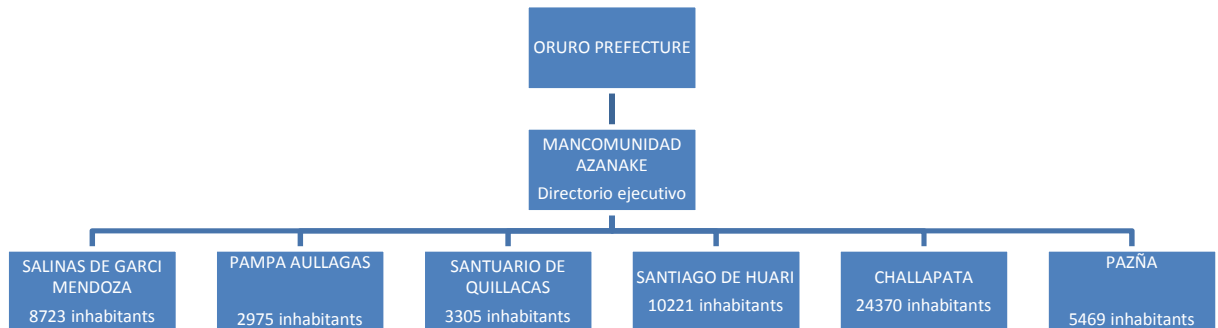
Bolivia is administratively organised into departments. Oruro is the department in which the team set to work and where the links with the local authorities and NGO were found. Departments are governed by a *prefecto*, who in the country's current political situation of unrest may or may not support the views of the central government in La Paz. Oruro is currently (2008) one of the few departments that maintain a consistent support for the elected prime minister, Evo Morales.

Departments are organised internally into provinces, and provinces are divided into municipalities. Sometimes municipalities unite under a bigger *mancomunidad* to cooperate for a common aim, even if they belong to different



Mural in Challapata in support of Evo Morales

provinces, as is the case with Mancomunidad Azanake. It is within this frame that the team set to work with the local authorities of Azanake, which has its seat in the biggest and most populated municipality, Challapata.

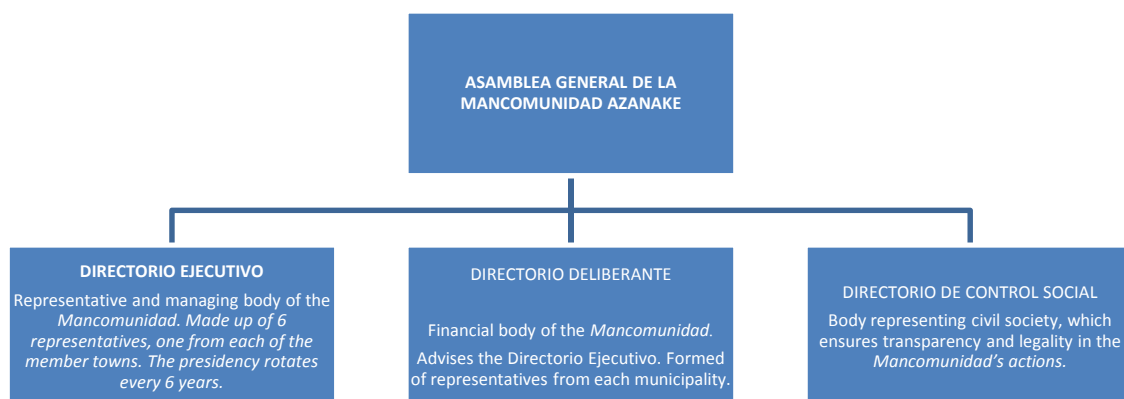


### 6.3.3.2 Mancomunidad Azanake

The Mancomunidad Azanake is located in the South-West of the Oruro department. It takes its name from the Azanake mountain range that surrounds the area. It was founded in 2000 with the aim of improving the health conditions and facilities for the population in its municipalities. In 2004 it expanded its objectives of development to more fields.

Nowadays it comprises 6 municipalities with a total population of over 55,000 inhabitants. Municipalities in Bolivia are the basic units political organisation and administration, each of them presided over by an elected mayor who holds office for a five year term. The Mancomunidad Azanake is structured in 3 directories and its decisions are taken at the General Assembly where all the three are present. The Executive Directory is formed by the mayors of the 6 municipalities members of the Mancomunidad Azanake (see diagram above), and presides over the other two directories at the assemblies. Presidency within the Executive Directory is rotative for the six mayors that form it.

Internal structure of the Mancomunidad management body:





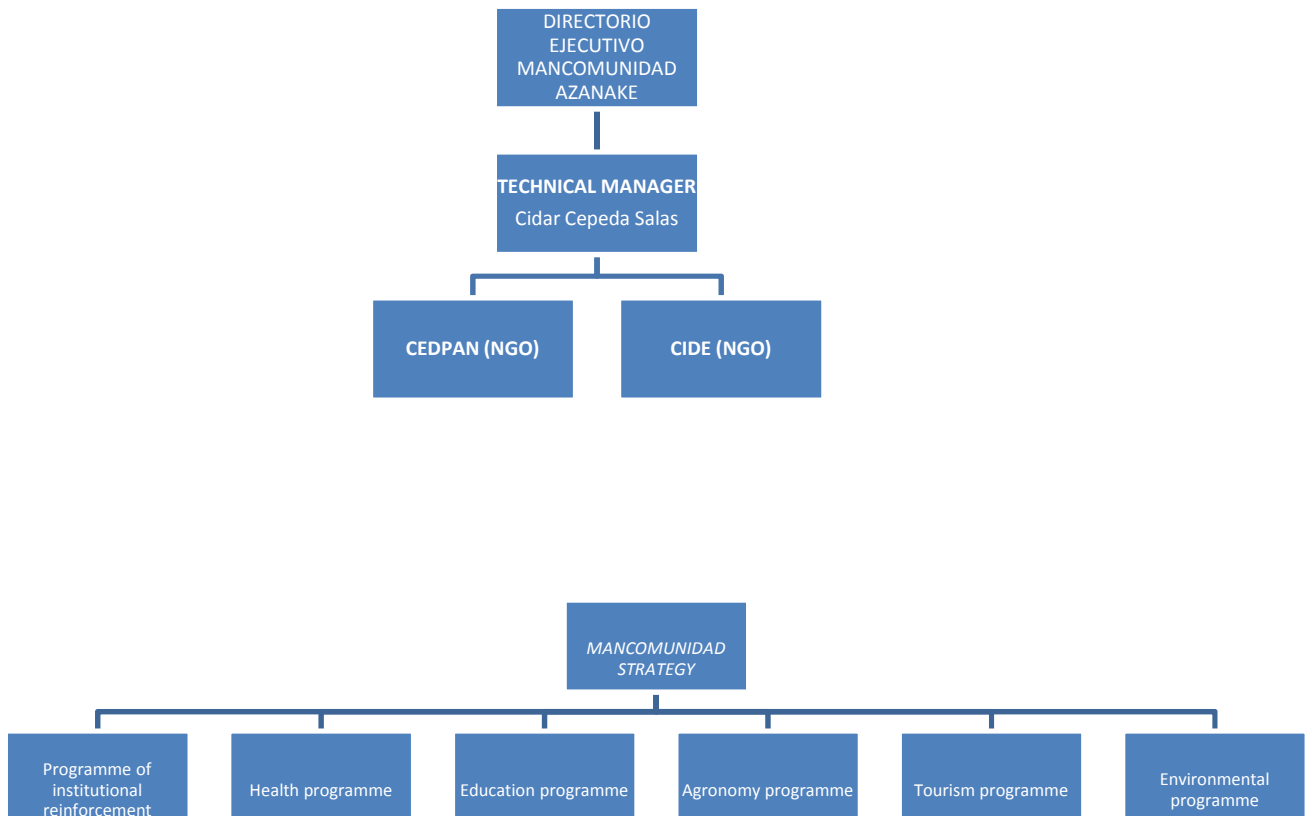
## Section 6: Sociology Report

When working in the area, it is important to note that the ultimate local governmental authorities are the corresponding mayors but, for development projects, the Mancomunidad management team is above them. In practical terms for the expedition, this meant that the person responsible for welcoming the team and programming a working schedule for them was Engineer Cidar Cepeda, technical manager of the Mancomunidad.

The Mancomunidad has an on-going programme, *Plan Estratégico*, started in 2004, that covers six main fields for development: institutional reinforcement, health, education, agropecuarian issues, tourism and environment.

For some particular projects within this programme, two local NGOs cooperate with the Mancomunidad as allies: CEDPAN (Centro de Estudio y Desarrollo de los Pueblos Andinos) and CIDE (Centro de Investigación de Producción Educativa). Although independent bodies, they are subordinate to the Mancomunidad. For this reason, the team was sent by CEDPAN to see Cidar Cepeda in the first place.

Structure of the Mancomunidad and its allied NGOs; sections of the development plan in which they cooperate:



### 6.3.3.3 CEDPAN

The expedition team had a first meeting in La Paz with CEDPAN's main coordinator, Trifón Choque Jiménez, and CEDPAN's representative for Challapata, Germán Ríos. After this meeting, they referred the team to Cidar Cepeda in Challapata. CEDPAN is only one of the many NGOs working in the area. Its main roles are connected to technical advice, education and experimental projects such as potable water, agriculture and animal husbandry. They have experience in cooperating with other international organisations and with



CEDPAN's offices in Challapata

volunteers coming from Europe. Cedpan provides coordination for all projects, but nothing goes ahead without Cidar Cepeda's approval, whose responsibility is to ensure coherence and that different agencies are working in the same direction.

For every project they implement, CEDPAN follows a protocol to make the communities sign a volunteer work contract, which obliges them to donate time and labour. Communities cooperating with CEDPAN are already familiar with this procedure.

### 6.3.3.4 Organisation of indigenous peoples

Bolivia is the most indigenous country in South America: 64% of the population claims to belong to one of the *pueblos originarios* of the Andes. The significance of this for the expedition rests on the fact that there is a coexisting structure of indigenous power. This structure is not regular throughout the territory. The basic social unit above the family is the *ayllu*<sup>1</sup>, and in the case of Challapata there is one *autoridad originaria* (elected once and for a year) for each of its 8 *ayllus*. The *ayllus* are presided over by a *corregidor*. Communities belonging to different *ayllus* do not cooperate with each other.

Three of the communities visited belong to the indigenous district Norte Condo: Rio Blanco, Cortaviento and Calacala. Norte Condo has a special status, it is a *sub-alcaldía* on its own, partially independent from the main *alcaldía* (townhall or municipality).

### 6.3.4: Conclusions

Although united for the same goals, CEDPAN and the Mancomunidad have two very different philosophies of work. The Mancomunidad implements projects according to a budget and relies on the decisions of its leaders taken from the offices. CEDPAN were more receptive to the team's ideas and understood better their desire to interact with

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<sup>1</sup> Ayllu- traditional rural community with a believed common ancestor comprising a number of villages on different natural habitats that work together for self-sufficiency and survival.

## Section 6: Sociology Report

the communities to find out about their needs and make a cultural exchange with them. The Mancomunidad did not grasp the size of the projects the team was able to do, and sent the expeditioners to communities where they could be of very little help. The original working programme included Macallo, Kehuallani, Peñas and Rosario. On return to Challapata for a change in the original schedule after having visited Kehuallani, the team found that Cidar Cepeda was away on a work trip for the whole week. Then, CEDPAN was able to send the team to the more appropriate communities in the native district of Norte Condo. One main difficulty the team encountered was that none of the organisations nor the communities themselves have demands arranged in order of priority, and they showed reluctance to do so when asked. This worked against the optimisation of the time spent in the communities, but allowed the team to establish their own priority list later.

Neither of the two organisations could understand the point of the trek or the camping, so they endeavoured to provide the team with means of transport and accommodation. Communities always offered a building for the team to sleep in, and in Norte Condo they shared their cuisine and crafts. With the exception of football, there is a lack of sport culture as understood in Western countries. Locals rely on motor transport, and would not understand the concept of challenge that the trek, the altitude and the cold posed for the expeditioners. This modified the initial conception of the expedition as a long trek, as it had to be adjusted to a given schedule designed from different assumptions.

Both CEDPAN and the Mancomunidad were very keen to establish a long-term link with student expeditions from Imperial College. CEDPAN mentioned they would prefer to start with small projects and then build up slowly. Both expressed their will to stay in touch via email. During the meetings, two main concerns arose from the organisations. Firstly, CEDPAN and the Mancomunidad were worried about financial support for future projects. This was also an issue for communities, as all they can offer is their working force. The Mancomunidad, however, might be able to make a small contribution or to help in collecting it. Secondly, CEDPAN insisted from the very beginning that the expedition should not raise expectations in communities that it would not be able to satisfy.

The guidance of both organisations was vital for the expedition. Without their intervention, the team would not have been introduced to the authorities and into the villages. But, at the same time, this type of cooperation reduced the team's access to only the communities that the governmental authority considered relevant to choose. Every future expedition team should evaluate how much of their autonomy is taken away by this fact. Also to consider is the fact that in the communities the expeditioners arrived as sent by the Mancomunidad. To what extent this affects the expedition's independence and objectivity in the eyes of the community members should be considered by future expeditioners.

Finally, the team agreed that cooperation with CEDPAN proved more efficient and effective, and is desired for the future, while intermediation of the Mancomunidad is to be sought only when strictly required and for the official approval of projects. CEDPAN representatives are more reliable as a contact in Challapata, since they rarely abandon

their offices, while the Mancomunidad manager has to leave the town on work trips very often and cannot be contacted as easily.

## 6.4: Findings

### 6.4.1 Macallo

Estimated population: 10 families<sup>2</sup>

Municipality: Challapata

A first meeting was held in Challapata with the *comunarios* (leaders) of Macallo and Cidar Cepeda. During this meeting, the requests of the comunarios, in order of priority, were:



First view of Macallo from the bus

- Drinking water and irrigation system coming from a borehole in the village
- Bridge over an irrigation canal for animals and people to reach the fields on the other side during the rainy season
- Improvements to the dirt road to access the village
- Construction of a community building, and improvements to family houses; request for a plan to build better houses in the future (especially to fight the cold)

It was explained that the team would evaluate their requests, and prioritise the ones that were more feasible and beneficial for the community. During the visit, the team was guided through the village by the *autoridades* Armando Barrera and René Colque (water supervisor).



Women herding animals to water

Macallo is a farming community. The animals they keep are sheep, cows and a herd of around 50 alpacas. They are not working with Cedpan, and do not know about their activity in the area. Electricity was brought to Macallo thanks to the selling of alpaca wool, which is very valuable in the market. The community has no running water but takes it from an open well.

There is a deeper well which is currently sealed and not functioning. The farming activity in Macallo is determined by the dam that provides water to the canals. This dam is called *Represa n°2* and is situated further north in Tacahua. The dam is managed yearly by an elected president

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<sup>2</sup> Average families consist of 4 members. From families, adult male members are usually the ones who would volunteer in a community project. Emigrants from the village to larger towns are not included in the estimation, although their number is high. It was mentioned they would be happy to return to the village to work.

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(2008: Francisco de la Cruz) and has a society of 1200 members that pay 20 bolivianos per year per hectare irrigated. Macallo community members own 18 hectares.

Following the rain cycle, the dam is opened according to this pattern:

**December/January:** rainy season starts

**March/April:** end of rainy season

**September:** dam opens for 45 days, then closes for a fortnight

**October:** dam opens again until it runs out of water or re-opens in December in exceptional years when there is some water left.

The community members regret that because of the shortage of water the crops they grow are just about enough to feed the animals during the year. Currently they grow beans, potatoes and alfalfa, the latter to feed the animals and produce cheese which they sell at the market. They can only grow vegetables in September and October, when water from the reservoir is being provided.

The team was guided by an authority along the canals and examined the crossing where a bridge for the animals is needed during the rainy season, as well as the dirt road that leads to Macallo. Then they also examined the houses and suggested that improvements could be made to the existing buildings, rather than building new ones. Finally, the main mission of the team was to examine the deeper well of quality drinking water existing in a yard in the village. This well was commissioned by the municipality of Challatapa to a foreign company, but it was left sealed without any pump or system to make it functional, a task which corresponded to the current municipal authorities. Thanks to the interviews with the locals the team found out that the well was dug when Cidar Cepeda, manager of the Mancomunidad, was mayor in Challapata, but the project was left unfinished. Suspicion arose when it was also found that the manager still owns a property in the village, and from the fact that Macallo was the first community in the itinerary drawn up by the *Macomunidad*. However, drinking water being a basic human need, the expeditioners' presence there felt more than justified.

Because the visit took place on a Sunday, it was impossible to arrange a community meeting and evaluate the views of other villagers besides the authorities. The only other source of information for the team were three elder villagers who were interviewed on the spot. An old woman insisted on the importance of water so that they can grow their own vegetables and do not depend on Challapata market. An old man stressed the economic dependence that the lack of water creates: because they cannot grow anything but food for their animals, all other products must be bought at the market. It is hard to



Lorena interviewing the village leader



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make a living, so people migrate to larger towns. Finally, a local brick layer showed his house to the team, explained that there was a previous attempt to pump water from the new well with an electric pump, but they could not afford the electricity bills. He mentioned that there are 7 people available to work in a potential project in the village, and that they would be happy with more basic solutions to their petition of modern houses with toilets, if latrines were provided.

Macallo is one example of Bolivian villages where the lack of water is the main limiting factor, but not the only one. Improvements to housing, roads and sanitation could also significantly improve the life of its inhabitants.

### 6.4.2: Quehuallani

Estimated population: 200 people

Municipality: Peñas

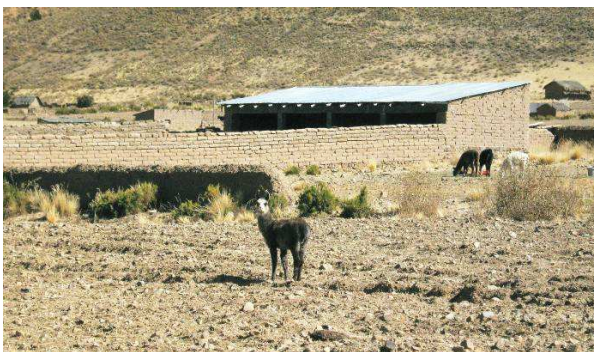
Quehuallani is set in a wide valley, alongside a river, on the opposite side of which is the town of Apanake. Access to Challapata is by dirt road, of reasonable quality in the dry season but sometimes impassable in the wet season. There is currently a ford which connects the town to Apanake in the dry season.



Meeting community leaders

The focus of the town appears to be the plaza and the adjacent community centre and church, all of which were constructed with outside financial help (source unknown). However, the square did not appear to be used socially, perhaps because the town is quite spread out.

The 45 houses stretch around 1km along the road. All have electricity and some have television; one satellite dish was seen. All inhabitants have access to an outside latrine. There is a bricklayer, and 4 new houses were under construction. Material for adobe bricks is readily available.



llamas, cows and sheep. They also grow beans, potatoes and alfalfa for their own consumption and to sell at market.

The town has a water tank which is filled by runoff from the mountains. In the wet season this gives a constant supply of water, but in the dry season there is only water for 1-2 hours per day. The tank feeds a number of taps spread around the town, so people do not have to walk far for water. Most people are farmers, with flocks of



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The team had most contact with the 3 community leaders. It was surprising that only one of these actually lived in Quehuallani, with the others only travelling in every week or so.

The team faced a number of problems in Quehuallani:

- The main translator was ill, meaning that all communication had to go through two non-fluent Spanish speakers. This hampered communications but also meant that local people were less inclined to trust in the team's abilities as engineers.
- The team made the mistake of arriving on foot, which appeared to be inexplicable to the community.
- The community had previously been visited by another group of engineers, and were under the impression that this expedition had come to follow up on their work. This meant that expectations were raised and the team felt that they had to let the community down.
- It proved very difficult to arrange meetings with the community leaders once they realised that the team were not going to build the requested bridge.

The team's experience in Quehuallani really illustrated CEDPAN's warning that Andean communities are often distrustful of outsiders who come in with promises and then leave without delivering. Unfortunately it seems that in this case, this expedition may have contributed to this belief, as the community were certainly very disappointed that the team could not meet their requests. This was obviously exactly counter to the impression that the team wanted to give. It was this which motivated the team to return to Challapata to arrange a revised itinerary with CEDPAN, to try to avoid any similar situations in other communities.

The expedition also spent far more time in Quehuallani than was really appropriate, because it became very difficult to arrange a final meeting with the community leaders. This meeting was necessary so that the team could inform them of their actions and discuss ideas for future work, and the team did not want to leave without speaking to the leaders. However, this meant that there was less time available to spend in other places.

### 6.4.3: Norte Condo district

With the assistance of Germán Ríos, a meeting was held at the CEDPAN offices with *comunarios* from the indigenous Norte Condo district, situated north of Challapata. Norte Condo is administratively a semi-autonomous entity (*subalcandía*) of Aymara people. At the meeting, representatives of 4 communities were present: Río Blanco, Catavicollo, Cortaviento and Calacala. The *comunarios*, generally middle-aged men or elders, quickly agreed among themselves an itinerary for the expeditioners (Río Blanco- Cortaviento- Calacala), and provided transport and accommodation as well as a volunteer to introduce the team to each of the communities.

### 6.4.3.1: Río Blanco

Estimated population: 35 families (including migrants to Challapata)

Municipality: Norte Condo

Rio Blanco is divided into 2 *ranchos* or quarters, Calamarca and Visuri, that lie on a steep mountain slope on one side of the river. On the other side, the villagers own land and some of them take their animals there to graze. Only one villager lives on the other side of the river. The community of Rio Blanco make a living from their animals; llamas (200-300), sheep (around 80) and cows (15-20). On the other side of the river they grow crops because the land there receives



Llamas grazing on the steep valley sides

more sun, but the cold conditions of the valley and the frost still ruin the crops too often. In August and September they plant barley, grain, alfalfa, and two types of potatoes, one of them specifically resistant to the cold. They harvest in April, when the river can get to waist high. The community has a water tank on the inhabited side (installed by World Vision), and expects electricity soon, for those who can afford to pay the bills.



Playing football with the school children

Instigated by the teacher, a meeting was held with some of the community members of Rio Blanco. The teacher is the most respected figure in the community, and even the authorities would not interrupt him when he was speaking. This posed a significant problem during the meeting, when the teacher tended to lead the conversation and take over the others' turn to impose his own priorities, which focussed on education. Finally, with the mediation of the expedition members, a turn for petitions was established, from which the following were obtained:

- Solar panels (to warm the water for showers), 35 potential installations.
- Communication antenna (mobile reception), which would benefit the whole valley.
- TV and computer room for the school.

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- Anti-parasite treatments for their animals

The people attending the meeting were mainly mature or old men. There were 10 of them, and only 2 of their wives were present. Of the women, one remained silent despite repeated encouragement from the team, and the other supported the teacher's idea for education equipment.

The presence of the teacher appeared to strongly influence the requests, and the team was not able to persuade people to prioritise their needs. Five people did not express any particular personal view, or said they would be happy with whatever they could obtain. It is relevant to note that the petition for a bridge, which was presented in Challapata by the Rio Blanco authority, was not mentioned at all during the meeting. Obviously, this authority, or the owners of land or animals on the other side of the river, were not present that day. The team interviewed other two mature men individually. One of them showed no interest in community work, saying that they had just finished the school and there were no young men in the village anyway. The other informed about the use they could make of a bridge: daily use for farming and animals.

Rio Blanco left the expedition members with an impression of lack of cohesion in the community and a strong doubts about their capacity or involvement on a potential project. However, two factors to bear in mind are that Rio Blanco was the first community visited in Norte Condo, and the residents had very little time to organise themselves. Equally, the team had very little time to check for themselves how deep this disintegration actually was. The second factor counterbalances the initial impression, and tells a lot more about Rio Blanco's capacity for community work: Rio Blanco has a recently built primary school that educates 15 students up to 3<sup>rd</sup> grade (12 years old). Rio Blanco community has an internal agreement to educate their children at the village school even if parents have already migrated to town. This reveals their desire to maintain the community feeling alive. The locals have recently devoted much of their time and effort to the construction of this school building. They mentioned at the meeting that they are used to donating time and work, on rotating shifts, for about 6-7 hours a day. The number of workers available was not specified, but they said they would make sure it is enough for the completion of any potential project.

Due to the cold temperatures Rio Blanco endures, the frost, and the consequences it may have on health issues, the team agreed that advice on housing, solar panels and suitable crops should take priority over education equipment such as TV or computers, and especially over a bridge that does not seem to benefit the whole of the community. One other suggestion from the locals to be considered was the building of lodgings for travellers that pass by on the main road (Oruro-Potosí) near Rio Blanco. This could bring a new source of income for the community. For advice on parasite treatments, the community members were referred to CEDPAN.

### 6.4.2.2 Cortaviento

Estimated population: 10 families

Municipality: Norte Condo



Adobe houses in Cortaviento

Cortaviento is a community situated in the middle of a wide plain where their llamas and alpacas are grazed. Cortaviento is currently cooperating with CEDPAN in a project to fight parasites in camelids. Gregorio Colquillo and Valerio Pilleco are the Cortaviento coordinators of this project, and the two community members that are most in contact with the NGO. The link with this community should be

found through them. No other engineering projects have been implemented in the community before. Cortaviento has a well for drinking water, and no electricity.

Cortaviento community had an extra day to prepare for the visit of the expeditioners, and the team perceived from arrival the great interest and good organisation of the locals. One of the authorities of Cortaviento picked up the team from Rio Blanco and took them to Cortaviento. The team was received by two *comunarios*, lodged at the community house and provided with warm food at every meal time, making them feel really welcomed. A time was agreed to examine the crossings in the pampa where the community would like to have two pedestrian bridges built. This was the main need expressed at the previous meeting in Challapata. The men came along, while the women and the children stayed in Cortaviento. Two major crossings were examined, as well as two others that were not so problematic.

There are 10 children in Cortaviento and 2 other children in the neighbouring *estancia* Ichurata. All of them go to school at Catavicollo, a bigger *estancia* 4 km. further out in the Pampa and closer to the main road from Challapata to Potosí. They have a month's holiday in December, when the rainy season starts. They should start school again in January, but if the rain is too heavy they cannot cross the streams on the pampa and do not attend school regularly until

April. The rivers are often frozen, and the ice breaks under a child's weight. Children walk in company of other children, adults very rarely have the time to come with them. During the rainy months, some children are taken temporarily out of their home so they can keep attending school at a different town. School attendance is the main reason why the community would like pedestrian bridges built. However it would also help them take



The community leader and his son

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their llamas further out into the pampa. The bridges should be built both for people and for a considerable number of animals. The llamas avoid running water and are afraid of it and the noise it makes. During the design and the construction process, this fact should be taken into account. During the interviews it was also revealed that Cortaviento can get completely isolated for 3 or 4 consecutive days during heavy rain periods, and that access is blocked not only for school, but also for the bus to arrive and for basic needs like healthcare and markets. The nearest doctor is located in Crucero, some kms away from Cortaviento, on the road to Challapata.

During the visit, a main meeting was held (at night) in which 7 families out of the 10 in Cortaviento were represented. Attendants were 4 adult women, 3 mature men and 1 young man, and 3 children; sitting in circle in the meeting house where the team was lodged. Turns to speak were given to all, but many just stated the consensus in the community. All the 7 families expressed their will to work in the potential project. They do not have skilled labourers but are used to working. They also provided very exact information as to how work could be done: from 8 am to 5.30 pm, in two shifts of five people each. In case a bridge would be too big a project for their small community, they pointed out that the neighbour villages, Ichurata and Cosillumá would also cooperate, as they would equally benefit from the bridges. There are in total 10 families in these communities, and 2 or 3 members of each would work. The fact that Cortaviento can get these 2 communities involved shows their great interest in the project, since their neighbours belong to different ayllus, which traditionally do not work for each other.

The Cortaviento community members were able to list other needs efficiently, but they clearly showed the bridges were their most urgent priority:

- Pedestrian bridges
- Solar panels, solar showers
- Drinking water system
- Latrines
- Irrigation system to produce enough fodder
- A new meeting house

They were aware of and ready to do any maintenance work required if a project was implemented. The community were eager to sign a document on the spot, so that the contract between them and the team was already established. The team said that any contract should be negotiated through Cedpan first.



### 6.4.2.3 Calacala

Estimated population: 40 families, 60 more families living in town

Municipality: Norte Condo



From Cortaviento, the team was guided to Calacala on foot by a woman from this community. Calacala was the biggest community visited in Norte Condo, although as with many communities, some members do not live there permanently anymore. They also have

better facilities than the communities visited before: latrines, a tap with running water during the warmer hours of the day, a good dirt road with a drainage system, and a primary school along the dirt road, where 20 children attend lessons. The dirt road diverts at one point, towards the school in one direction, and into the pampa towards Cortaviento in the other. Calacala is situated on one of the sides of the same pampa as Cortaviento, but nearer to the mountains where a main dirt road connects the village to the road Potosí-Challapata. This main dirt road, approximately 1.5 kms away from the village, is still functional during the rainy season, so Calacala does not get isolated. A minibus goes through Calacala once a week towards Challapata.

CEDPAN has been cooperating with Calacala in the camelid anti-parasite project since 2007. Like their pampa neighbours, they keep mainly llama and alpaca herds and sheep flocks. The man to be contacted in Calacala for future projects who is in contact with Cedpan is Germán Parina.

Calacala is well-organised when it comes to communal work, as was proved by the dirt road built by themselves. On arrival, the team was received by the community chief, who called the neighbours to a general meeting. Proportionally, fewer people attended this meeting than in Cortaviento, but here we have to note that it was a time of the day (mid-morning) when most people are busy working. In attendance were 6 men of different ages, standing at the front; and 9 women of different ages, sitting at the back. The petition from Calacala at the previous meeting in Challapata was essentially the same as Cortaviento's: pedestrian bridges to avoid cold, dangerous streams during the rainy season. At the meeting in the village, these were the petitions, as prioritised by the locals:

- 2 pedestrian bridges for children, adults and animals during rainy season
- A lodging house for tourists



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Although not everyone used their turn to speak, it was noted that a consensus about their priorities seemed to have been reached before. So, the team was guided to the crossings on the river by the chief and some other community members. They said that they do not have skilled labourers, but the chief showed confidence that he could get someone with the right knowledge, if needed for the project. There are 25-30 people available to cooperate in Calacala, who would work in rotations of 5 or 6 people at a time, from 9am to 5pm daily. They have already applied this system during the dirt road construction. Like Cortaviento, Calacala seemed a focused and determined community.



The dirt road constructed by the community

The women presented the team with local food and drinks, and showed the team their wool crafts for sale, making them feel welcomed at all times.

### 6.4.3 Conclusions

Before departure from Oruro, the team held two final meetings with both Cedpan and the Mancomunidad.

Cidar Cepeda was happy to let the team work with Cedpan, and offered to help by sending information if the organisations that will fund a future project should require it. He also approved of contacting Engineers Without Borders in the UK to pass on the information about potential projects in Kehuallani. He thanked the team and invited them to come back whenever they would like. He insisted on keeping touch via email.

Germán Ríos received the team at Cedpan offices, and encouraged them to keep touch frequently once the project was decided upon, so that when the next team arrives everything is ready to start the actual construction. Any legal issues within Norte Condo district should be discussed with Norte Condo *subalcaldía*, and the problem of communities being in different ayllus can actually be solved by negotiating an agreement with all parties at the *subalcaldía* too.



Final meeting with Germán

The team agreed that they would send information on road, house, and other maintenance and health tips for all the communities visited through the organisations,

and that the most suitable communities to implement a bigger project, namely a pedestrian bridge, were those in the Norte Condo pampa, Cortaviento and Calacala. It was made clear in every community, that the team had limited time and budget, and that they had to prioritise one petition over the others on feasibility and sociological grounds.

The team decided to choose the pampa communities and their requests for pedestrian bridges mainly for the interest, involvement and willingness of the people. They already have experience in community projects (e.g. the excellent dirt road in Calacala), and they have a consensus on their needs and their prioritisation. All these factors together make the construction a bit more possible.

From a sociological point of view, building one of those bridges would definitely contribute to establish the link between Imperial College students, Cedpan and the altiplano communities, create an atmosphere of reliability and guarantee future communication. Even if a civil engineering project like a pedestrian bridge is not a matter of survival for the communities involved, it still shows that the will of cooperation from Imperial College students is real, and would suppress the locals' understandable suspicion that the European students may never come back.

From a purely sociological point of view, Cortaviento should have priority over Calacala for two reasons. Even if it is a much smaller population, Cortaviento gets completely isolated from basic needs such as doctors, market and access to town and other areas during the rainy season. Their need was clearly shown when they brought a ready-to-sign contract to the meeting with the expeditioners. Calacala is a much bigger community but does not become completely isolated at any time of the year, and has already facilities that other communities lack. However, Calacala is a more convenient place where a new expedition could start a building project. If Calacala is the chosen site for the project in summer 2009, maybe it is worth to posit some temporary alternative for the school children in Cortaviento, such as re-arranging their school calendar together with the local teacher, so that they attend school more days during the dry season to compensate the missed lessons during summer.

A possible negative effect of implementing projects in Altiplano communities is that cooperation might degenerate into dependence, but in order to avoid this the project has to be taken as their own by each community, and they have to be made fully responsible for their maintenance.

Future sociological projects can follow two main lines. One is to investigate the needs of particular altiplano communities, the other is to educate and monitor the population on making the most use of and maintaining the facilities they already have or are working on. Simple habits like placing a lid on a well so that animals do not fall into it; or giving latrines the use they were meant for, can make a difference in the health of those communities. But because these habits are not traditionally part of the altiplano life, people finally abandon them, making the facility useless. Altiplano people have very different conceptions from European people, so actions we assume in our culture might be not so obvious for them. In this sense, it is very important that during the future construction of pedestrian bridges in either community of Norte Condo, the

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workers and everybody else at the community follows a parallel educating programme about the importance of maintenance and technical advice on how to do so.

Due to the desert conditions of the Altiplano, the extreme temperatures and the lack of water, it seemed obvious that communities there would benefit greatly from agronomical engineering projects and veterinarian advice. Since their economy is purely agronomical, a sound base for the improvement of their life conditions lies in this field. The impact of such projects in the area might be seen in the long run, especially in stopping rural population migrating to town and abandoning their homes and traditional way of life. Little improvements, like obtaining a slightly better harvest, can make big differences, by allowing a family to trade and invest their money in other needs. Also, the Bolivian substrata are not lacking deposits of good quality water, it only needs to be pumped up. Communities would ask repeatedly for means to keep their animals healthy and productive, for sources of drinking water and for irrigation systems that would help them extend the harvest time during the year. Engineering solutions can also be helpful but maybe the more so when the agronomical problems are solved.



Irrigation channels are dry for most of the year

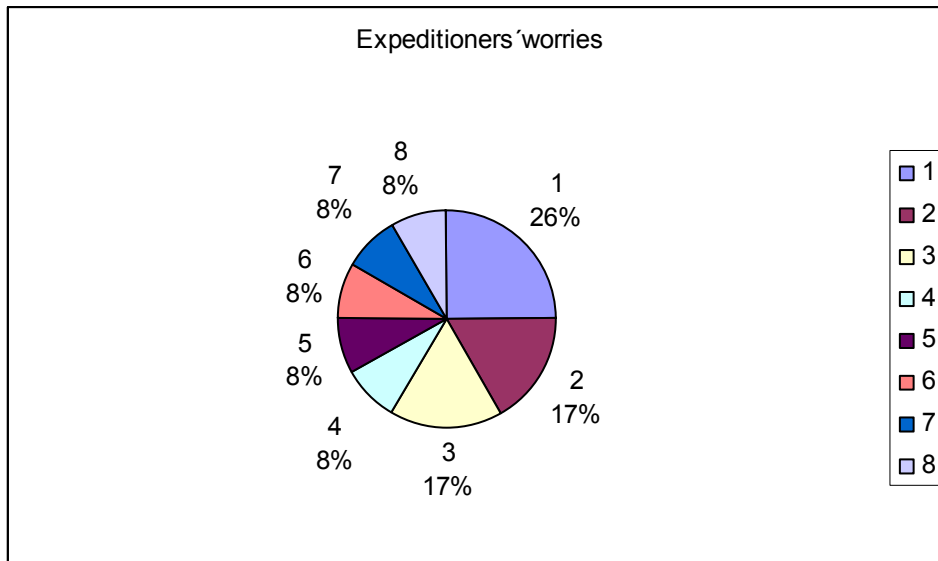
### 6.5: Team member experiences

During the journey to Bolivia, the members of the team were asked to reflect on their expectations and their anxieties about the expedition. Sharing their worries with the other members contributed to team-building and improved the personal knowledge of others. Two questions were posed:

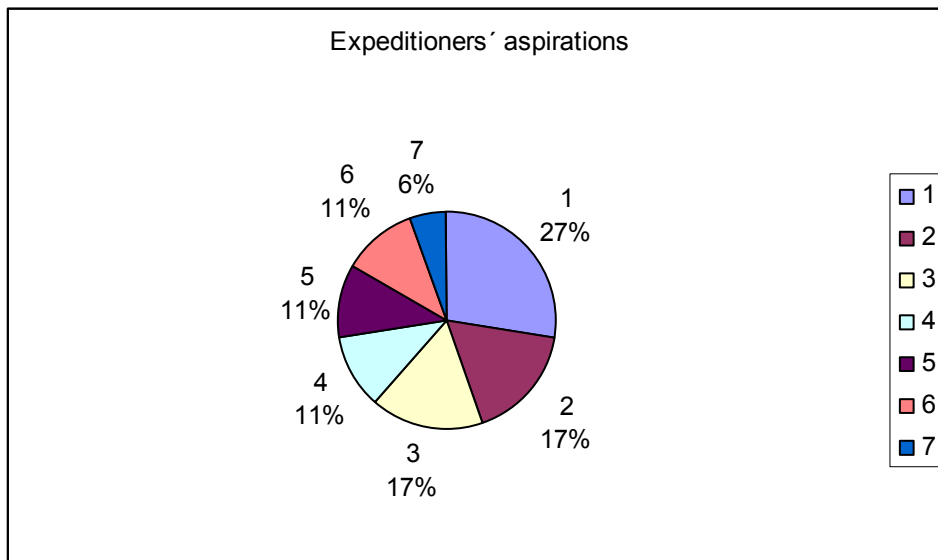
- **What are your worries about the expedition?**
- **What are your aspirations / what are you looking forward to in the expedition?**

Their answers have been analysed and grouped together under the same heading when corresponding to the same basic aspiration or worry. Recurrences have been counted, producing the following comparative graphics:

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1. inability to speak Spanish
2. deterioration of personal relations or communication within the team
3. holding the team up
4. falling ill
5. physical weakness
6. delayed flights and lost luggage
7. responsibility for the team's wellbeing
8. pressure to find a suitable project



1. the physical challenge
2. engineering and problem solving: putting skills to use
3. experiencing new cultures and places
4. improving the life of local people
5. having enjoyable and satisfying experiences
6. focus on sociological aspects
7. learn new skills

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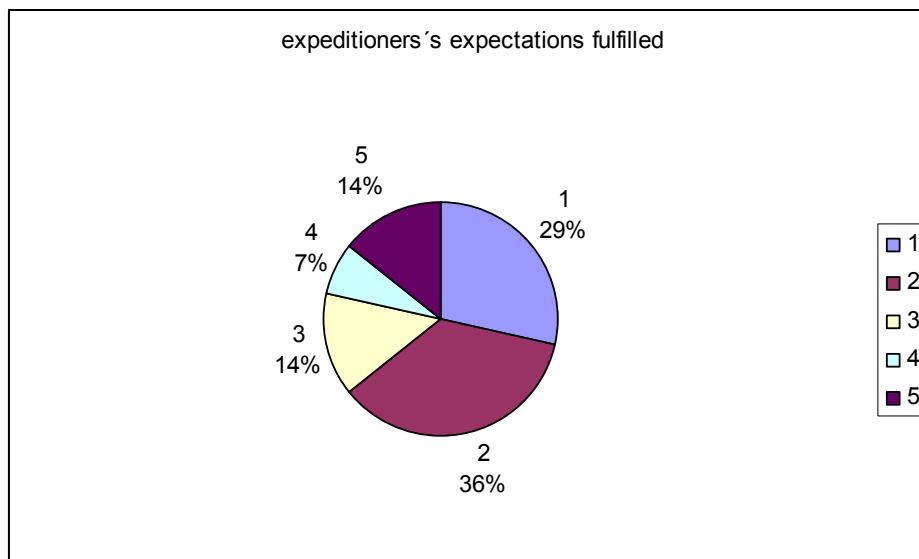
At the end of the expedition, the team members were asked again to analyse their experience, and express themselves freely about the aspects that most fulfilled their expectations, and those who were sources of frustration. The questions posed were:

- **Which personal expectations were fulfilled by the end of the expedition?**
- **Which personal expectations were not fulfilled by the end of the expedition?**

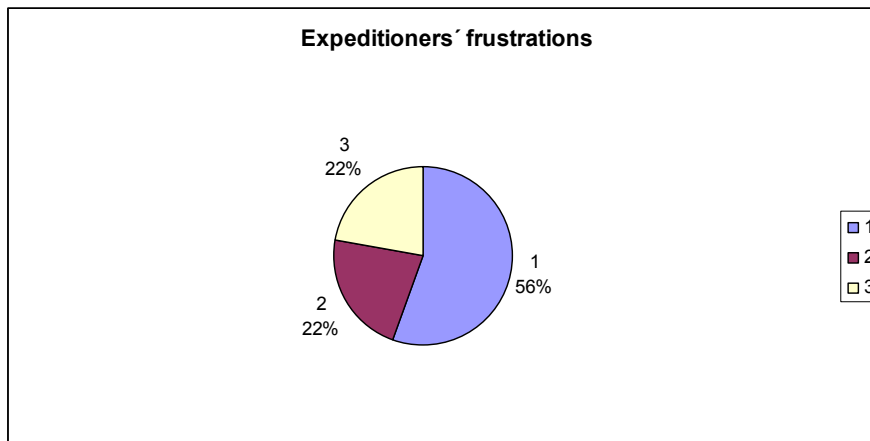
The expectations fulfilled do not always coincide exactly with those they specified as “aspirations” but still give a good account of what the expeditioners enjoyed most. Their frustrations pick up elements from both their worries and their initial aspirations.

When possible, the experiences compiled in this section have been grouped under the same headings than those in the pre-expedition survey, for the sake of comparison.

The expeditioners’ fulfilled aspirations do not in all cases coincide with their stated aspirations. From these diagrams we can deduce that the main source of satisfaction after the expedition was the experiencing of new cultures and places (rated as 3<sup>rd</sup> aspiration and as 1<sup>st</sup> expectation fulfilled) while the main source of frustration was the lack of a long physical challenge as planned (rated as 1<sup>st</sup> aspiration and as 1<sup>st</sup> main frustration).



1. **engineering project found, skills put to use**
2. **experiencing new cultures and places**
3. **completing the expedition**
4. **personal relations within the team**
5. **learning new skills**



- 1. lack of long physical challenge**
- 2. unsuitability of the initial itinerary**
- 3. illness management**

As a conclusion to draw from the team's main source of frustration, due to the non-existent concept of sport in the area any expedition that aims to combine engineering with climbing or trekking should allow separate times for both activities, and contact the local authorities only when they are ready to devote all their time left to the engineering. They should also decide where the focus of the expedition is beforehand, and how much effort and time they would like to devote to each activity.

One last question was posed to the expeditioners, from which relevant textual answers follow:

**Have you learnt or achieved something you did not expect? What?**

- *"It is hard to know how hard to push your point to people of other cultures, if we do not want to offend or annoy them."*
- *"Although not always a good thing, it was still interesting to see how people's behaviour in the team changed out of their comfort zone."*
- *"I learnt that patience and liaison skills are indispensable when trying to communicate ideas in a foreign country. I had underestimated the importance of these values."*



*Cholitas* (Bolivian women in traditional dress) in a La Paz market



## Other Activities

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### 7.1: Trekking

Despite the initial plans of the expedition to trek between the communities, once the team arrived in Bolivia it became apparent that this was not a feasible option for two main reasons. Firstly, due to the time taken for the delayed baggage to arrive in Arica, nearly a week had been lost, and it was decided that it would be in keeping with the main aim of the expedition to sacrifice some of the trekking, so that the work with the communities would be affected as little as possible. The team was also told that the communities might not understand our reasons for choosing to trek rather than using transport such as a bus, and proved to be true at the one village that the team did trek to, Quehuallani.

The team decided to use the return journey from Macallo to Challapata as a chance to get in some trekking. However with Lorena feeling ill, and Andras looking after her as the team first aider, only four members of the expedition were able to walk the 12km back to Challapata. Mostly on road, this only took a couple of hours.

Again only four members of the expedition trekked to Quehuallani, taking in the same 9km of road as on the way to Macallo, before turning off for around 11km on dirt tracks, and across scrub. The pace was much slower off the tarmac, however as the route was very flat the 20km were covered in five and a half hours. Arriving in the village the warning that the team had received on people not understanding the expedition's reasons for walking proved to be true.



Andras on top of Cerro Follo Khaina at sunrise

With Lorena still overcoming her illness, and Sarah agreeing to accompany her to Potosi, Andras, Harriet, Hilary and David used the trip back to Challapata from Calacala as a two day trek, taking in two peaks over 5000m. Taking the bus from Calacala to Estancia Crucero, the group started trekking late in the morning on their way up towards the peak of Cerro Follo Khaina. A delay in getting a bus in the morning meant that it was not possible to reach the peak that day, however they made good headway, and managed to set up camp at over 4800m,

having trekked over 8km horizontally, and climbed near to 1000m. Rising early the next morning saw the team just 20m below the summit at sunrise, and the peak of Cerro Follo Khaina (5058m) was reached soon after. From here the team trekked a route back to Challapata that took in both Cerro Serkhe (4995m) and Cerro Chumpiri (5048m), before dropping down, into and across valleys towards Challapata. Despite useful directions received in the small village on the route, the team did not manage to make it back before dark as had originally been planned, having to walk an hour on the track into Challapata in the dark. At high altitude it proved to be a very hard day of trekking, with just over 25km covered in 14 hours, however was a great achievement for the team.

As well as the trekking to and from villages, Cerro Sirpo (4746m), a mountain overlooking Challapata also offered a rewarding day walk. On the second day of the fiesta, with Lorena resting due to her illness, the rest of the team used the day to climb Cerro Sirpo, and stretch out their legs. Andras and Lorena then climbed Cerro Sirpo on the rest day, after the team had returned from Calacala, so none of the team would have missed out.



Challapata seen from the summit of Cerro Sirpo; Lago Poopo in the distance.

## 7.2 Culture & tourism

The only time scheduled for leisure activities during the expedition was at the very beginning, so to allow for acclimatisation, and then at the end which was to act as a buffer in case of delays. In Arica the team 'climbed' El Morro for the fantastic views, visited a steel church designed by Eiffel himself and even braved the winter sea.



A display of local instruments in the musical instrument museum

La Paz being much larger meant there was more to see and do. The team by no means exhausted the cultural delights of the city but did manage to fit in visits to the Coca Museum and the Museum of Musical Instruments, both of which are thoroughly recommended. The city is also full of markets, including the notorious Witches' Market which needs to be seen to be believed. This market stocks every type of mixture and potion to cure all sorts of conditions, carvings of the local gods, and of course dried llama foetuses which are believed to bring luck to a new building if buried in the foundations!

Although Challapata is only a small town there are still things to experience. The team took a short walk up the hill behind town to visit the shrine of the Virgin del Carmen, after whom the local Fiesta is named. The Fiesta is held every July and was one of the highlights of the expedition. The team were the only Europeans present when everyone from the surrounding area converged on the town in amazing costumes and ready



Women dance at the fiesta

to dance for two days straight.

As the team did not have time to visit the famous Uyuni salt flats, it was decided to take a trip to the nearby lake Poopo which also was surrounded by salt flats. Finally after we had visited all the villages we had two days spare. Due to illness two of the group chose not to climb Cerro Follo Khaina but instead headed to Potosí. There is a lot to do in Potosí as it is heavily tourist-centred and also very Spanish in feel. This is due to the large amounts of money made from mining. The pair only spent 24 hours here but would recommend a return visit especially to El Cerro, the largest silver mine in the area.



The strange world of the salt flats



Some of the amazing costumes seen at the Fiesta del Virgen del Carmen



# Conclusions

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## 8.1: Results and Decisions

On returning to the UK, the team allowed some time for reflection and to collate information, and then met to decide on the future of the project. The aims of this meeting were:

- Should a team return to any of the communities visited to implement a project?
- If so, which community, and which project?
- What follow-up should be provided to other communities?

It was quickly decided that the most suitable projects for a return expedition are the pedestrian bridges requested by Corta Viento and Calacala. This was based on the following factors:

- An expedition to Bolivia is a relatively large financial and logistical undertaking, so the end product should be something that could not be delivered in another manner
- These projects were felt to be within the capabilities of a student expedition
- Both communities showed good communal sense of purpose and were aware of the work that would be required

In order to decide which community to visit, a number of important deciding factors were identified, for example number of beneficiaries. The factors were each giving a weighting to show their relative importance. Each community was then ranked in terms of these criteria, with a higher number showing a greater need. The rankings and weightings were then multiplied together. The community with the highest overall score was considered to be the most appropriate for next year's expedition. The results can be seen in Appendix K.

This exercise clearly pointed to Calacala being the best choice for the bridge-building project. However, this conclusion was then discussed to check that everyone was in agreement. It was considered that Calacala would be ideal, as the welcoming attitude of the community and the slightly higher level of facilities would ensure a reasonable standard of living for the team, and reduce chances of illness. It was thought to be very important that team members have a good experience on expedition, as this will increase the chance of them wishing to return to the region in future to run other similar projects (perhaps in Corta Viento).

It was noted in the Sociology Report that Corta Viento can be completely cut off from Challapata when the rivers are high, and this is not the case for Calacala. Therefore it might be expected that Corta Viento is a higher priority for the project. However, Corta Viento has a much smaller population, which in the scoring system used, outweighed the isolation.

While in Bolivia, community leaders from Corta Viento and Calacala stated that the two villages would not be able to work together on a project, because they are in different *ayllus* (administrative units). CEDPAN then said that it might be possible to work around this, if a higher level of authority was consulted. Therefore the team will attempt to find a way for the two communities to cooperate. This would mean that, in 2009, both villages would work to

## Section 8: Conclusions

construct bridges in Calacala. The following year, both communities would work in Corta Viento. Clearly the second project would require less outside input.

There were several issues which the team encountered in a number of communities, such as poor sanitation, improvements to dirt roads and improvements to adobe houses. These type of issues are not large enough to justify an expedition, but considerable help can be given by providing information. It has been agreed with CEDPAN that information sheets will be sent out, giving advice on simple, inexpensive improvements that can be made by the local people. It is hoped that CEDPAN can use these sheets as a basis for an education programme.

### 8.2: Overall Conclusions

Overall, this was a successful expedition, in terms of both measurable outcomes and more subjective criteria.

- A suitable project for a return expedition has been identified, and the necessary relationships with local organisations have been put in place
- Large amounts of information on the region and on specific projects have been gathered and are stored for future use
- The team learned about the political and social sides of development work, the roles of various parties and the importance of good communication and understanding
- The engineering students were able to put skills learned in the classroom to practical use, as well as learning about low-technology construction
- All team members were at times placed in new and challenging situations, and learned to deal with a variety of tests, whether technical, physical or social.

As discussed in the Sociology report, there were also several areas which caused frustration, the main ones being communication difficulties and the lack of trekking. These two were connected, as the team had believed that the trekking element of the expedition would be possible following email and phone communication with the authorities in Bolivia. However, this was an example of genuine cultural misunderstanding. For future expeditions, it is recommended that the team should not try to force a physical element into the itinerary, as it caused confusion. To the expedition team, the twin aims of carrying out feasibility studies and trekking seemed to fit well together; but to the Bolivian organisations, the two aims seemed to be in conflict.

It is hoped that on next year's expedition, communication difficulties with partner organisations will be less problematic, as a relationship has already been established. However for other similar projects, it is recommended that additional time is allowed for meetings at the start of the trip, even if arrangements have already been made by phone or email, as it was noticed that decisions are usually not seen as final until a face-to-face meeting has been held.

At the time of writing (January 2009), planning for the second phase of this project is well underway. A team of 12 students has been selected to return to Calacala to construct the requested footbridges, in partnership with the local community and CEDPAN.



## Acknowledgements

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*The team would like to thank the following individuals and organisations for their support and advice, without which this expedition would not have been possible.*

CEDPAN (especially Trifón Choque Jimenez and Germán Ríos)

City and Guilds College Association, Old Centralians' Trust (especially Chris Lumb)

Engineers Without Borders

Imperial College Department of Civil and Environmental Engineering (especially Prof David Nethercot and Alison Ahearn)

Imperial College Exploration Committee (especially Lorraine Craig, Chris Green, Ciaran McKeown and Nigel Wheatley)

Institution of Civil Engineers Graduates and Students Committee (especially Chris Joyce, Daniel Hing and Shaman Pottage)

Laing O'Rourke (especially Paddy O'Rourke, Julia Stevens and John Green)

Royal Geographical Society

University of London Union Convocation Trust

Buro Happold

Elena Bailey

Richard Beckett (Khana Wayra)

Daniel Carrivick

David Chinn (Imperial College Finance Department)

Alice Clarke

Sarah Cuellar

Valerie Fraser (Centre for Latin American Studies, University of Essex)

Joseph Johnstone

Peter Millward, (Lecturer in Sociology, University of Liverpool)

Ross Moorhouse (Sunny Days Hostel, Arica, Chile)

Yoke Thye Pean

Paul Rathbone (Rathbones of Keswick)

Katie Willis (Department of Sociology, Royal Holloway)

## Appendix A: Contacts

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### **NGOs**

#### **CEDPAN**

Email: cedpanch@gmail.com

Tel: 00 591 222 8447

Contacts: Trifón Choque Jimenez, Director.  
Germán Ríos, Azanake Region Coordinator

#### **Suma Jayma**

Email: sumajayma@gmail.com

Website: www.sumajayma.org

Contacts: Jaime Rosa and Braulio Rojas

### **Local Government**

#### ***Mancomunidad Azanake***

Email: cidarcepeda@yahoo.com

Tel: (00 591) 2557 2549

Contact: Cidar Cepeda, Technical Manager

## Appendix B: Accounts- Income and Expenditure

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### Income

Personal contributions	500	6	3000
Exploration Committee grant	3000	1	3000
Old Centralians' Trust	1000	1	1000
ULU Dunsheath Award/Convocation Trust	2000	1	2000
Engineers Without Borders	500	1	500
Laing O'Rourke	1000	1	1000
Anonymous source	500	1	500
<b>Total income</b>			<b>£11,000</b>

### Expenditure

<b>Expenditure prior to expedition</b>			
<b>Medical</b>	Price per unit	Units	
Medical training - Wilderness	138	2	276.00
Vaccinations			285.50
Medical kit			222.68
Water purification			7.49
<b>Communication</b>			
Phones			15.00
Postal - stamps and envelopes			11.88
<b>Miniexpedition Dartmoor</b>			
Travel - fuel costs		1	41.56
Food			31.16
Team meal		1	48.44
<b>Equipment</b>			
Sleeping bags	average 162.33	6	973.95
Down jackets	average 162.15	5	810.75
Trekking equipment - safety			29.38
Other trekking equipment			221.29
<b>Studies</b>			
Memory cards	average 16.49	2	32.98
Dictaphone		1	41.97
Batteries			16.36
<b>Subsistence</b>			
Food - purchased UK			58.35

## Appendices

<b>Travel</b>			
Flights - returns Heathrow to Arica, Chile	average 770.83	6	4,624.99
Travel to training days			128.20
<b>Miscellaneous</b>			
Non-Imperial expedition member insurance		1	101.19
			<b>£7,919.12</b>
<b>Subtotal expenditure prior to/post expedition</b>			

<b>Expenditure during expedition</b>			
<b>Medical</b>			
Treatment expenses			25.95
<b>Communication</b>			
Phones			104.29
Internet			8.18
Satellite phone usage			79.14
Postal			19.27
<b>Equipment</b>			
Replacements for delayed gear			56.01
<b>Studies</b>			
Equipment for studies			136.26
<b>Subsistence</b>			
Accommodation			502.59
Food - while in towns			392.61
Food - while carrying out studies			185.35
Bottled water			31.32
Petrol			5.86
Toilet/toilet roll			4.82
<b>Travel</b>			
Taxis on expedition			73.36
Buses on expedition			182.76
<b>Miscellaneous</b>			
Cultural expenditure			26.83
Lost/stolen		1	37.59
Miscellaneous		1	1.04
Lost in exchange rates			29.55
<b>Subtotal expenditure on expedition</b>			<b>£1,902.80</b>

<b>Total expenditure</b>	<b>£9,881.92</b>
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**Personal expenditure**

Expedition members spent personal money on souvenirs and other items using part of the cash advance that had been made before the expedition left the UK, on the understanding that they would then reimburse the expedition after its completion.

Since the expedition is in profit, some of the remaining amount in the accounts is used to give members a refund on any expenditure made buying items in preparation for the expedition. The remainder was then donated to the Altiplano 2009 expedition. The amount owed by each member to the expedition for personal expenditure while in Bolivia is subtracted from the amount they would receive in refund.

<b>Total Income</b>	11,000.00
<b>Total Expenditure</b>	9,881.92
<b>Remainder</b>	1,118.08
<b>Reserved for report printing</b>	50.00
<b>Updated remainder</b>	1,068.08

**Allocation of remaining sum in expedition account**

<b>Personal expenditure refund per member</b>	<b>184.21</b>
Owed to expedition for personal expenditure	
HK	40.73
HD	36.92
DB	67.19
SC	44.15
AS	62.96
LM	71.47
<b>Total personal expenditure</b>	<b>£323.41</b>
<b>Personal expenditure refund divided into:</b>	

.(1)



<b>Amount donated to Bolivia 2009</b>	<b>£400.73</b>	.(2)
<b>Amount refunded to members</b>	<b>£342.94</b>	.(3)
<b>Sum (1) + (2) + (3)</b>	<b>£1,068.08</b>	

### Comments

The expedition under-spent in comparison with the original budget. This was partly due to lower-priced flights and reductions obtained on equipment purchases. Whilst in Bolivia itself, the expedition expenditure reflected the changes to the time schedule of the expedition that were necessary. Therefore subsistence in towns cost more than expected, but this was still easily within the budget (£4 per person per day) for subsistence in urban areas. Expenditure on food during trekking and living in communities was also just within budget (£3 per person per day).

Expenditure that had not been budgeted for included the purchase of a mobile phone in Bolivia to allow communication between the two groups at the beginning of the expedition and to facilitate communication with the authorities whilst in communities. The travel expenditure to training events was also not foreseen in the original budget.

### Insurance

#### Replacement equipment insurance claim

Hilary made an insurance claim to Air Comet on behalf of the expedition on returning to the UK for the luggage item that had been completely lost and the amount that was subsequently spent on rental of equipment. Air Comet was contacted several times after this claim was made to follow its progress, but no result was forthcoming. On the advice of AIG Insurance, a claim was then made to them for the lost luggage item cost only. This was successful, and Hilary received the reimbursement for the full cost of the luggage lost. She then reimbursed the expedition for the replacement items that had been purchased whilst on the expedition.

#### Cost of replacement gear subsequently reimbursed to expedition

	Bolivianos	Dollars	Sterling
Sleeping bag liner	421	58.47	30.77
Water bladder	264	36.67	19.30
Trek towel	153	21.25	11.18
Sunhat	32	4.44	2.34

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Socks	12	1.67	0.88
Gloves	25	3.47	1.83
Trousers	70	9.72	5.12
<b>Total</b>	<b>977</b>	<b>135.69</b>	<b>71.42</b>

## Appendix C: Risk Assessment

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In general, Bolivia was considered to be a safe country to visit, and there were no travel restrictions advised on the Foreign Office website at the time of departure.

### General

Hazard	Possible Consequences	Prevention	Cure
Road Traffic Accident	Minor injuries, serious injuries, death	Hire a local driver with experience of local driving conditions.  Only drive in daylight.  Wear seatbelts at all times.	Evacuate casualties to hospital. Inform police if necessary.
Snake bite, insect bites	Serious illness, death	Use insect repellents and wear protective clothing when in affected areas.  Avoid undergrowth, log piles etc.  No team members to walk around alone after dark.	Immobilise casualty, administer antihistamine, evacuate to hospital as soon as possible.
High altitude	Headache, nausea, reduced exercise capacity.  Acute Mountain Sickness.  Pulmonary Oedema, Cerebral	Allow time for acclimatisation before starting trek. Only 300m per day of ascent. Drink plenty.	Do not ascend. If condition persists or worsens, descend.  Evacuate if necessary.

## Appendices

	Oedema. Death		
Water-borne diseases	Sickness, diarrhoea, dehydration	Treat water with iodine or by boiling.	Drink plenty of fluids. May require antibiotics if persistent.
Dog bites	Inability to use affected body part. Rabies, other infections.	Do not approach or touch animals. Exercise caution when approaching settlements. Team members to have rabies vaccinations.	Clean and dress wound. Seek prompt medical attention.
Robbery/mugging/scams	Loss of money, passport etc. Possible injury.	Seek local advice and avoid dangerous areas. Do not travel alone. Do not attempt to resist. Be aware of well known scams and stay alert.	Inform police and embassy. Seek medical attention if required.
Protests / demonstrations*	Delay to schedule. Difficulty travelling.	Build extra days into schedule. Seek local advice before travelling.	

\* In 2007 there were major demonstrations in Cochabamba over water prices, which effectively paralysed the city. This issue was resolved and it was not expected that the expedition should face such serious problems. However, due to the National Referendum which took place on the 10<sup>th</sup> August 2008, there were several major protests in La Paz during the team's stay before departure for Chile. These were usually easy to spot from far away, did not turn into riots and could be avoided appropriately. These type of events do occur from time to time in Bolivia but were not found to pose a threat.

### Trekking

Sunburn, dehydration	Sunstroke, heat exhaustion	Wear sunblock and/or cover skin. Cover head. Seek shade where possible. Drink 3-4 litres of water per day. Be aware of locations of water sources in advance.	Place casualty in shade, give water.
Cold (at night)	Hypothermia	All team members to be properly equipped. Change out of wet clothing. Monitor other team	Warm casualty (place in sleeping bag, in shelter). Evacuate if

## Appendices

		members.	necessary.
Terrain	Trips/falls- minor injuries (cuts, bruises, sprains)  Major injuries (breaks, head injuries)	Wear supportive footwear. Assess terrain beforehand.	Treat injuries as required.  Evacuate if necessary.
Lifting heavy packs	Muscle strains, inability to use affected body part	Divide loads according to individual abilities.	Rest affected body part. Alter trekking schedule if necessary.
Bad weather	Difficulty in navigating, team may become tent bound	Share navigation between the team, and refer to compass/GPS frequently. Ensure surplus food and fuel to account for delays. Build surplus days into schedule.	Wait for weather to improve if necessary.
Fatigue, exhaustion	Difficulty concentrating, irrational behaviour, stumbling	Be aware of individuals' capabilities and move at the pace of the slowest. Flexible schedule with frequent rest. High calorie diet with surplus taken in case of extra rest days.	Rest, make camp if required. Take extra rest day if required.

## Hazards Associated with High Altitude

Hazard	Symptoms	Consequences	Prevention	Response
<b>Altitude sickness in general</b>	Headache Nausea Feeling weak	Normal activities might be difficult, or impossible	The standard approach to acclimatization applies. Don't fly or drive to high altitude. Start below 10,000 feet (3,048 meters) and walk up. *	Depending on severity: remain at altitude or descend.
Fluids collecting in lungs and or increasing pressure on brain as a direct result of decreased air	Shortness of Breath Decreased level of consciousness Altered behaviour	If left untreated, possible progression into:  Ataxia  Coma	As this will not be possible, the team will take additional acclimatisation days once driven onto the	Although medications, such as <i>diamox</i> , <i>dexamethasone</i> and <i>nifedipine</i> exist to aid acclimatisation or to reduce the effects of

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<p>pressure due to a significant gain in Altitude</p>	<p>(among others, see details below)</p>	<p>Death</p>	<p>plateau.  Above 10,000 feet (3,048 meters), only increase altitude by 1,000 feet (305 meters) per day and for every 3,000 feet (915 meters) of elevation gained, take a rest day</p>	<p>Altitude sicknesses, they will not be taken for this expedition, as members should be able to cope with the altitudes without them, as far as they keep to the preventative measures mentioned.  <u>Headache: Ibuprofen</u> is effective.</p>
<p><b>Mild Acute Mountain Sickness</b></p>	<p>Headache Dizziness Fatigue Shortness of breath Loss of appetite Nausea Disturbed sleep General feeling of malaise.</p>	<p>Mild decrease in levels of concentration and performance</p>	<p>As above**</p>	<p>Inform other members of team.  Depending on severity: remain at altitude or descend.</p>
<p><b>Moderate Acute Mountain Sickness</b></p>	<p>Severe headache that is not relieved by medication. Nausea and vomiting. Increasing weakness and fatigue. Shortness of breath. Early signs of</p>	<p>As above, plus: Normal activity is difficult. Member might have to be aided by others.</p>	<p>As above</p>	<p>Descending even a few hundred feet (70-100 meters) may help and definite improvement will be seen in descents of 1,000-2,000 feet (305-610 meters).  Twenty-four hours at the lower altitude will result in significant improvements.  The person should</p>



	Ataxia possible			<p>remain at lower altitude until symptoms have subsided (up to 3 days).</p> <p>It is important to get the person to descend before the ataxia reaches the point where they cannot walk on their own (which would necessitate evacuation).</p>
<b>Severe Acute Mountain Sickness</b>	<p>Increase in the severity of the aforementioned symptoms, including:</p> <p>Shortness of breath at rest.</p> <p>Ataxia (Inability to walk).</p> <p>Decreasing mental status.</p> <p>Developing signs of HAPE and HACE (see below).</p>	<p>Normal activity is impossible.</p> <p>Member has to be aided by others throughout evacuation.</p>	<p>Condition of members should not be left to deteriorate to this stage, by:</p> <p>Recognising signs of AMS at an early stage;</p> <p>No further ascent made, and preventative measures, as described above, should be followed.</p>	<p><b>Immediate descent</b> to lower altitude (2,000 - 4,000 feet [610-1,220 meters]) even if medication is available.</p>

<p><b>High Altitude Pulmonary Edema (HAPE)</b></p> <p>Fluid build up in the lungs</p>	<p>Shortness of breath even at rest.</p> <p>‘Tightness’ in the chest.</p> <p>Marked fatigue.</p> <p>A feeling of impending suffocation at night.</p> <p>Weakness.</p> <p>A persistent cough bringing up white or pink, watery, or frothy fluid.</p> <p>Confusion and irrational behaviour are signs that insufficient oxygen is reaching the brain.</p>	<p>Serious blood oxygen level reduction, leading to:</p> <p>As for Severe AMS plus:</p> <p>Cyanosis</p> <p>Impaired cerebral functions.</p> <p>Coma</p> <p>Death.</p>	<p>As above</p>	<p><b>Immediate descent</b> is a necessary life-saving measure (2,000 - 4,000 feet [610-1,220 meters]). ***</p> <p>Anyone suffering from HAPE must be evacuated to a medical facility for proper follow-up treatment.</p>
<p><b>High Altitude Cerebral Edema (HACE).</b></p> <p>Increased pressures on Brain, due to swelling tissue as a result of fluid leakage inside the skull.</p>	<p>Symptoms can include headache, loss of coordination (ataxia), weakness, and decreasing levels of consciousness inc. disorientation, loss of memory, hallucinations, psychotic behaviour, and coma.</p>	<p>Increasing pressures on brain, leading to:</p> <p>As for Severe AMS plus:</p> <p>Impaired Cerebral functions</p> <p>Coma</p> <p>Death</p>	<p>As above</p>	<p><b>Immediate descent</b> is a necessary life-saving measure (2,000 - 4,000 feet [610-1,220 meters]). ****</p> <p>Anyone suffering from HACE must be evacuated to a medical facility for proper follow-up treatment.</p>
<p><b>Cheyne-Stokes Respirations</b></p>	<p>Periodic breathing during sleep known as</p>	<p>Lower blood oxygen levels, due to</p>	<p>As above.*****</p>	<p>This type of breathing is not considered abnormal at high</p>

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	<p>Cheyne-Stokes Respirations. The pattern begins with a few shallow breaths and increases to deep sighing respirations then falls off rapidly.</p>	<p>inadequate respiratory functions during sleep.</p> <p>This slows acclimatisation or possible worsens of symptoms of AMS during sleep.</p>		<p>altitudes. If it occurs first during an illness (other than altitude illnesses) or after an injury (particularly a head injury) it may be a sign of a serious disorder.</p>
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Notes with regards to medications used for High Altitude related conditions and their prevention:

Dexamethasone and Nifedipine were taken as both were easily available from previous Imperial College expeditions to high altitude- however it was not expected that either would be required in Bolivia.

\* Preventative medications such as *Diamox* may be taken to aid acclimatisation, normally 125mg twice daily.

\*\* *Dexamethasone*, (a steroid) is a prescription drug that decreases brain and other swelling reversing the effects of AMS. Dosage is typically 4 mg twice a day (it may be taken with *Diamox*).

\*\*\* *Nifedipine* rapidly decreases pulmonary artery pressure and relieves HAPE but is no substitute for descent so should only be used on a descent as a temporary measure.

\*\*\*\* *Dexamethasone* decreases brain and other swelling and can alleviate HACE. Like *Nifedipine*, only to be used during descent as a temporary measure. Dosage: 4mg twice daily.

\*\*\*\*\* *Diamox* has been found particularly useful for increasing blood oxygen levels during sleep.

## Appendix D: First Aid Kit

<b>Medications</b>			
<b>Purpose</b>	<b>Name</b>	<b>Package of</b>	<b>Taken</b>
<b>Antimicrobials</b>			
stomach  acidy nausea rehydration	Ciprofloxacin	20x250mg	<b>5</b>
	Metronidazol	21x200mg	<b>4</b>
	Loperamide	30x2mg	<b>2</b>
	Activated charcoal	varies	<b>2</b>
	Bisodol (or gaviscon)	100 tabs	<b>1</b>
	Prochloroperazine	84x 5mg	<b>1</b>
	DyoroLyte packs	1x10	<b>3</b>
<b>General Infections</b>			
	Amoxicillin (Co-amoxiclav)	21x375mg	<b>2</b>
	Clarithromycin	14x250mg	<b>1</b>
<b>Pain killers</b>			
	Aspirin	32x300mg	<b>1</b>
	Co-codamol (mix Parac + Cod)	100x(500+30)	<b>1</b>
	Tramadol	16x50mg	<b>1</b>
	Paracetamol	100x500mg	<b>1</b>
	Ibuprofen	84x400mg	<b>1</b>
<b>Altitude</b>			
	1 Acetazolamide	112x500mg	<b>1</b>
	2 Dexamethasone	20 x 2mg	<b>4</b>
	3 Nifedipine	28 x 10mg	<b>3</b>
<b>Other</b>			
Antyhistamine	Chlorpheniramine	28 x 4mg	<b>1</b>
	Hydrocortizone	30g	<b>2</b>
Anti-Malaria	Doxycycline		<b>2</b>
	DEET		<b>2</b>
Colds	Throat lozenges	box	<b>2</b>
	cold things		<b>0</b>
Water purification	Iodine	bottles	<b>3</b>
<b>General 1st Aid</b>			
Disinfection	Betadine	8ml	<b>1</b>
	Hydrocortisone	30g	<b>0</b>
	Antisepticwipes feminine hygiene		<b>1</b> <b>30</b>
Misc	Safety pins		<b>12</b>
	scissors		<b>2</b>
	thermometer		<b>2</b>
	Sterile supply kit		<b>1</b>
	Steril eye-wash	plastic tubes	<b>6</b>
	Dental kit		<b>1</b>
	Disposable Scalpel		<b>1</b>
	Sterile Gloves	1pair	<b>12</b>

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Dressings	bandages		8
	bandages		8
	Wound dressings		6
	Gauze swabs		3
	Melanin (small)		10
	Steri strips		
	Triangular Bandage		2
	Plasters	box	2
	Strong tape	rolls	3
	Moleskin	sheets	2
Documents:	Altitude Sickness		
	patient report forms		
	mini first aid booklet		
	full list of medications		



## Appendix E: Team Member Health Form

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Imperial College – Altiplano 2008 Expedition

Medical questionnaire

<b>Forename:</b>	<b>Surname:</b>
<b>Citizenship:</b>	<b>NI #:</b> <b>EHC #:</b>
<b>UK address:</b>	<b>Home address:</b>
<b>Next of Kin Details</b>	
<b>Name:</b>	<b>Languages spoken:</b>
<b>Contact #, Tel:</b>	<b>Mobile:</b>
<b>Address:</b>	<b>Comments:</b>

<p>1. Which vaccines have you had/planning to get?</p> <table border="1"> <tr> <td><a href="#">Typhoid</a></td> <td><input type="checkbox"/></td> <td><a href="#">Yellow fever</a></td> <td><input type="checkbox"/></td> </tr> <tr> <td><a href="#">Hepatitis A</a></td> <td><input type="checkbox"/></td> <td>Polio, Tetanus</td> <td><input type="checkbox"/></td> </tr> <tr> <td><a href="#">Diphtheria</a></td> <td><input type="checkbox"/></td> <td>Tuberculosis</td> <td><input type="checkbox"/></td> </tr> <tr> <td><a href="#">Tuberculosis</a></td> <td><input type="checkbox"/></td> <td><a href="#">Rabies?</a></td> <td><input type="checkbox"/></td> </tr> <tr> <td><a href="#">Hepatitis B</a></td> <td><input type="checkbox"/></td> <td><a href="#">Meningococcal meningitis</a></td> <td><input type="checkbox"/></td> </tr> </table>	<a href="#">Typhoid</a>	<input type="checkbox"/>	<a href="#">Yellow fever</a>	<input type="checkbox"/>	<a href="#">Hepatitis A</a>	<input type="checkbox"/>	Polio, Tetanus	<input type="checkbox"/>	<a href="#">Diphtheria</a>	<input type="checkbox"/>	Tuberculosis	<input type="checkbox"/>	<a href="#">Tuberculosis</a>	<input type="checkbox"/>	<a href="#">Rabies?</a>	<input type="checkbox"/>	<a href="#">Hepatitis B</a>	<input type="checkbox"/>	<a href="#">Meningococcal meningitis</a>	<input type="checkbox"/>	<p>If none or not all that were recommended, are you taking alternative treatments?</p>
<a href="#">Typhoid</a>	<input type="checkbox"/>	<a href="#">Yellow fever</a>	<input type="checkbox"/>																		
<a href="#">Hepatitis A</a>	<input type="checkbox"/>	Polio, Tetanus	<input type="checkbox"/>																		
<a href="#">Diphtheria</a>	<input type="checkbox"/>	Tuberculosis	<input type="checkbox"/>																		
<a href="#">Tuberculosis</a>	<input type="checkbox"/>	<a href="#">Rabies?</a>	<input type="checkbox"/>																		
<a href="#">Hepatitis B</a>	<input type="checkbox"/>	<a href="#">Meningococcal meningitis</a>	<input type="checkbox"/>																		
<p>2. Are you taking anti malaria tablets? Yes/ no If yes, which type?</p>	<p>If no, are you taking alternative treatments?</p>																				
<p>3. Are you taking any other medicine?</p>																					
<p>4. Do you have any health problems that might affect you whilst on the trip?</p>																					
<p>5A. Are you allergic to anything? If so please state what and how severe is the reaction and will you need medical treatment, if so how much time do we have what medicine will you take and the dosage?</p>																					

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5B. Are you specifically allergic to any of the expedition medications taken / or could be taken:	
Ciprofloxacin, Metronidazol, Loperamide, Bisodol (or gaviscon), Prochloroperazine, Amoxicillin (Co-amoxiclav), Clarithromycin, Aspirin, Co-codamol (mix Paracetamol + Codein), Tramadol, Paracetamol, Ibuprofen, Acetazolamide, Dexamethasone, Nifedipine, Chlorpheniramine, Hydrocortizone, Betadine (weakened Iodine solution), Hydrocortisone, Antiseptic wipes	
6. Blood Group if known?	
7. Do you wish to provide any additional information?	

I, ....., hereby sign that I filled out this form to the best of my knowledge, I have read the risk assessment and therefore understand the dangers involved with the expedition. I am aware that the medical officer (Andras Szollar), and any other members providing first aid or any medical advice, act to the extent of a first aider only. They are NOT professional medical personal and CANNOT be held responsible for any of their advice exceeding an average first aider's one. (This holds to any special medication for altitude, antibiotics, and all other medications taken on the expedition).

Signed:

Date:

## Appendix F: Personal kit list

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<b>General kit</b>	
Rucksack	Large enough to carry all personal gear plus share of group kit (at least 65l).
Walking Boots	
Head torch	These are essential due to the short daylight hours in Bolivian winter, and lack of electricity in many communities.
Knife	Should have a decent blade and a tin-opener. Multi-tools with scissors, pliers etc are useful.
Sleeping Bag	We took RAB Ladakh 800 which can be used to down to -15°C. These were ideal for Bolivia and some members even complained about them being too warm when we stayed in huts!
<b>Clothing</b>	
Thermals	Leggings and long-sleeve top. Can wear at night when it's cold, and the top can double as your second base layer. It was found that it was definitely worthwhile to spend money on these; Merino Wool really does smell less.
T-shirt	Generally rural areas in Bolivia are quite conservative- so girls should keep reasonably covered up. No vest tops, and t-shirts should not be too tight. This was not a problem as it was rarely warm enough to strip off!
Long-sleeve base layer	Thin, can be worn instead of or as well as t-shirt
Warm top, long-sleeved	Something like a fleece or a technical top for winter walking/climbing in the UK.
Warm jacket	The RAB Neutrino Endurance jackets taken were fantastic; incredibly warm and lightweight.
Windproof jacket	In exposed areas windchill can decrease temperatures significantly. In the dry season a waterproof is not required but several members took waterproof jackets to wear as windproofs.
Trousers	Should be durable, outdoor type. One pair that zips off into ¾ length can be a good idea.
Thick socks	
1 set of smart clothing	The team took a pair of smart trousers and a shirt each to wear when attending meetings. However it was found people are quite informal and the cold meant that everyone was wrapped up anyway.
Lightweight trainers	These were found to be very useful when travelling and in towns.

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Gloves	Warm gloves were useful at night and in the early mornings.
Hat / buff	Warm. Buffs are good because they're really versatile- can go on your head, round your neck, over your mouth in a dust storm, over your eyes if you want to sleep... etc etc
Sunhat / cap / bandanna & sunglasses	It is very sunny during the day and due to lack of ozone layer the risk of getting burnt is high. So these are advised and sunglasses need to be at least Grade 3.
Towel	Take a trek towel rather than a normal towel; it's lighter, dries faster but can be packed wet if needed
Toiletries	These will only really be used when in towns so only one small bottle of shampoo is needed. A small bottle of biodegradable soap and a couple of small packs of baby-wipe type things were extremely useful when in villages. Each team member brought their own and so carried what they thought they would use. It is very important to take high factor sun-screen.

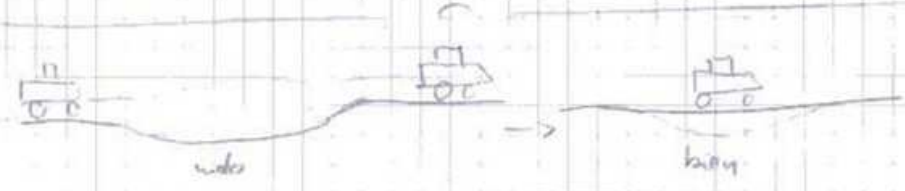
## Appendix G: Road Improvement Recommendations

① Alignment / Surface Levelling

- Fill in potholes 
- Level across 
- Middle section issue 

② Methods (compaction sample):

- Material → mostly gravel (between 3-8cm diameter)
  - × NOT more sand than water to fill in between rocks
- Compact → layers of 10-15cm @ a time
  - by 4 • feet 
  - 2 • hand compactor  - balls/can filled with coarse
  - 1 • drum  - drum filled with coarse (steel pipe in middle as axle to go through)
  - 3 • By trucks driving over 



② Drainage:

Importance: Wet road material  $\rightarrow$  cavity deformed

i.e.

TO DO:

- clear out existing drainage channels
- Drainage channel right next to road

$\rightarrow$  at least  $\sim 50\text{cm}$  below top of road level (A)

OR  $\sim 30\text{cm}$  below bottom of road foot (if road is on a slope) (B)

$\rightarrow$  Shallow Angles:

If Road is on a slope (like "hillside") & water collects on high side

$\rightarrow$  use Cross drainage

$\rightarrow$  use pipe ( $\sim 30-50\text{cm}$  below road)

OR  $\rightarrow$  stone channel

Note: this document was translated in Spanish for distribution to communities.



## Appendix H: Sociological Aspects Handout

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### TOPICS we want to find about:

- **housing** (adequate/healthy/safe?)
- **food** (shortage/access to farming fields or market)
- **education** (do children go to school? How far/safe is it? Do children work?)
- **transport and communication** (are paths, roads adequate/safe? Is school/market/doctor accesible?)
- **health** (house, diet, access to doctors and health centres, hospital)
- **culture** (is there a community centre? Where? Is it usable? If not, would one be useful for the community?)

### METHOD

- Qualitative interviewing (conversations with a purpose)
- Direction and duration open, but conversation guided by an aide-de-memoire (set of topics to tackle). Avoid yes/no questions, questionnaires.
- Who to interview? Ideally, all stakeholders: local authorities, NGO, village chiefs, locals (men, women, elderly people, youths, children)

### HOW TO CONDUCT INTERVIEWS

- agree time and place with interviewees (suitable and comfortable for them)
- use simple language and questions, no technical words
- allow them time to answer or digress, do not put pressure on them
- be interested but neutral listeners
- interviewers: be conscious of appearance, avoid too much dirt, expensive objects like watches, sunglasses, etc.
- ideally, interview one or two people at a time, make sure no interviewee is inhibited by the presence of others (eg. when interviewing women, do not do it in the presence of their husbands)
- when interviewing men, presence of a male expeditioner recommended (if only to sit and listen)
- at least two interviewers for each interview (questioner and recorder, interchangeable roles)
- spatial distribution: avoid confrontation, but keep some eye contact, semicircles preferred, or sit at 90° .

### How to record the interview

- reassure them all the information will be confidential and their names or addresses will not be written down
- ask them for permission to use the voice recorder
- if they refuse, are reluctant or inhibited, take notes instead
- even if we are recording, occasionally take some notes (makes people feel listened to)

### AFTER THE INTERVIEWS (end of the day)

- transcribe, write down or collect all the relevant information and collate into topics
- share the information with all members of the expedition
- discussion and evaluation of possibilities, combining technical-engineering and sociological aspects

## Appendix I: Interview Guide

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### 1. Warm up

- ask if they feel comfortable / ok
- say what we have come for: we are students, site surveying, not raise too high expectations, say explicitly what we can and cannot do
- we can do: community buildings, pedestrian bridges, sanitation systems, water transport systems
- reassure them about confidentiality
- ask them for permission to record / say we will take notes

### 2. Aide-de-memoire

<p><b>FACTUAL INFO</b>                  ¿a qué se dedica usted?                  ¿qué edad tiene?                  ¿con quién vive?                  ¿cómo es su familia? ¿cuántos son y de qué edades?                  ¿cuánto tiempo llevan viviendo aquí?                  ¿pertenece a alguna organización?</p> <p><b>TO ASK AUTHORITIES &amp; NGO</b>                  ¿qué proyectos se solicitan y dónde?                  ¿se buscó ya alguna solución?                  ¿por qué no son capaces de encontrar una solución?</p> <p><b>TO ASK COMMUNITY MEMBERS</b>                  ¿qué problemas afronta usted en su vida diaria?                  ¿cuál de ellos es el más grave? ¿por qué?</p>	<p>What do you do for a living?                  What is your age?                  Who do you live with?                  How is your family? (size, ages)</p> <p>How long have you been living here?                  Do you belong to any organisation?</p> <p>What projects have been demanded, where?                  Any previous attempt to solve the problem?                  Why are you not able to solve the problem by yourselves?</p> <p>What problems do you encounter in your daily life?                  Which is the most important one? Why?</p>
<p><b>CORE QUESTIONS</b></p> <p><b>HOUSING</b>                  ¿dónde vive usted?                  ¿cómo es su casa?                  ¿la encuentra cómoda/salubre?                  ¿tiene problemas para vivir bien en ella?                  ¿dónde consiguen el agua?                  ¿qué utilizan como baño?</p>	<p>Where do you live?                  How is your house?                  Do you find it suitable/ healthy?                  Do you have problems living in it?                  Where do you get water from?                  What do you use as a toilet?</p>
<p><b>FOOD AND TRADE</b>                  ¿trabaja usted la tierra?                  ¿qué siembra?                  ¿trabaja igual todo el año?                  ¿dónde siembra?                  ¿cómo llega hasta allí? Describa el camino                  ¿cosechan lo suficiente para todo el año</p>	<p>Do you farm?                  What do you grow?                  Do you work as hard every season?                  Where do you farm?                  How do you get there? Describe the way                  Are crops enough for the whole year and</p>

<p>y toda la familia?          ¿venden o compran cosas en el mercado? ¿con qué frecuencia?          ¿dónde está el mercado? Describa el camino          ¿es importante para ustedes el mercado?</p>	<p>for the whole family?          Do you trade in markets? How often?          Where is the market? Describe the way.          Is it important for you to trade?</p>
<p><b>TRANSPORT, LINKS TO EDUCATION AND HEALTHCARE</b>          ¿Tiene usted hijos? ¿de qué edades?          ¿trabajan con usted en casa?          ¿van a la escuela? ¿por qué no?          ¿dónde está la escuela?          ¿cómo es el camino hasta allí? ¿en qué van?          ¿van todo el año o a temporadas?</p> <p>¿le gustaría que todos sus hijos fueran a la escuela? ¿durante todo el año?          Si fuera fácil enviarlos, ¿lo haría?          Si hubiera transporte, ¿acudirían más?</p> <p><i>Note: woul they send boys to school but not girls?</i></p> <p>¿dónde está el centro de salud más cercano?          ¿viene el doctor de visita? ¿por qué no?          ¿si alguien está mal, lo llevan al doctor o al hospital?          ¿cuánto tiempo lleva llegar al doctor?          ¿cómo llevan a los enfermos al doctor?          ¿hay algún problema de salud en la zona, enfermedades crónicas, epidemias?</p>	<p>Do you have children? What ages?          Do they work at home?          Do they attend to school? Why not?          Where is the school?          How is the way to reach school?          Transport?          Do they attend the whole year or seasonally?          Would you like all your children to attend school? During the whole year?          Would you send them if it was easier?          Would they attend if transport was available?</p> <p>Where is the nearest health centre?          Does the doctor come on visits? Why not?          If someone feels ill, can you take him to the doctor or hospital?          How long does that take?          How do you take patients to the doctor?          Is there any health problem in the area, chronic diseases, epidemics?</p>
<p><b>CULTURE</b>          ¿tienen un centro social en la comunidad?          ¿qué hacen en él?          ¿cómo es el edificio?          ¿dónde está? Describa el camino para llegar          Si tuvieran uno, ¿qué harían en él?</p>	<p>Do you have a community centre?          What do you do in it?          How is the building?          Where is it? Describe the way to get there          If you had one, what would you do in it?</p>
<p><b>ENGAGEMENT</b>          ¿seguirá usted viviendo aquí?          ¿estaría dispuesto a trabajar gratis en un proyecto para la comunidad?          ¿cuántas horas cree que puede aportar?</p> <p>¿depende de la temporada del año?</p> <p>¿dejaría a su familia cooperar?</p>	<p>Will you stay living here?          Would you volunteer in a project for the community?          How many hours/day do you think you could?          Would it depend on the season of the year?          Would you allow your family to volunteer?</p>

<p>¿cuánta gente cree que se puede beneficiar de la obra?</p> <p>¿con qué frecuencia la usarían?</p> <p>¿está dispuesto a trabajar en el mantenimiento de la obra? ¿cree que tendrá tiempo para ello?</p> <p>¿necesitará ayuda o información para el mantenimiento?</p>	<p>How many community members do you think would benefit from the project?</p> <p>How often would they use it?</p> <p>Would you be ready to work in maintenance? Do you think you will have time for it?</p> <p>Do you need help or information on maintenance?</p>
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## Appendix J: Altiplano Vocabulary

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**Almuerzo, el-** lunch

**Alpaca, la-** one of the three main camelids of the Altiplano, alpacas can be domesticated and their wool is valuable in the market

**Autoridades originarias, las-** politically correct term for indian chiefs

**Ayllu, el-** traditional rural community with a believed common ancestor, comprising a number of villages on different natural habitats that work together for self-sufficiency and survival

**Aymara-** one of the native peoples of the altiplano, Aymara language

**Coca, la-** traditional crop of the Andean people used for medicine, socialising and religious rites

**Comunarios, los-** elected community leaders that gather in meetings for community decisions

**Contraparte, la-** one of the parties that contributes financially to a common project

**Chipayo-** one of the native peoples of the altiplano

**Choclo, el-** corn

**Chola, cholita, la-** peasant woman, normally wearing the traditional skirt and hat

**Frazada, la-** wool blanket

## Appendices

**Llama, la-** the most important camelid of the Altiplano, easy to breed and revered as sacred since ancient times

**Movilidad, la-** public transport: minibus

**Nevado, el-** literally, snowed top; volcano

**Pachamama, la-** mother earth, native goddess

**Pampa, la-** plateau on the altiplano

**Papa, la-** potatoe

**Peso, el-** old term to refer to the modern currency, *boliviano*

**Pollera, la-** traditional skirt

**Pueblos originarios, los-** politically correct term for indian peoples

**Puna, la-** literally, altitude; also, altitude sickness

**Quechua-** one of the native peoples of the altiplano, Quechua language

**Quinoa real, la-** traditional crop of the Altiplano, valued for the nutritious properties of its grain

**Vicuña, la-** the smallest of the three main camelids, less abundant than llamas or alpacas, lives wild in the altiplano and produces the finest wool of all. Protected species.

## Appendix K: Return Project Decision Template

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Issue	Weighting	Corta Viento		Calacala	
		Score	Comments	Score	Comments
<i>Transport</i>	1	3	Access for truck	3	Access for truck
<i>Labour available</i>	3	1	5 ppl / day	3	15-20 ppl / day
<i>Beneficiaries</i>	2	1	10 children	2	20 children
<i>Current need</i>	3	3	Totally cut off during rainy season	2	Can access longer route in emergency
<i>Community enthusiasm</i>	2	3	Good	3	Good
<i>Existing facilities</i>	2	1	No latrines, water from well	2	Tap, latrines
<i>Bridge sites</i>	3	2	2 reasonable sites, spans approx. 20m	1	1 good site, 1 suspect, spans 20-25m
<b>Total (weighting x score)</b>		<b>34</b>		<b>35</b>	



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