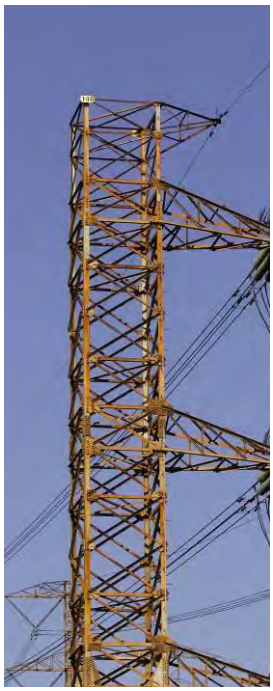
Draft Environmental and Social Impact Assessment - Appendices

Project Number: 46915-014
November 2015

MON: Combined Heat and Power Plant Number 5 Project

Prepared by Mott MacDonald





CHP5 Environmental and Social Impact Assessment

Volume III - Appendices

November 2015

CHP5 Consortium

CHP5 ENERGY FOR TOMORROW

Mott MacDonald

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Issue and revision record

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A	October 2015	Various	L. Jones		Draft Appendices
B	26 October 2015	Various	L. Jones	A.Day	Final for disclosure
C	27 October 2015	Various	L. Jones	A.Day	Consultation leaflet added
D	29 October 2015	Various	L. Jones	L. Jones	Updated
E	30 October 2015	Various	A.Day	A.Day	Updated
F	5 November	Various	M. O'Brien	A. Day	Updated

Appendices

Appendix A. ESIA Scoping Consultation Leaflet

A.1 English Version

Feedback Form

Full Name (optional)	
Please identify how you wish to be contacted: mail, telephone, e-mail (delete as appropriate) Please provide your contact details to the right unless you wish to remain anonymous. If you wish to remain anonymous, please indicate whether we can discuss the issue with a third party acting on your behalf and provide their contact details. Third party communication requested (tick box) ☐ By telephone: By e-mail: By Post: Please provide mailing address:	
Preferred language of communication?	Mongolian / Other (please specify)……
Description of feedback	
(For office use only) Feedback received by and date: Reference number:	

CHP-5 Coal Fired Power Project

Information Leaflet (2015)

We, a group of companies (GDF SUEZ, Sojitz, POSCO Energy and Newcom), have been selected by the Government of Mongolia to build and operate a coal-fired combined heat and power plant ("**CHP-5**") on the outskirts of Ulaanbaatar.

CHP-5 is a coal fired power plant, and will generate electricity benefiting over 400,000 homes and heat for nearly 80,000 households.

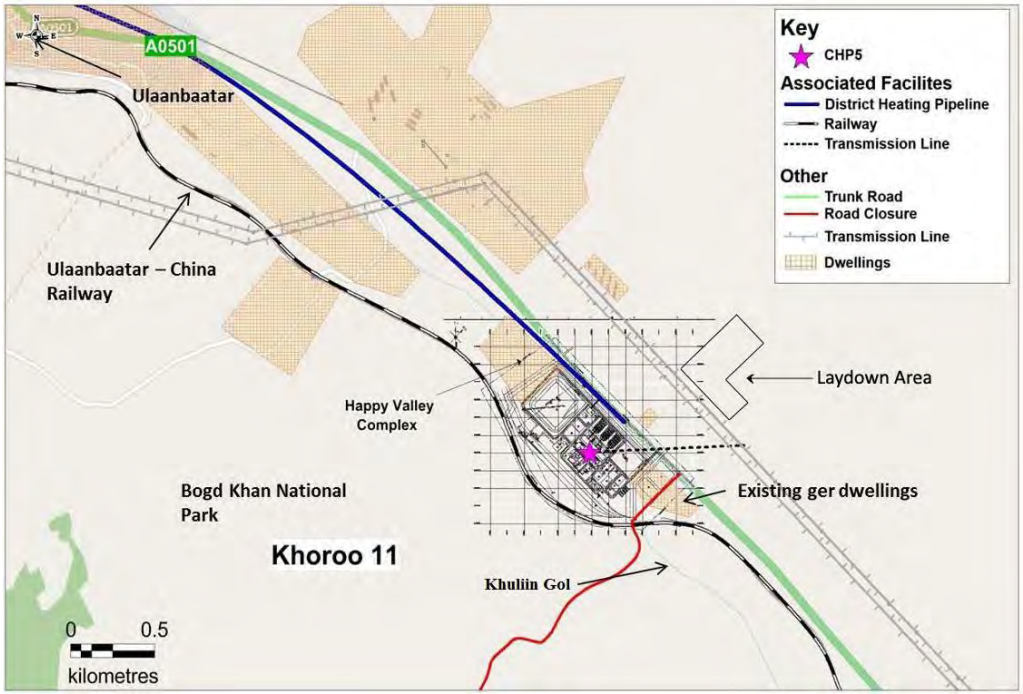
The new plant will support the growing energy demand in Mongolia, which is largely driven by the mining sector and the abundant supply of natural resources, together with a growing population.

The construction and operation of CHP-5 will:

- Provide additional power and heating to the Ulaanbaatar citizen.
- Generate power more efficiently and eco-friendly,
- Provide a range of job opportunities during construction and operation.
- Follow national and international standards to minimise environmental and social impacts.

Works during the construction phase will include:

- Connection to the existing overhead power lines.
- Establishment of temporary storage area for materials.
- District heating pipelines to be constructed from the CHP-5 site to the Ulaanbaatar district heating system.
- Modification to the railway line adjacent to the site to allow the delivery of coal from Baganuur and Shive-Ovoo mines.
- A separate site will be developed for the disposal of ash that will be generated from the power plant.
- The river currently on site will be diverted into a new channel.



Plan showing how CHP-5 will look like after construction

Environmental and Social Impact Assessment

We are committed to meet the International and national environmental and social standards. An Environmental and Social Impact Assessment (ESIA) will be carried out to identify the environmental and social impacts. The study will show how these will be mitigated, managed and monitored throughout construction and operation of CHP5.

To ensure that the ESIA addresses all relevant issues, we want to hear which environmental and social topics are important to you.

Some of the topics include:

- Air quality
- Social impacts
- Land use and resettlement
- Hydrology, hydrogeology & flood risk
- Biodiversity
- Greenhouse gases
- Landscape and visual impacts
- Traffic and transport
- Waste management

Public Consultation and Contact Details

This leaflet provides information to people and organisations who may be interested in CHP-5 (stakeholders) or affected by CHP-5. Stakeholders for CHP-5 include the wider community, governmental authorities at national, regional, provincial, district and neighbourhood levels; and non-governmental organisations. We want the ESIA study to take into consideration the views of as broad a number of stakeholders as possible.

We would like to hear what you think is the most important environmental and social issues, and how possible impact could be mitigated.

For this you can contact:

Ms. B. Battsetseg Community Liaison Officer, Newcom LLC
battsetseg@newcom.mn, утас: 11313183
10F, Naiman Zovkhis Building, 21 Seoul Street, Ulaanbaatar 14251, Mongolia

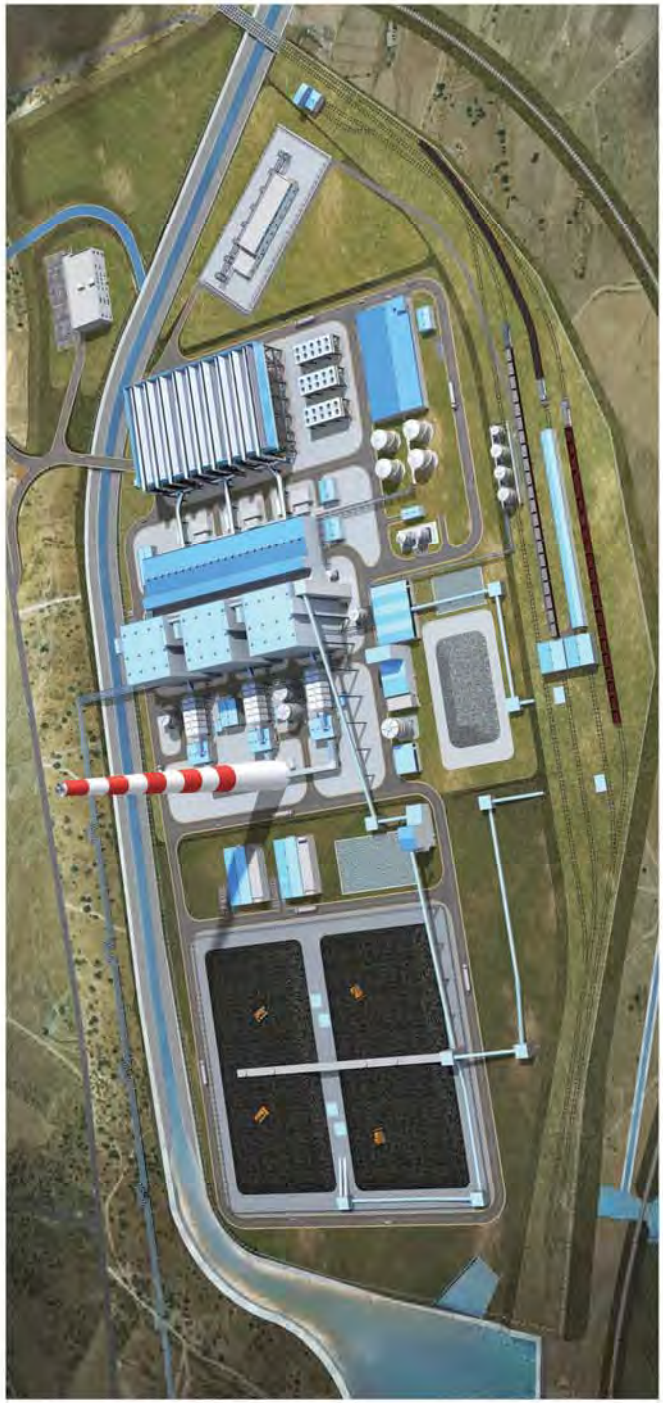
As soon as the relevant studies are finalized, a draft ESIA report will be published in the Mongolian language for your review and comment.

Up to date information regarding the project will be provided on a regular basis and available through the dedicated website: **www.CHP5.mn**

You can use the attached feedback form if you have any comments or suggestions regarding CHP5.

The CHP-5 Project Site

A.2 Mongolian Version



ОЛОН НИЙТИЙН ХЭЛЭЛЦҮҮЛЭГ БОЛОН ХОЛБОО БАРИХ

Энэхүү танилцуулга нь төслийн хэрэгжилтийн хүрээнд өртөж болзошгүй болон төслийн талаар сонирхсон хувь хүн, байгууллагуудыг (Сонирхлын бүлэг) мэдээллээр хангах зорилготой юм. Сонирхлын бүлэг гэдэгт тухайн орон нутгийн иргэд, орон нутгийн засаг захиргааны байгууллагууд, төрийн бус байгууллагууд зэрэг хамаарна. Бид энэ төслийн БОННҮ-г боловсруулахдаа холбогдох сонирхлын бүлгийг өргөнөөр хамруулж, тэдний санаа бодлыг тусгах зорилготой ажиллаж байна.

Та бүхний хувьд чухал ач холбогдолтой байгаль орчин болон нийгмийн асуудлууд, тэдгээрийг хэрхэн бууруулж болох талаархи санал хүсэлтийг тань бид сонсох хүсэлтэй байна.

Холбогдох ажилтны мэдээлэл:
Б. Батцэцэг – Олон нийттэй харилцах ажилтан, Ньюком ХХК
battsetseg@newcom.mn,
Утас: 11 313183 (18)
Монгол улс, Улаанбаатар 14251, Сөүлийн гудамж 21, Найман Зовхис барилга, 10 давхар.

Төслийн танилцуулга хурлыг зохион байгуулсны дараагаар, бид БОННҮ-ний урьдчилсан тайланг та бүхэнд хүргүүлж, санал хүсэлтийг тань авах болно.

Төслийн тухай шинэ мэдээллийг манай компанийн www.CHP5.mn гэсэн цахим хуудсаар байнга авч болно.

Танд төслийн талаар ямар нэгэн санал хүсэлт байвал энэхүү танилцуулгад хавсаргасан санал хүсэлтийн хуудсыг бөглөн, дээр дурдсан хаягаар ирүүлэх, эсхүл бидэнтэй утсаар холбогдоно уу.

CHP5
ENERGY FOR TOMORROW

ДУЛААНЫ ТАВДУГААР ЦАХИЛГААН СТАНЦ (ДЦС-5) ТӨСЛИЙН ТАНИЛЦУУЛГА (2015 ОН)

Newcom Group — Innovating for success
GDF SUEZ — BY PEOPLE FOR PEOPLE
POSCO ENERGY
sojitz

ДУЛААНЫ ТАВДУГААР ЦАХИЛГААН СТАНЦ (ДЦС-5)

Францын Жи Ди Эф Суэз групп (GDF Suez), Японы Сожитцу (Sojitz), Солонгосын Поско Энержи (Posco Energy) болон Монголын Ньюком компаниудын хамтарсан консорциум нь Монгол Улсын Засгийн газраас зарласан Улаанбаатар хотын зүүн захад баригдах Дулааны тавдугаар цахилгаан станцыг барьж, ашиглах төслийн тендерт шалгарсан билээ.

ДЦС-5 нь нүүрсээр ажилладаг дулааны цахилгаан станц байх бөгөөд хүчин чадлын хувьд 400,000 гаруй айл өрхийг цахилгаанаар, 80,000 гаруй айл өрхийг дулаанаар хангах юм.

Монгол Улсын хүн амын өсөлт болон байгалийн баялагт түшиглэсэн уул уурхайн салбарын хөгжлийг даган өсөн нэмэгдэж буй эрчим хүчний хэрэглээг хангахад ДЦС-5 нь голлох үүргийг гүйцэтгэх юм.

ДЦС-5-ыг барьж, ашиглалтанд оруулсанаар:

- Улаанбаатар хотын иргэдэд цахилгаан, дулаан нийлүүлнэ.
- Байгальд ээлтэй технологоор өндөр үр ашигтайгаар цахилгаан, дулаан үйлдвэрлэнэ.
- Барилга угсралт болон ашиглалтын явцад олон тооны ажлын байр бий болно.
- Байгаль орчин, нийгмийн нөлөөллийг бууруулах үүднээс Олон улсын болон дотоодын стандартуудыг удирдлага болгоно.

Төслийн барилга угсралтын үед хийгдэх ажлууд:

- ДЦС-5-ыг одоо ашиглагдаж буй цахилгаан дамжуулах агаарын шугамд холбох ажил,
- Бараа материалыг хадгалах түр агуулах барих,
- ДЦС-5-ыг Улаанбаатар хотын дулаан хангамжийн сүлжээнд холбох дулааны шугамыг барьж байгуулах,
- ДЦС-5-дхэрэглэх нүүрсийг Багануур, Шивээ-Овоогоос тээвэрлэхтэй холбогдуулан төслийн талбайн ойролцоох төмөр зам дээр хийгдэх нэмэлт ажлууд,
- ДЦС-5-аас гарах үнсийг хаях талбайг төслийн талбайгаас салган, хотоос зайдуу байршилд сонгож бэлдэх,
- Төслийн талбайгаар урсан өнгөрч буй голын голдиролыг хэсэгчлэн өөрчилж урсгах зориулалтын суваг барих

ДЦС-5 баригдаж дууссаны дараа харагдах байдал

БАЙГАЛЬ ОРЧИН БОЛОН НИЙГМИЙН НӨЛӨӨЛЛИЙН ҮНЭЛГЭЭ (БОННҮ)

Бид энэхүү төслийн хүрээнд Олон улсын болон дотоодын байгаль орчин, нийгмийн холбогдолтой стандартын шаардлагыг бүрэн хангаж ажиллана. Төслийн байгаль орчин болон нийгэмд нөлөөлөх нөлөөллийг тодорхойлох зорилгоор Байгаль Орчин болон Нийгмийн Нөлөөллийн Үнэлгээ (БОННҮ)-г хийдэг. Түүнчлэн энэхүү үнэлгээнд төслийн барилга угсралт болон ашиглалтын хугацаанд гарч болох нөлөөллийг хэрхэн бууруулах, хязгаарлах, хянах талаар тусгадаг. Уг үнэлгээнд хамаарах бүхий л асуудлыг багтаах үүднээс та бүхэнд чухал ач холбогдолтой байх байгаль орчны болон нийгмийн асуудлын талаархи саналыг тань сонсох хүсэлтэй байна.

Холбогдох асуудлуудаас доор дурдвал:

- Агаарын чанар
- Нийгмийн нөлөөлөл
- Газар ашиглалт болон нүүлгэн шилжүүлэлт
- Ус судлал, гидрогеологи болон үерийн эрсдэл
- Биологийн төрөл зүйл
- Хүлэмжийн хий
- Газар нутгийн үзэгдэх байдал
- Замын хөдөлгөөн, тээвэр
- Хаягдлын менежмент

Appendix B. Draft ESIA Disclosure Consultation Advertisement

Appendix C. Stack Height Determination

Table C.1 presents the results of the dispersion modelling with no terrain included within the model and Table C.2 presents the results with terrain included in the air dispersion model.

Figure C.1 to Figure C.4 present graphs of each of the modelled scenarios. Modelled results indicate that, when not considering terrain, building wake effects no longer have a significant effect on dispersion when the stack height is above 170m. Figure C.1 and Figure C.2 show that, for heights above 170m, the decrease in ground level concentrations is small but not significant. Figure C.3 and Figure C.4 present the one hour 99.79 percentile and annual mean process contributions only when including terrain in the model. Although building wake effects are overcome at 170m (as above), these results show that no additional benefit is achieved with respect to the maximum one hour 99.79 percentile impacts with an increased stack height. It should be noted that although the maximum predicted ground level concentrations do not decrease with increased stack height when terrain is included the increase in stack height does have the effect of reducing the size of the area where these higher concentrations are predicted. Based on the modelled results, it can be considered that the proposed stack height of 170m is sufficient to overcome building wake and terrain effects while minimising the Project's effect on local air quality.

Table C.1: Maximum Modelled Process Contributions without Terrain – 1g/s (µg/m^3)

		Stack Height (m)													
Scenario	Averaging period	80	90	100	110	120	130	140	150	160	170	180	190	200	210
Scenario 1	1 hour 99.79th percentile	1.5	1.1	0.8	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1
	24 hour Max	1.0	0.7	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0
	Annual mean	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scenario 2	1 hour 99.79th percentile	4.2	2.8	1.6	1.2	0.9	0.7	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.2
	24 hour Max	2.4	1.7	1.2	0.8	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1
	Annual mean	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C.2: Maximum Modelled Process Contributions with Terrain – 1g/s (µg/m^3)

		Stack Height (m)													
Scenario	Averaging period	80	90	100	110	120	130	140	150	160	170	180	190	200	210
Scenario 1	1 hour 99.79th percentile	1.5	1.0	0.7	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3
	24 hour Max	0.9	0.6	0.5	0.5	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Annual mean	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scenario 2	1 hour 99.79th percentile	5.7	3.0	2.8	2.4	1.9	1.8	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	24 hour Max	3.3	1.6	1.0	0.7	0.6	0.6	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5
	Annual mean	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Results are rounded to 1 decimal place

Figure C.1: Scenario 1 Maximum Modelled Process Contributions without Terrain

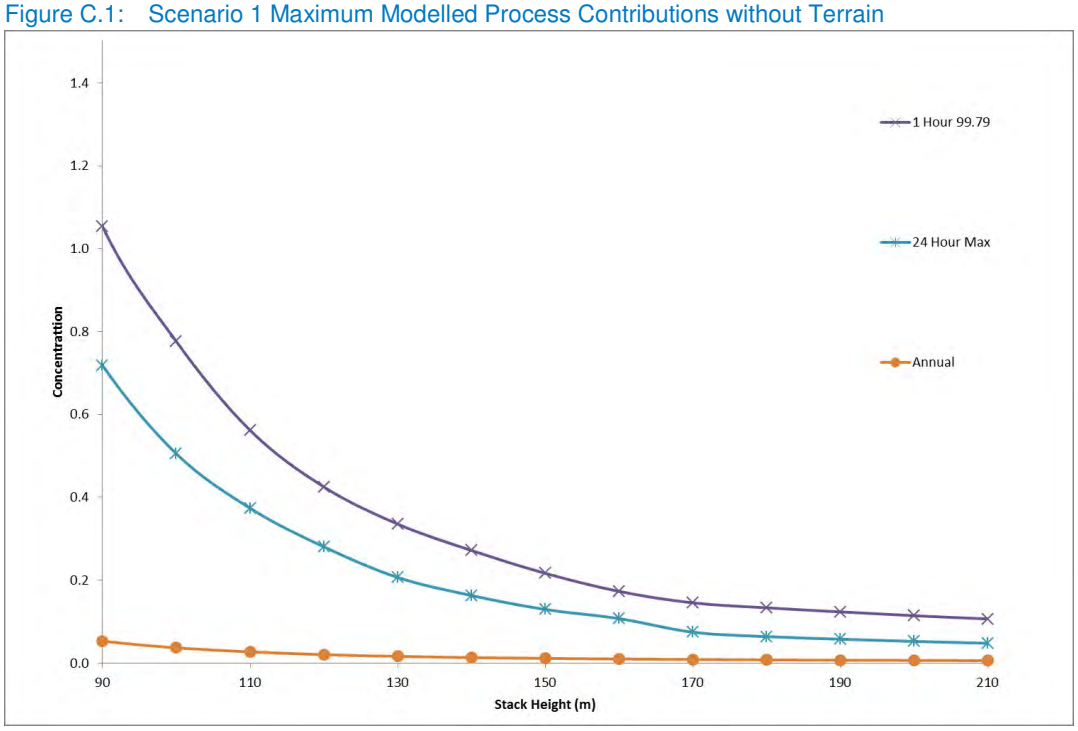


Figure C.2: :Scenario 2 Maximum Modelled Process Contributions without Terrain

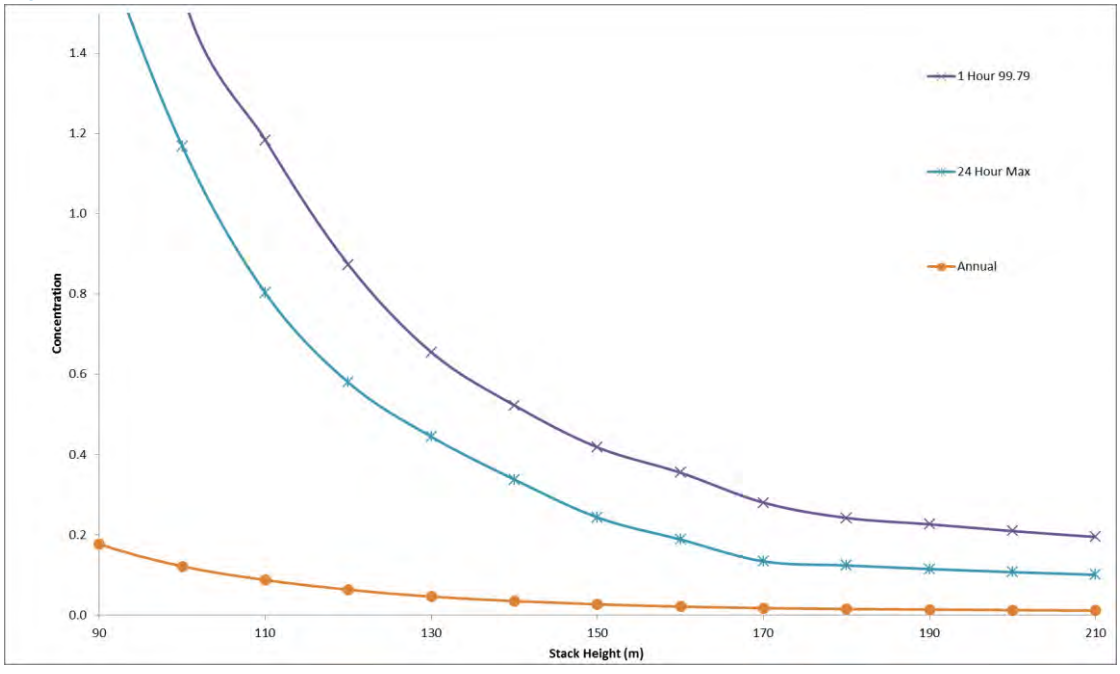


Figure C.3: Scenario 1 Maximum Modelled Process Contributions with Terrain

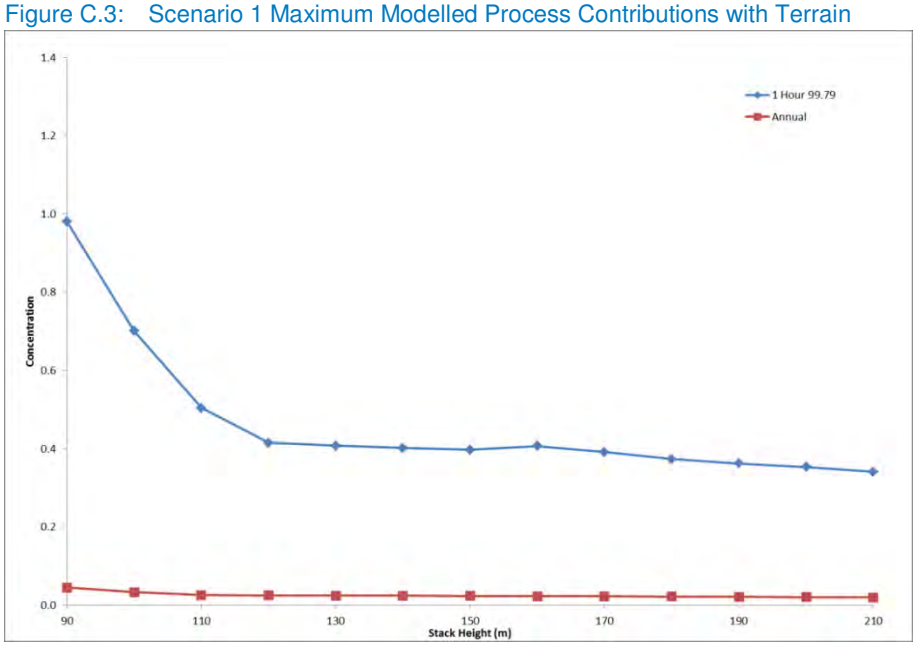
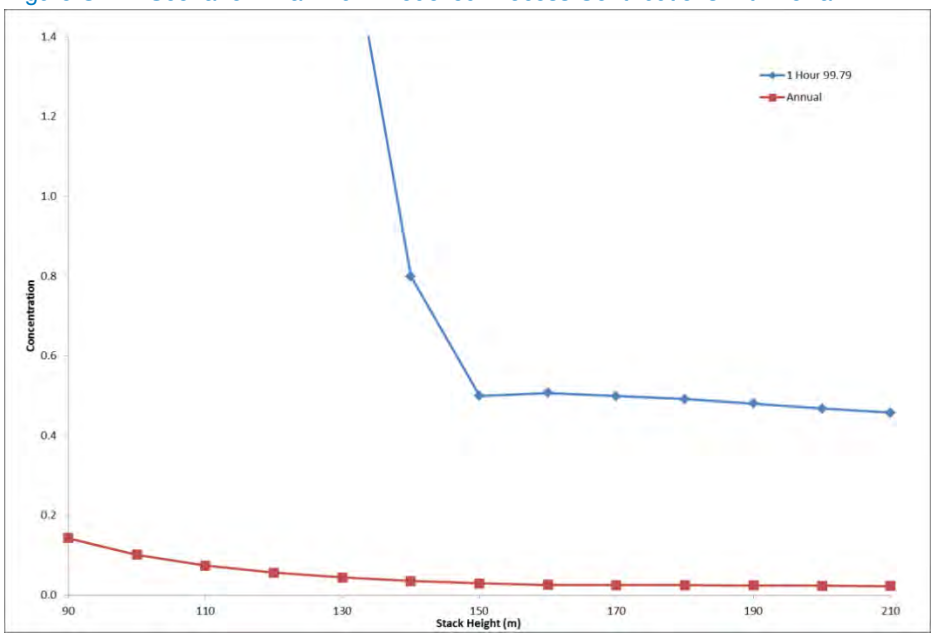


Figure C.4: Scenario 2 Maximum Modelled Process Contributions with Terrain



Note: 1 Hour 99.79th percentile results for stack below 130m not shown to allow consistent scale with previous graphs

Appendix D. Scenario 1 – Comparison with Mongolian Standards

D.1 Overview

This appendix presents a comparison of the modelled process contributions against the Mongolian ambient air quality standards. As described in Volume II, Section 7.2.3.3 the main assessment has been undertaken against the EU ambient air quality standards as the Mongolian standards are not considered appropriate. However, to meet the requirements of the IFC EHS Guidelines, and for completeness, process contributions have been compared with the Mongolian standards and these are presented in the following sections.

D.2 NO_2

The results indicate that for annual mean concentrations of NO_2, process contributions from the Project are small relative to the Mongolian standards (4.2%). The process contributions are predicted to occur approximately 11km to the south east of the Project.

The modelled results show that the maximum modelled 20 minute NO_2 process contribution across the modelled grid is predicted to exceed the Mongolian standards of 85µg/m^3. However, Figure D.1 demonstrates that these areas are limited to three small geographic areas which represent less than 5% of the study area in total. Two of the areas are located over high terrain where the risk of exposure is low. The modelling assessment has also demonstrated that the highest predicted values that exceed the 20 minute NO_2 standard are rare and will only typically occur a few times a year. This is demonstrated by Table D.2 which presents an analysis of the highest four modelled concentrations for the Mongolian 20 minute NO_2 standard.

The maximum predicted 24 hour process contributions are predicted to be 91.2% of the Mongolian standard. The area where the process contributions are highest is very small and represents less than 1% of the modelled area and is located over an area of elevated terrain.

The contour plots demonstrate that process contributions from the Project are predicted to be below Mongolian standards at nearby villages.

D.3 SO_2

Maximum annual mean SO_2 process contributions from the Project are 18% of the Mongolian standard and therefore below the 25% guideline suggested by the IFC . They are predicted to occur in the same location as the annual mean NO_2 contributions.

The modelled results show that the maximum modelled 10 minute, 20 minute and 24 hour SO_2 process contributions are above the relevant Mongolian standards. However, Figure D.3, Figure D.4 and Figure D.5 demonstrate that these areas are limited to small geographic areas which represent less than approximately 3% of the study area in total. These areas are located over high terrain where the risk of exposure is low. As with NO_2, the modelling assessment undertaken has also demonstrated that the

highest predicted values that exceed the standard are rare. The 10 and 20 minute SO_2 standards are only exceeded 3 times per year for each averaging period as demonstrated by Table D.2.

The results demonstrate that process contributions are below 25% of the Mongolian standards for the majority of the project airshed.

D.4 PM_{10} and $PM_{2.5}$

Annual mean PM_{10} and maximum 24 hour PM_{10} process contributions are below 25% of the Mongolian air quality standards and occur in the same locations as those identified for NO_2 and SO_2.

Annual mean $PM_{2.5}$ and maximum 24 hour $PM_{2.5}$ process contributions are also below 25% of the Mongolian air quality standards even when conservatively assuming all dust emissions are as $PM_{2.5}$.

D.5 Summary

The assessment against Mongolian standards has indicated that for the majority of the airshed the Projects process contributions are below 25% of the relevant standards. Where the modelling has indicated that the process contributions exceed the ambient standards the areas of exceedence are small and generally located in areas of high terrain where population exposure is unlikely. The assessment has also demonstrated that the number of occasions where the process contributions will be above the ambient standards will be limited.

Table D.1: Scenario 1 – 100% Load – Comparison with National Standards (µg/m^3)

Pollutant	Averaging Period	Max PC	% of Mongolian Standard	Mongolian Standards
NO_2	20 Minute	528.8	622.1	85
	24 hour	36.5	91.2	40
	Annual	1.3	4.2	30
SO_2	10 Minute	1245.9	249.2	500
	20 Minute	1057.5	235.0	450
	24 hour	52.1	260.4	20
	Annual	1.8	18.0	10
PM_{10}	24 hour	10.4	10.4	100
	Annual	0.4	0.7	50
$PM_{2.5}$	24 hour	10.4	20.8	50
	Annual	0.4	1.6	25

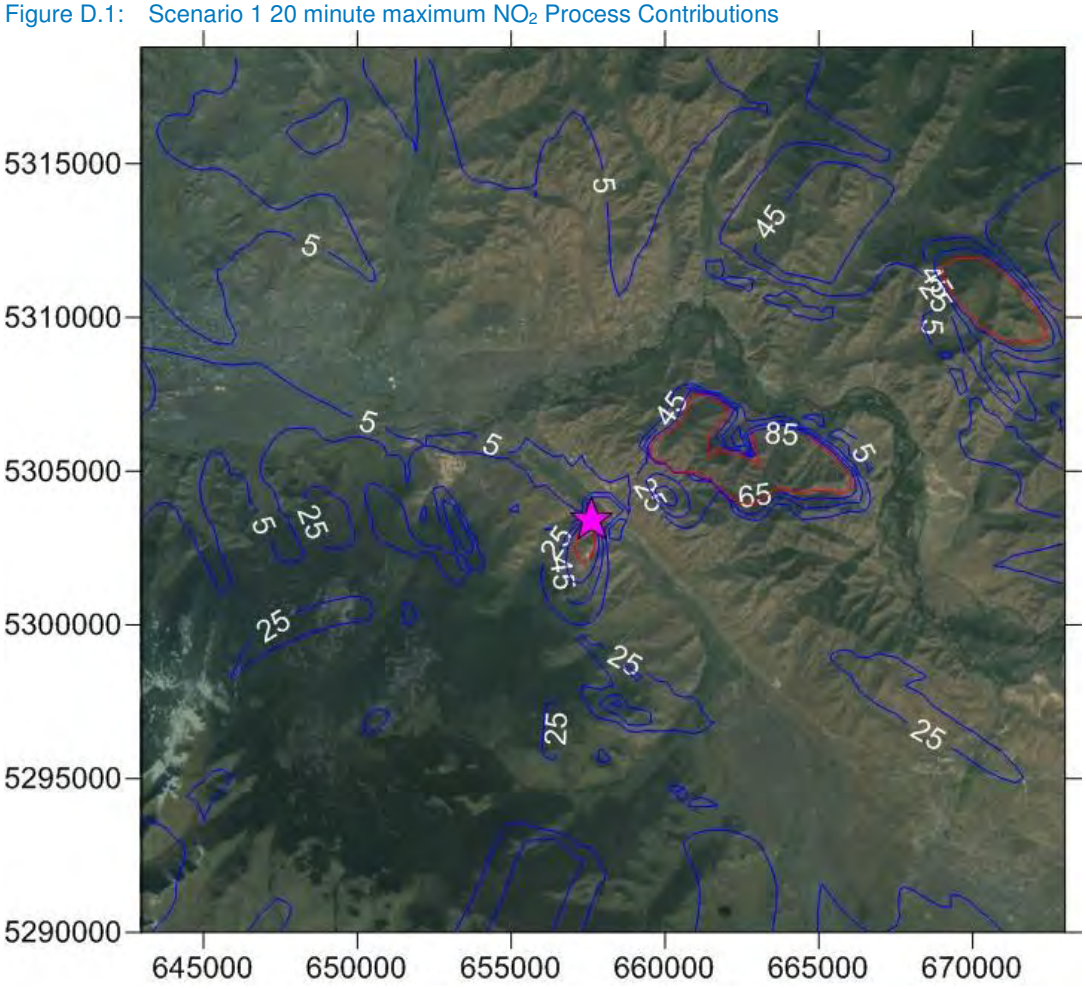
Notes: PC = Process Contribution, PC are maximum predicted values across the modelled domain, Results and percentages are rounded to 1 decimal place

Table D.2: Sensitivity Analysis of Maximum Process Contribution (µg/m^3)

Pollutant	Averaging Period	Maximum PC	2nd Highest PC	3rd Highest PC	4th Highest PC
NO_2	20 Minute	528.8	435.5	259.4	122.3
SO_2	10 Minute	1245.9	870.9	518.7	244.7
	20 Minute	1057.5	835.5	478.8	234.1

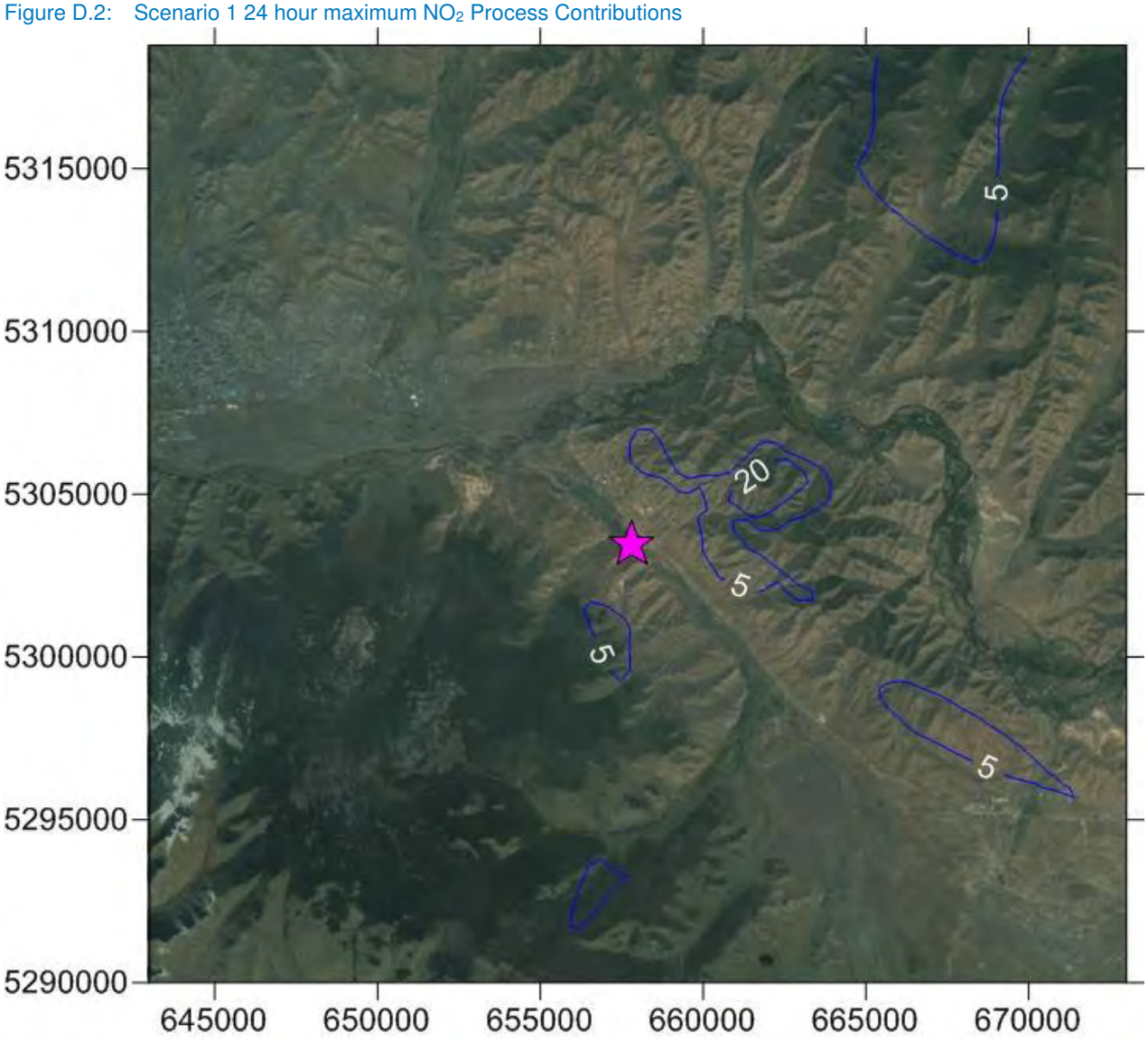
Notes: PC = Process Contribution

Figure D.1: Scenario 1 20 minute maximum NO_2 Process Contributions



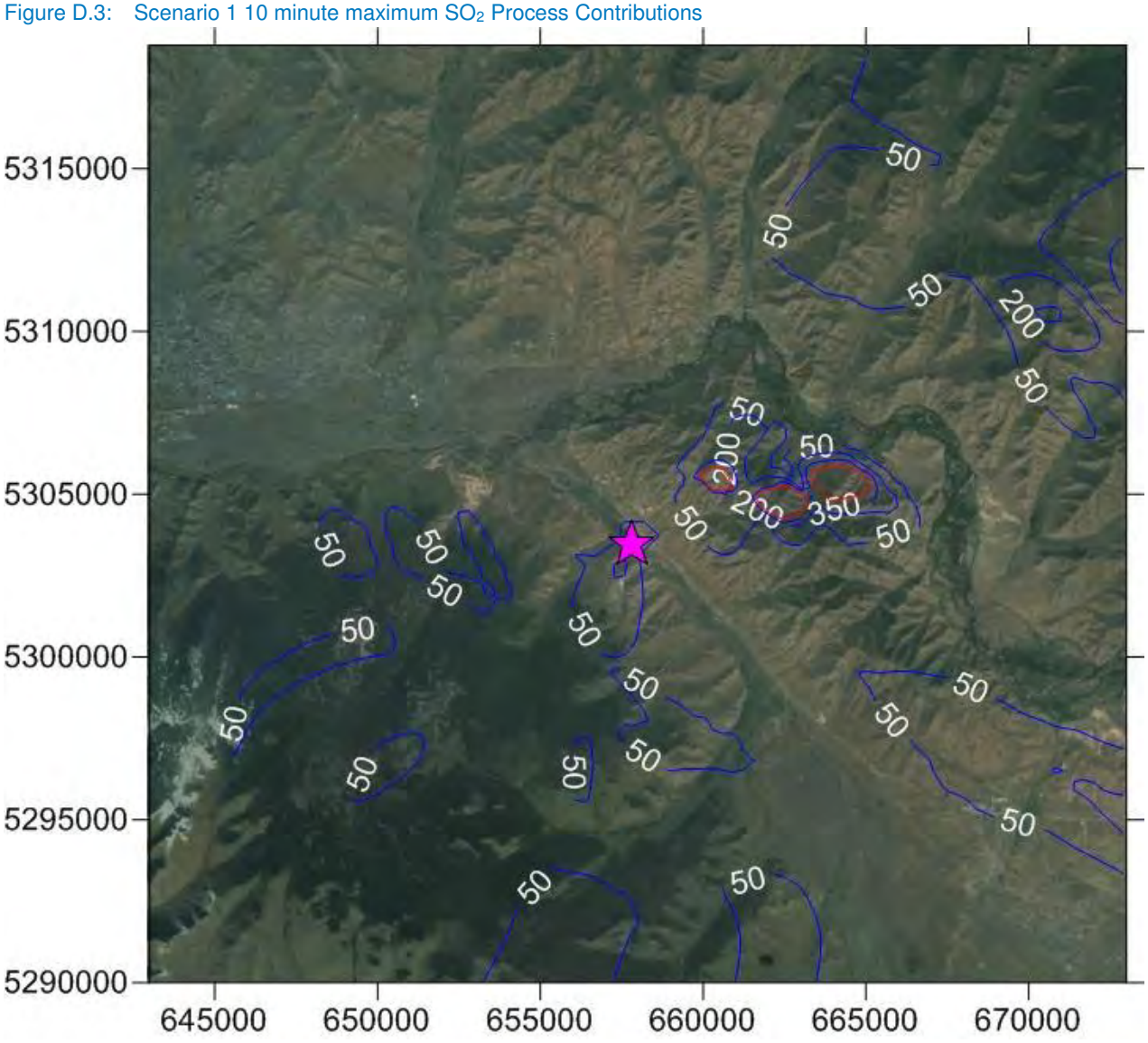
Notes: 2011 worst meteorological year, contour increments 20µg/m^3, red contour is 85µg/m^3

Figure D.2: Scenario 1 24 hour maximum NO_2 Process Contributions



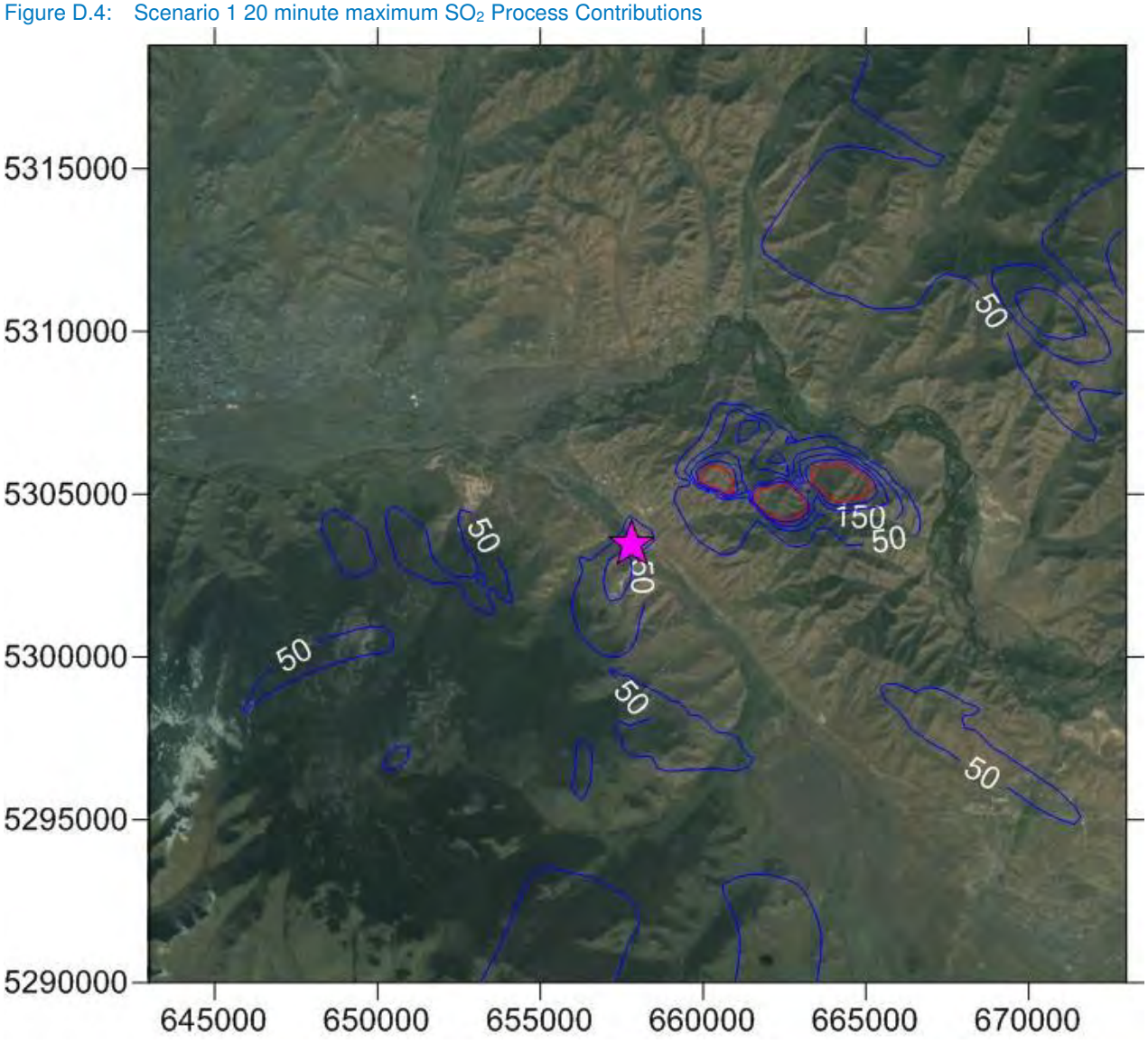
Notes: 2010 worst meteorological year, contour increments 15µg/m^3, highest contour is 20µg/m^3

Figure D.3: Scenario 1 10 minute maximum SO_2 Process Contributions



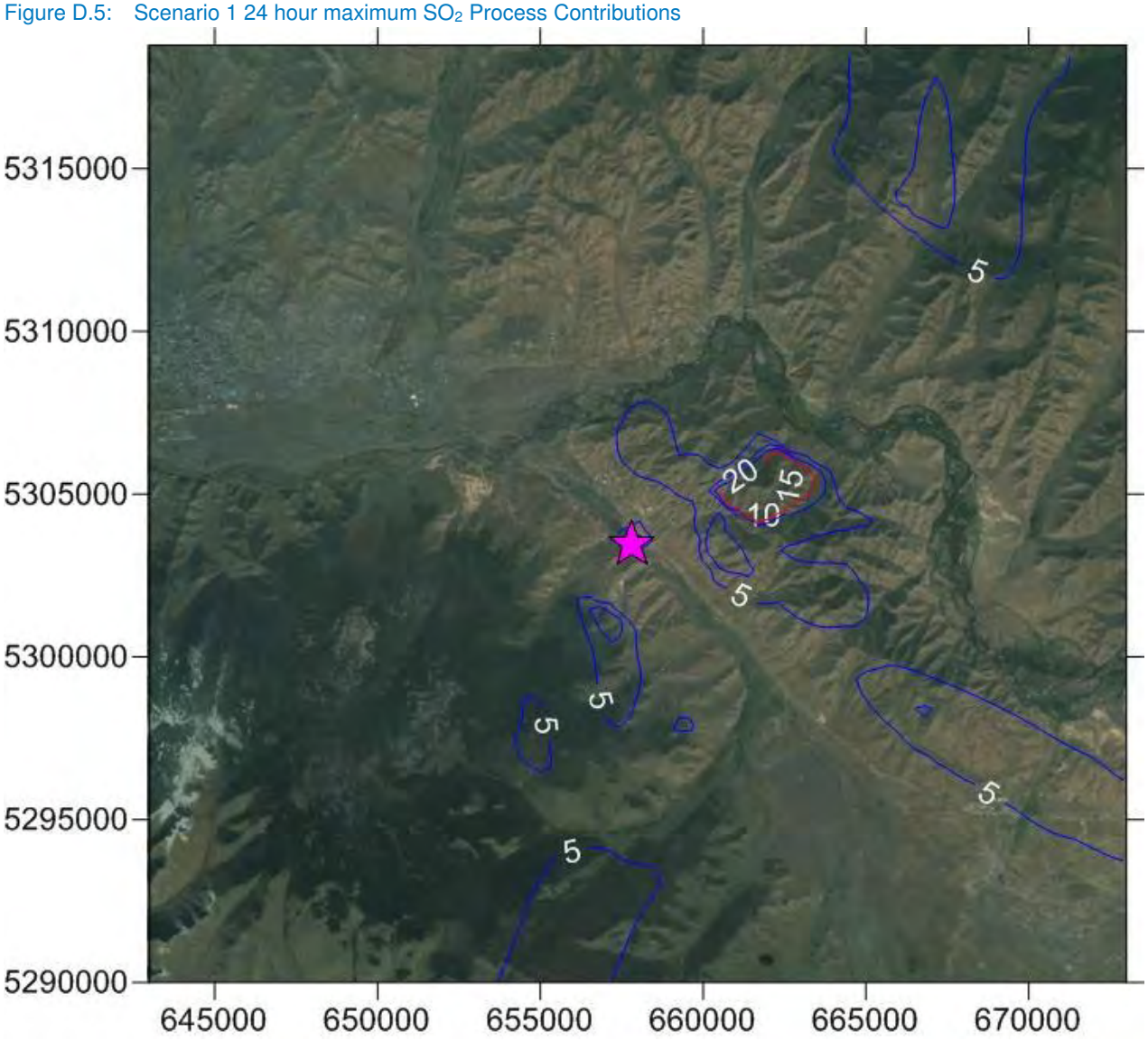
Notes: 2011 worst meteorological year, contour increments 150µg/m^3, red contour is 500µg/m^3

Figure D.4: Scenario 1 20 minute maximum SO_2 Process Contributions



Notes: 2011 worst meteorological year, contour increments 100µg/m^3, highest contour is 450µg/m^3

Figure D.5: Scenario 1 24 hour maximum SO_2 Process Contributions



Notes: 2010 worst meteorological year, contour increments 5µg/m^3, highest contour is 20µg/m^3

Appendix E. Scenario 2 Results

E.1 Scenario 2 – 40% Load

Results for Scenario 2 are presented in Table E.1 below and compared against EU standards.

At lower load, all process contributions are predicted to be lower than 25% of the relevant EU standards and impacts are predicted to be lower than those presented in Scenario 1.

Table E.1: Scenario 2 – 40% Load - Comparison with Relevant International Standards (µg/m^3)

Pollutant	Averaging Period	Max PC	% of EU Standards	Impact Magnitude	AC	PEC	% of EU Standards	EU Standards	Receptor Sensitivity	Impact Descriptor
NO2	1hr 99.79	7.7	3.8	Negligible	110.7	118.4	59.2	200	Low	Negligible
	Annual	0.5	1.4	Negligible	55.4	55.9	139.8	40	High	Negligible
SO2	15 Minute 99.9	28.3	10.6	Minor	24.8	56.0	21.1	266	Negligible	Negligible
	1 Hour 99.73	15.1	4.3	Negligible	24.8	42.9	12.3	350	Negligible	Negligible
	24hr 99.18	4.8	3.8	Negligible	12.4	18.7	14.9	125	Negligible	Negligible
PM10	24 hour 90.41	0.4	0.8	Negligible	84.9	85.3	170.6	50	High	Negligible
	Annual	0.2	0.5	Negligible	84.9	85.0	212.6	40	High	Negligible
PM2.5	Annual	0.2	0.8	Negligible	84.9	85.0	340	25	High	Negligible

Notes: PC = Process Contribution, AC Ambient Concentration, PEC Predicted Environmental Concentration
Results and percentages are rounded to 1 decimal place

Appendix F. Additional Meteorological Data

F.1 Additional Meteorological Data

The data presented below in Figure F.1 and Figure F.2 has been used for additional sensitivity analysis. It should be noted that in both cases data capture rates at both sites are relatively poor which can have a significant effect on modelled results and therefore this data has not been used within the primary assessment.

Figure F.1: Windroses for Ulaanbaatar International Airport

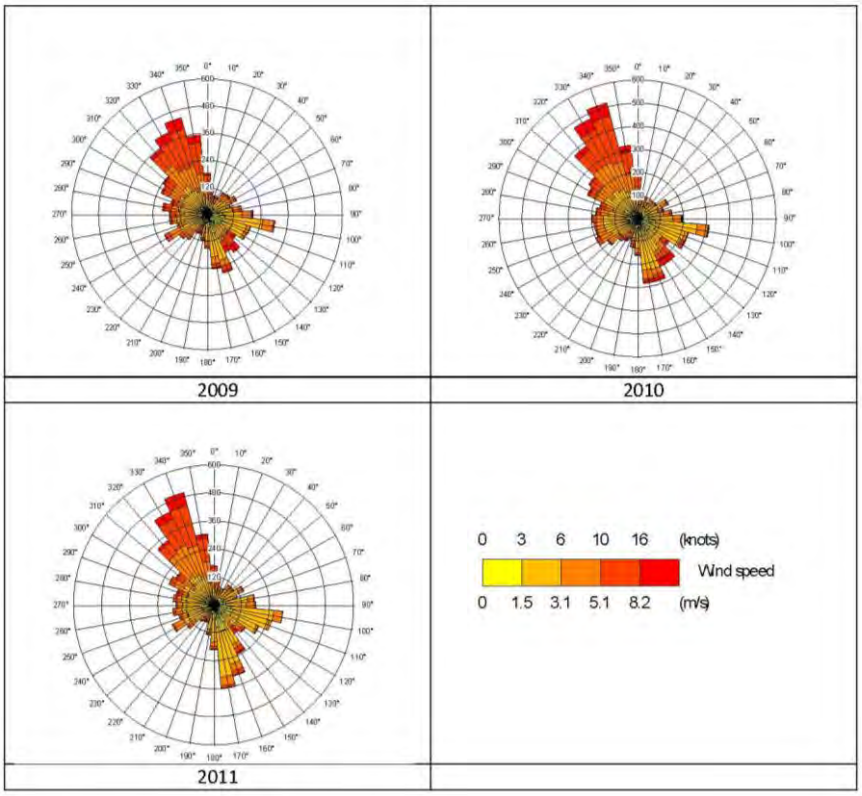
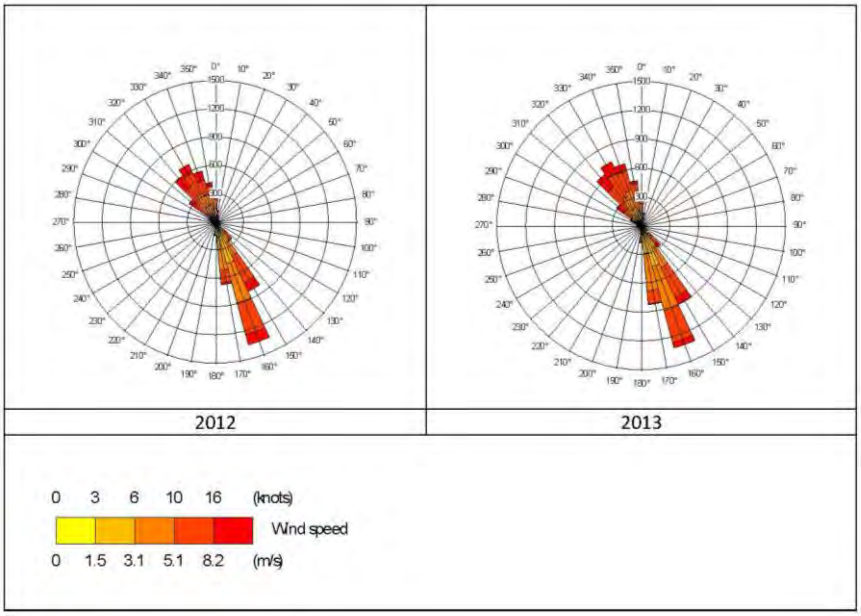


Figure F.2: Windroses from UB-08 Air Quality Monitoring Station



Appendix G. Additional Baseline Analysis

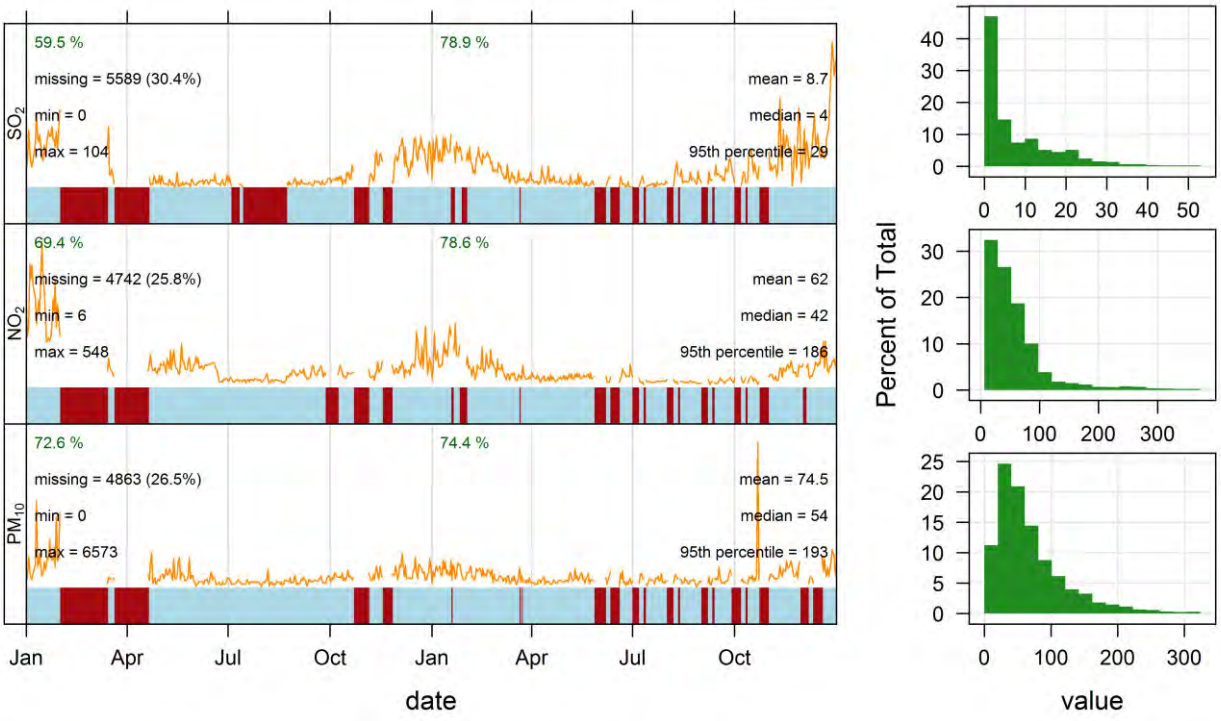
Table G.1 presents the average monthly averages at UB-08 for 2012, 2013 and 2014 and Figure G.1 presents the change in concentrations of SO_2, NO_2 and PM_{10} at the UB-08 monitoring station for 2012, and 2013 and the average concentrations across the period. The histograms present the percentage of the total pollutant concentrations. In the case of SO_2 the majority of monitored concentrations are below 10µg/m^3, for NO_2 and PM_{10} the majority are below 100µg/m^3. The plots clearly illustrate that there are very clear seasonal variations in pollutant concentrations. Concentrations of all pollutants in the winter are far higher.

Table G.1: Monitored Monthly Averages at UB-08 (µg/m^3)

	2012			2013			2014		
Month	NO_2	SO_2	PM_{10}	NO_2	SO_2	PM_{10}	NO_2	SO_2	PM_{10}
January	274	20	182	123	18	111	82	35	120
February	-	-	-	74	13	93	30	32	131
March	63	10	58	45	5	50	32	18	100
April	66	3	76	31	3	37	22	7	97
May	78	2	91	37	2	59	18	4	52
June	61	3	40	47	1	49	15	4	159
July	24	2	35	25	1	45	-	-	-
August	30	2	39	19	4	47	-	-	-
September	49	2	46	19	6	56	12	4	55
October	48	4	70	22	8	79	24	6	-
November	53	87	10	53	18	105	36	21	157
December	89	16	109	79	28	147	52	40	138
Average	81.3	7.7	76.9	46.5	9.5	72.3	38	20	106
Data capture	69%	60%	73%	86%	86%	82%	64%	51%	59%

Figure G.1 presents daily concentrations in comparison to the Ulaanbaatar air quality index and concentrations plotted against temperature. These plots indicate that for NO_2 and PM_{10} there are many more occurrences of high pollution levels in the winter months. The plot for SO_2 shows that throughout the year pollutant concentrations are considered ‘good’ or ‘very good’ in accordance with the Ulaanbaatar air quality index. However it should be noted that the same air quality index is applied to all pollutants and averaging periods and therefore should only be used as a guide and not for comparison against ambient air quality standards.

Figure G.1: Distribution of Pollutant Concentrations across the year



Notes: Green graphs show the percent of time where pollutant concentrations are at specific concentrations

Figure G.2 below presents the maximum, mean and 90th percentile value of NO_2, SO_2 and PM_{10} based on wind direction and speed. The results indicate that at the UB-08 monitoring location the highest PM_{10} concentrations are experienced when the wind is blowing from a north westerly location (from Ulaanbaatar) and when wind speed is above 15m/s. It also indicates that the highest NO_2 concentrations are recorded when the wind is blowing from the south east at around 10m/s. The highest SO_2 concentrations are experienced when the wind direction is from the north. It would be expected that the highest monitored pollutant contractions would be experienced when the wind is blowing from Ulaanbaatar and the monitoring data for PM_{10} and SO_2 are consistent with this.

The data for NO_2 are not consistent with this and indicate that there is a significant local NO_2 source in the study area that is having a large influence on baseline NO_2 concentrations. It is unclear what this source is but it may be that the monitoring location is being influenced by a nearby ger located to south east of the monitoring station. If this is the case it can be considered that the background concentrations assumed within the assessment for NO_2 are conservative and average concentrations within the airshed especially further downwind of the proposed Project site and further away from Ulaanbaatar are likely to be lower than those assumed within the assessment.

Figure G.2: 2013 Pollutant Concentrations and Wind Direction Monitored at UB-08

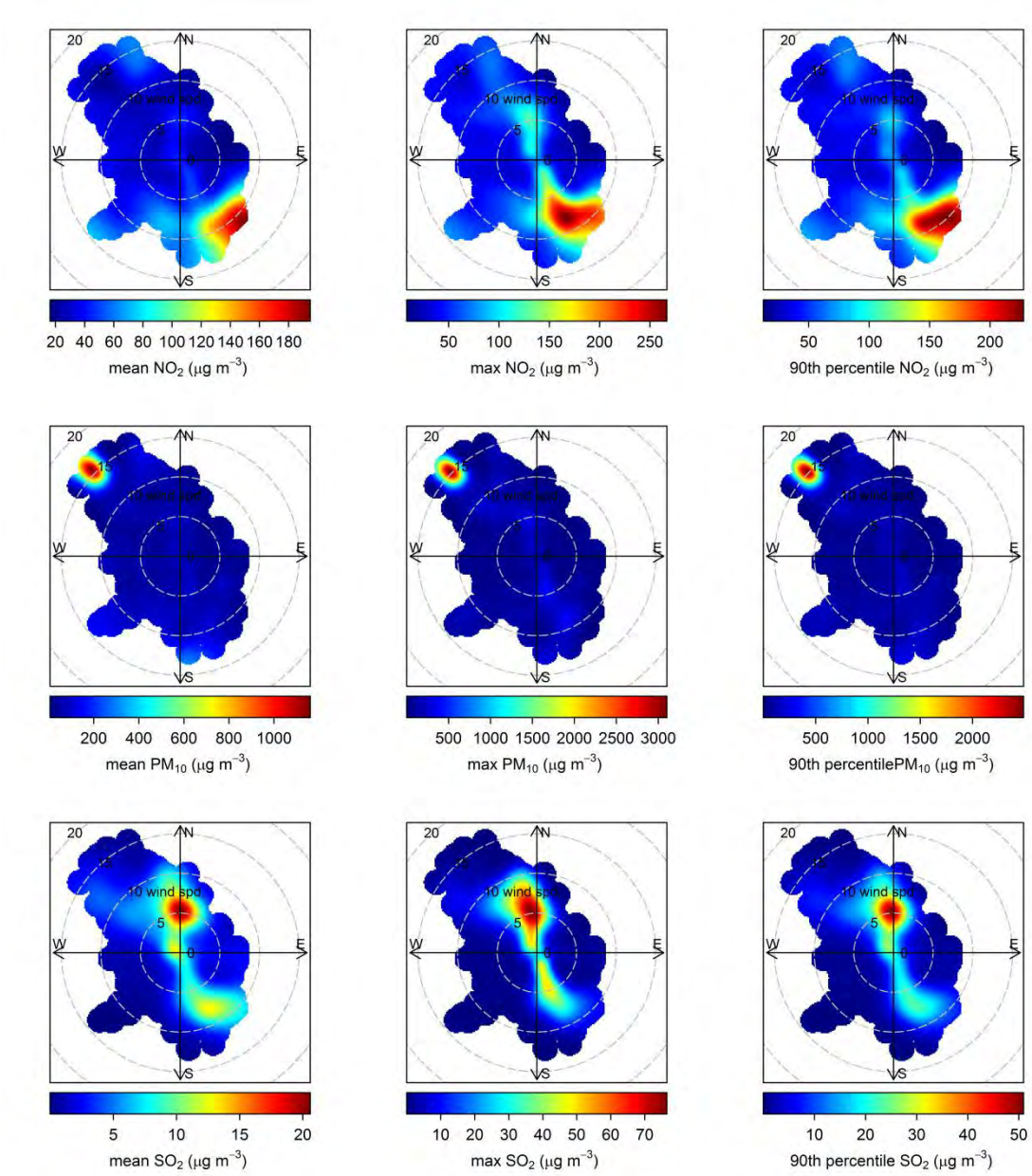
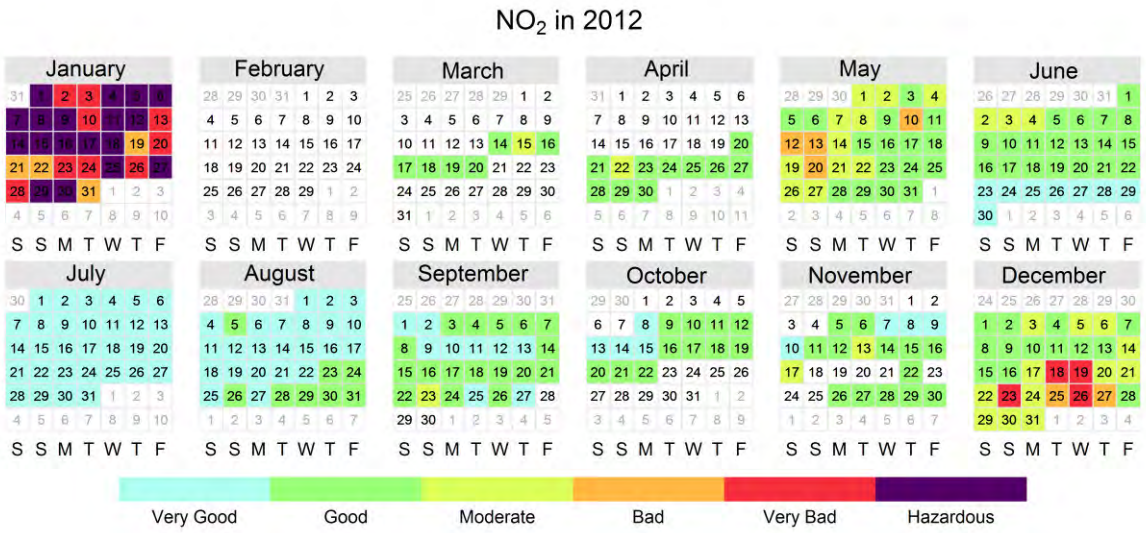


Figure G.3: Daily NO_2 concentrations based on Ulaanbaatar air quality index



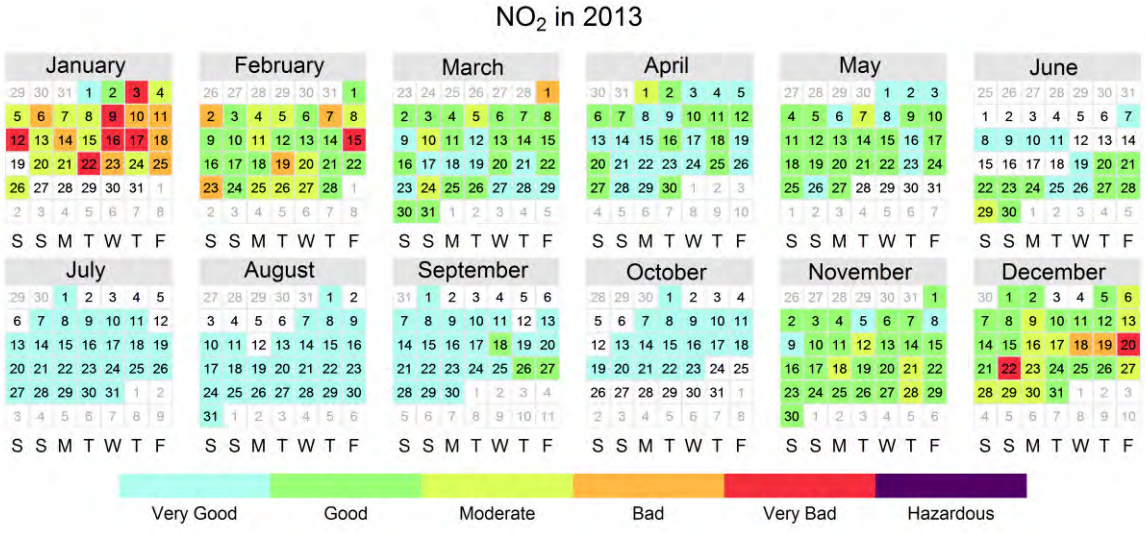


Figure G.4: Daily PM_{10} concentrations based on Ulaanbaatar air quality index

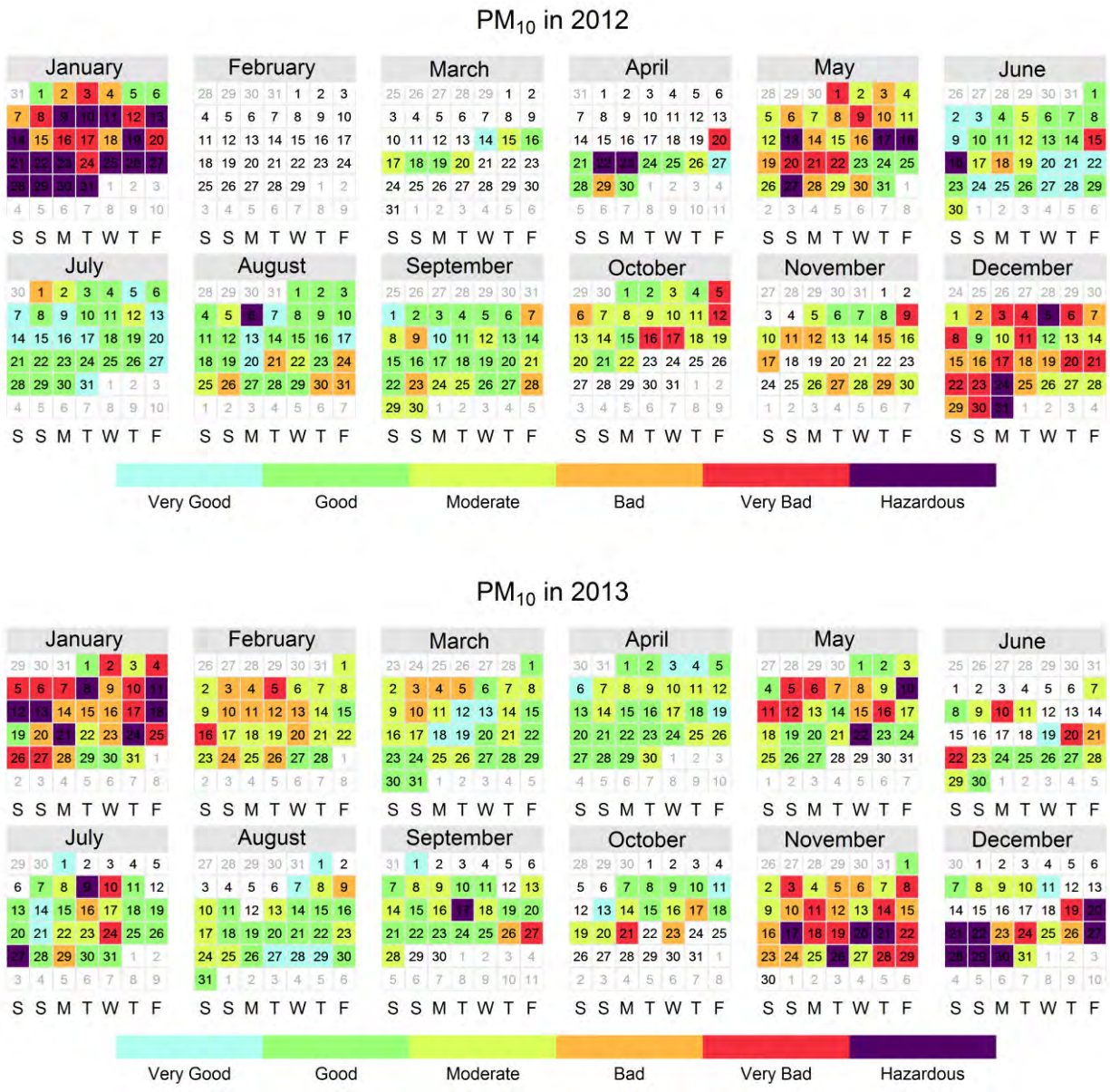


Figure G.5: Daily SO_2 concentrations based on Ulaanbaatar air quality index

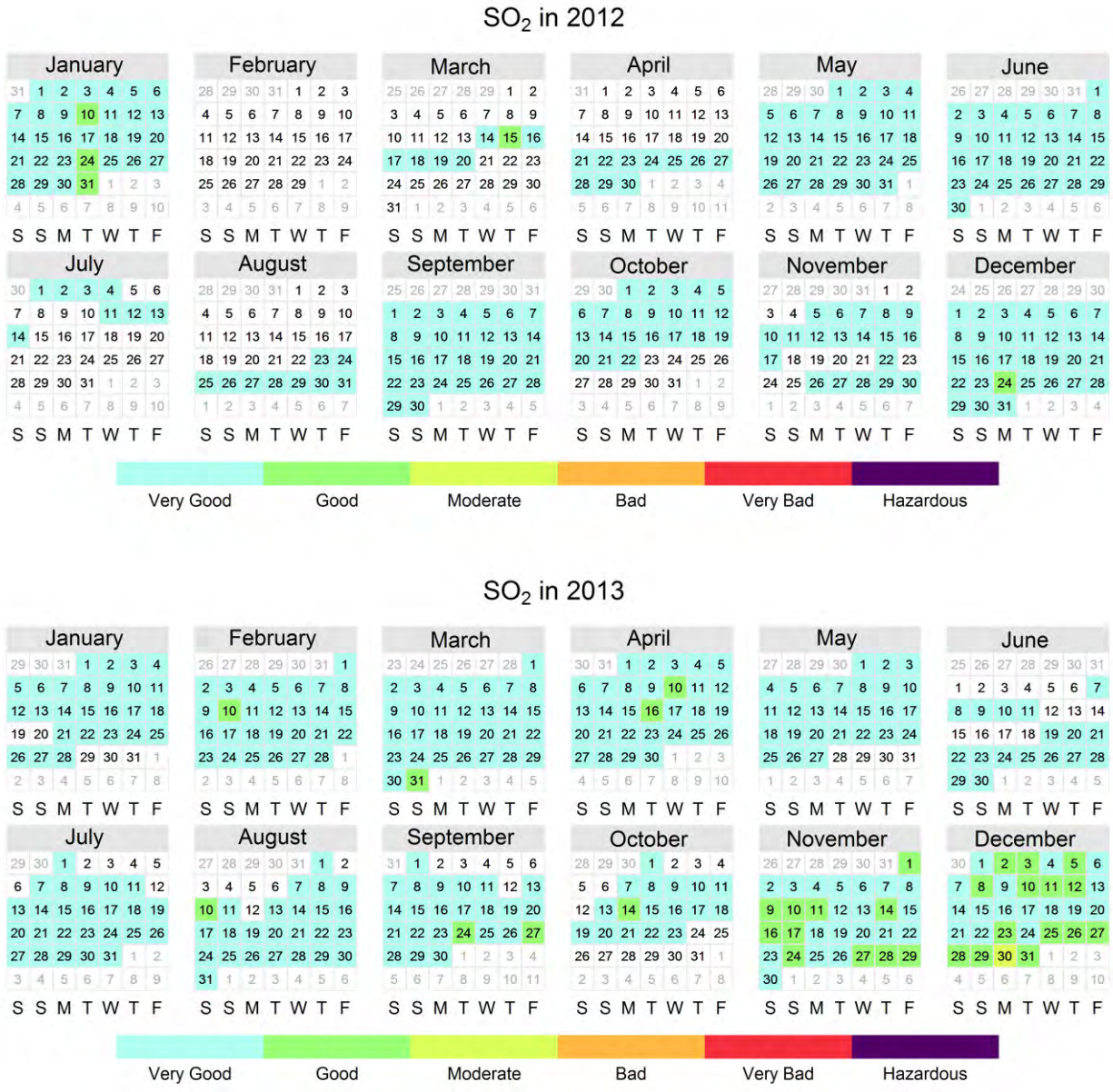
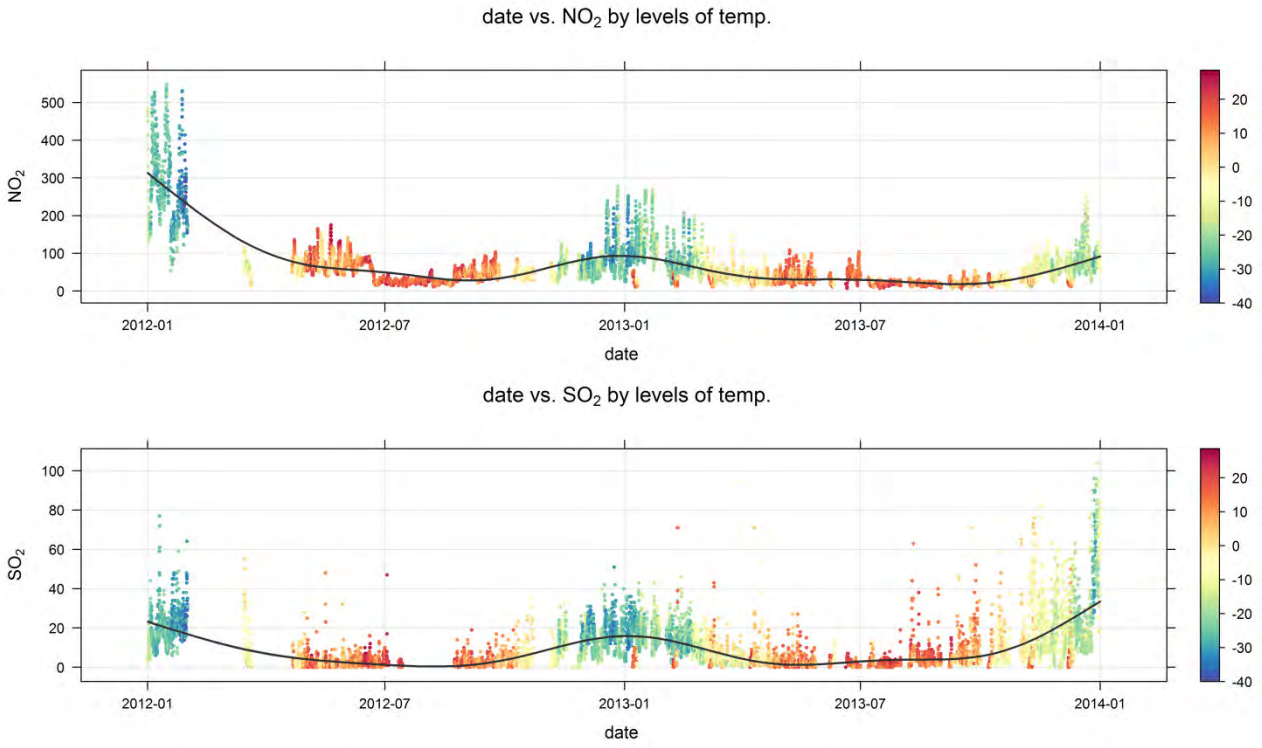


Figure G.6: Relationship between pollutant concentrations and temperature



Appendix H. Results for a 200m stack

Table H.1: Scenario 1 -100% load, 200m Stack, Comparison with International Standards (µg/m^3)

Pollutant	Averaging Period	Max PC	% of EU Standards
NO2	1hr 99.79	14.2	7.1
	Annual	1.1	2.8
SO2	15 Minute 99.9	66.0	24.8
	1 Hour 99.73	27.7	7.9
	24hr 99.18	14.1	11.3
PM10	24 hour 90.41	0.9	1.7
	Annual	0.3	0.8
PM2.5	Annual	0.3	1.2

Notes: PC = Process Contribution, AC Ambient Concentration, PEC Predicted Environmental Concentration,

Table H.2: Scenario 2 – 40% Load, 200m Stack, Comparison with International Standards (µg/m^3)

Pollutant	Averaging Period	Max PC	% of EU Standards
NO_2	1hr 99.79	7.2	3.6
	Annual	0.5	1.3
SO_2	15 Minute 99.9	24.9	9.4
	1 Hour 99.73	14.1	4.0
	24hr 99.18	6.2	5.0
PM_{10}	24 hour 90.41	0.4	0.8
	Annual	0.1	0.4
$PM_{2.5}$	Annual	0.1	0.6

Notes: PC = Process Contribution, AC Ambient Concentration, PEC Predicted Environmental Concentration

Appendix I. Sensitivity Analysis

Table I.1: Scenario 1 -100% load, 170m Stack Ulaanbaatar airport meteorological data comparison with international standards (µg/m^3)

Pollutant	Averaging Period	Max PC	% of EU Standards
NO2	1hr 99.79	48.0	24.0
	Annual	0.7	1.7
SO2	15 Minute 99.9	229.9	86.4
	1 Hour 99.73	61.2	17.5
	24hr 99.18	24.6	19.6
PM10	24 hour 90.41	0.6	1.1
	Annual	0.2	0.5
PM2.5	Annual	0.2	0.8

Notes: PC = Process Contribution, AC Ambient Concentration, PEC Predicted Environmental Concentration. Results and percentages are rounded to 1 decimal place

Table I.2: Figure I.1: Scenario 1 – 100% Load, 170m Stack UB-08 meteorological data comparison with international standards (µg/m^3)

Pollutant	Averaging Period	Max PC	% of EU Standards
NO_2	1hr 99.79	14.3	7.1
	Annual	0.6	1.6
SO_2	15 Minute 99.9	50.9	19.2
	1 Hour 99.73	28.0	8.0
	24hr 99.18	6.4	5.1
PM_{10}	24 hour 90.41	0.5	0.9
	Annual	0.2	0.4
$PM_{2.5}$	Annual	0.2	0.8

Notes: PC = Process Contribution, AC Ambient Concentration, PEC Predicted Environmental Concentration. Results and percentages are rounded to 1 decimal place

Appendix J. Literature Review – Air Quality in Ulaanbaatar

J.1 Overview

This section provides an overview of previous air quality studies that have been carried out within Ulaanbaatar and provides additional context for the baseline and impacts identified within this air dispersion report. Although the Project's airshed is not located within Ulaanbaatar, the Project is located approximately 15 km from the city and due to the prevailing wind directions in the study area provides further information on why pollutant concentrations are elevated at the project site. It also demonstrates the key sources of pollution in Ulaanbaatar which can be assumed to be similar to those within the proposed Project's airshed.

Following rapid urbanisation in the 1990s, Ulaanbaatar's population expanded significantly and now over 1.2 million people (around 40% of the total population of Mongolia) are understood to reside within the city's limits [1]. Although some of Ulaanbaatar's population live in the city centre, typically in old, energy-inefficient apartment blocks or small houses, approximately two-thirds of the population live on the outskirts of the city in traditional peri-urban Ger areas [3, 13].

Ulaanbaatar's climate is generally cold and arid; the city is prone to dust storms and subject to the largest annual temperature fluctuations of any capital city worldwide, with extremely cold winter temperatures [1]. The city itself is located in a valley surrounded by mountainous terrain, which (combined with the cold temperatures) can lead to frequent temperature inversions and poor atmospheric dispersion. At least 80%–96% of these temperature inversions occur between the months of October and April, with an average depth from 650m to 920m [2].

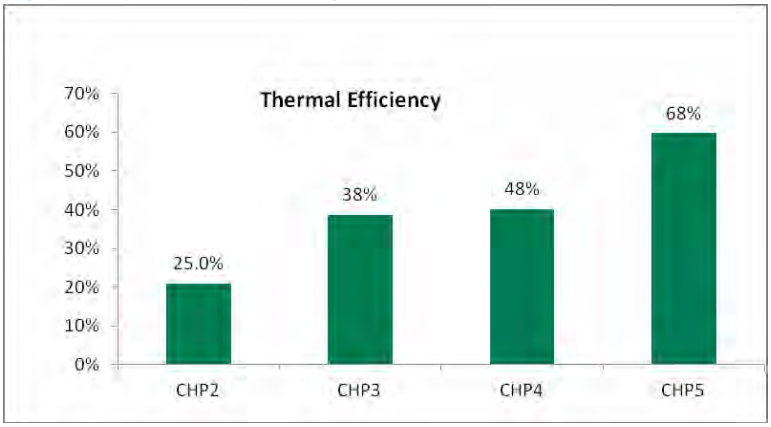
The extreme cold during winter months and rapid increase in population have resulted in significant demand for domestic heating. Around 80% of the city's apartment blocks are provided with heating and hot water from the three existing combined heat and power plants (CHP2, 3 and 4), 7% from heat-only boilers (HOBs) and 13% from individual stoves [3]. Population expansion and economic development have also led to an increased electricity demand, which is currently met by the existing coal-fired CHPs. Coal is the cheapest and most widely used fuel in Mongolia due to the widespread coal deposits throughout the country. In 2009, coal consumption from the three main power plants in Ulaanbaatar was 3.79 million tons. The NO_x, SO_2 and PM_{10} emissions from these power plants in 2009 were 14,381, 30,330 and 9,171 tons respectively [19].

Ger households rely on traditional stoves for heating, typically using inefficient stoves to burn poor quality coal and wood as fuel [4]. Open burning of waste is also common. This combination of climate, geographical location, socio-economic factors and the widespread use of coal and road transport mean Ulaanbaatar is one of the five most polluted cities in the world with respect to air quality [18]. The key pollutants of concern in Ulaanbaatar are particulate matter (as $PM_{10,}$ $PM_{2.5}$ and PM_1), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). An estimated 1 in 10 deaths in the city are attributable to air pollution [12], with poorer families living in Ger areas being the worst affected [14]. Improving Ulaanbaatar's air quality is recognised as a key step to improving social equality and promoting sustainable development.

J.2 Air Quality Initiatives and Projects

Given the severity of air pollution impacts in Ulaanbaatar, several national and international projects have been undertaken in Mongolia over recent years with the aim of improving air quality. These cover a wide range of approaches and abatement options, including advancements in stove technologies, the provision of permanent energy-efficient housing for Ger residents and the development and subsidised provision of cleaner fuels. In addition, the increase in electricity and heating demand as a result of the growing population in urban Ulaanbaatar is being addressed through the development of the proposed Project, which will in time reduce reliance on the older, less efficient, CHPs currently in operation (details of these are presented in Figure J.1 below).

Figure J.1: Thermal Efficiency of CHPs in Ulaanbaatar



Source: ERC (from Consortium)

Funding for these air quality initiatives and projects is provided by various parties, but largely delivered through funds executed by the World Bank and other international finance organisations such as the ADB and EBRD.

The majority of air quality projects underway in Ulaanbaatar focus on solutions to the air quality issues arising from stove use and waste burning in ger areas and, to a lesser extent, the potential to construct new energy-efficient residential housing. The following subsections therefore do not list these programmes in detail.

Ulaanbaatar Clean Air Programme

The World Bank Ulaanbaatar Clean Air Project (UBCAP) development objective is to enable consumers in ger areas to access heating appliances that produce less particulate matter emissions and to further develop selected medium-term particulate matter abatement measures in Ulaanbaatar in coordination with development partners. However, UBCAP also involved a monitoring survey and wider consideration of PM mitigation from CHPs and HOBs and therefore provides useful information relevant to the proposed Project.

The UBCAP project is comprised of three components:

1. Ger area particulate matter mitigation;
2. Central Ulaanbaatar particulate matter mitigation, comprising
   a. Mitigation of fugitive dust from lack of city greening
   b. Mitigation of dust from power plant emissions and ash ponds
   c. District heating feasibility study and knowledge building
   d. Affordable housing policy technical assistance
3. Public awareness raising, programme coordination and project management.

This programme comprises inputs from a number of organisations and spans various individual projects and initiatives. A key project which took place from 2008 to 2011 was the Air Monitoring and Health Impact Baseline (AMHIB) project; this aimed to establish the air quality baseline for Ulaanbaatar, present the results of a monitoring study from June 2008 to May 2009 regarding particulate matter concentrations, quantify the related health impacts and propose cost-effective pollution mitigation and abatement solutions in terms of their benefits with regard to health costs. The AMHIB study represents the most complete and spatially diverse monitoring results of Ulaanbaatar's particulate matter air pollution to date.

JICA Capacity Development Project for Air Pollution Control in Ulaanbaatar City

This project is funded by the Japan International Cooperation Agency (JICA). It supports capacity development of stakeholders concerned with air pollution control with the following activities:

4. Improve the related legal environment;
5. To develop an emissions inventory system and air quality evaluation capacity;
6. To provide training in stack gas measurement techniques;
7. To improve emission control systems through administration (development of a boiler registration system);
8. To support large and medium polluters for pollution control measures; and
9. To utilise and disseminate the project outcomes.

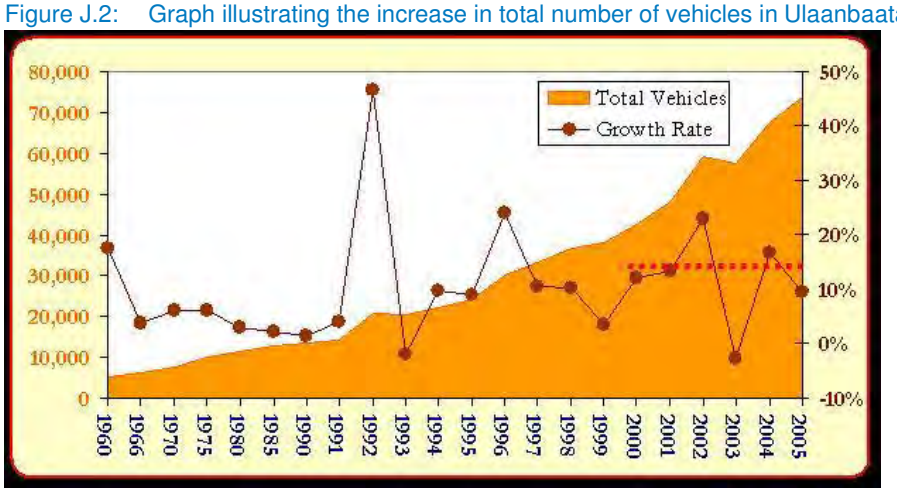
The project involves close collaboration and cooperation with the National Air Quality Professional Office of Mongolia, the Air Quality Agency of the Capital City (AQACC) and other government organisations.

J.3 Emissions Sources

Nitrogen oxides

As noted above, air pollution in Ulaanbaatar is emitted from a range of sources. Key sources of NO_x include road transport, coal combustion (in CHPs, HOBs and domestic stoves) and to a lesser degree, biomass and/or waste burning. The main source of NO_2 in Ulaanbaatar is vehicle exhausts [10]. Vehicle use has rapidly increased over recent years due to the increased availability and affordability of cars and population growth [11]. In addition, many of the heavy duty vehicles in use are old diesel trucks with relatively higher emissions than modern alternatives.

Figure J.2: Graph illustrating the increase in total number of vehicles in Ulaanbaatar from 1960 to 2005



Source: Dr. Sarath Guttikunda (2008). SIM-air Working Paper Series.

Sulphur dioxide

SO_2 in Ulaanbaatar is primarily emitted from coal combustion in CHPs, HOBs and Ger stoves. A recently published study on SO_2 pollution in Mongolia [16] also showed that concentrations in urban and industrial locations have increased over recent years. Distinct seasonal variation was observed, which was attributed to the vastly increased demand for district and domestic heating and therefore coal combustion in winter months. Mongolia has different coal deposits, most of which have relatively low sulphur contents. However, SO_2 concentrations remain a cause for concern due to the scale of coal combustion underway and the age of the existing CHP plants. No emission control equipment is used at HOBs and Ger stoves are typically highly polluting due to the outdated technology involved and the higher sulphur content coal that is combusted. [19].

Particulate matter

Air quality monitoring and research in Ulaanbaatar originally focused on NO_2 and SO_2, however since recognising the level of pollution and significant health impacts caused by PM_{10} and $PM_{2.5}$, most new studies are concerned with particulate matter instead. The primary PM sources differ depending on the size fraction of particles under consideration; fugitive dust and soil particles typically form a larger fraction of coarse particulates, whereas combustion sources (road transport, coal combustion and biomass burning) dominate the finer fractions. A number of different source-apportionment studies have been undertaken for particulates in Ulaanbaatar, the results of these are summarised below.

Emissions of PM_{10} particles in Ulaanbaatar were modelled using the SIM-air and ATMOS models for a 2006 base year, over a 30km x 20km grid at 1 km resolution [11]. The results of this indicate that power plants (CHPs) are the largest emitters of PM_{10}, contributing 36% of total emissions. HOBs contributed 17% and Ger areas contributed 25% in total (comprising a mixture of household stoves, kiosks and open burning). The remaining PM_{10} fractions comprised unpaved road-dust (7%), an unknown fraction (8%), and

other minor sources including vehicle exhausts, bricks and paved road-dust. However, these emission contributions do not directly translate into contributions to ground level ambient PM_{10} concentrations, as the height of the emission point (amongst others) has important implications for dispersion. CHPs have stacks between 100m to 200m high and therefore much more effective dispersion of pollutants than domestic heating sources, which typically have stacks less than 4m above ground level [22] and therefore contribute a greater proportion to the ground level pollutant concentrations.

The World Bank AMHIB study presents a PM source apportionment analysis obtained from Positive Matrix Factorisation (PMF) applied to ground level monitoring data collected from June 2008 to May 2009. This showed that an average of 75-95% of particulate matter (PM) concentrations in Ulaanbaatar could be attributed to coal and wood burning for heating in Ger areas and the suspension of dry dust from open soil surfaces and roads [14, 20]. Contributions from CHPs, HOBs and vehicle exhausts therefore form a relatively small fraction of the total ground level ambient particulate load.

The AMHIB study also produced estimates of the total emissions of PM_{10} and $PM_{2.5}$ from various sources for the study period (2008/2009), in addition to estimates of ambient concentrations and population-weighted average exposure. These values are reproduced in Table J.1 below.

Table J.1: Ulaanbaatar air pollution summary (AMHIB study)

Parameter	Source	PM_{10}	$PM_{2.5}$	Spatial Distribution
Emissions (tons/year)	Ger households	19,731	15,785	Throughout Ger areas
	HOBs	1,077	646	Dispersed over UB surroundings
	CHPs	18,589	7,436	3 point sources to the west of UB centre
	Vehicle exhaust	1,161	1,161	Mainly throughout the central city areas
	Dust from paved roads	9,954	771	Mainly throughout the central city areas
	Dust from unpaved roads	4,812	722	Mainly throughout the Ger areas
Concentration ($\mu g/m^3$)	Central city areas	150-250	75-150	Ger areas show much higher concentration levels
	Ger areas	350-700	200-350	
Exposure ($\mu g/m^3$)	Population weighted average	427	260	Ger households exposed to higher levels of air pollution

Source: [14]

Under the AMHIB study, the composition of the PM_{10} and $PM_{2.5}$ at selected sites was analysed and attributed to one of four possible source types. The total PM at each site is then assumed to be composed of varying percentages of PM from each of these sources. At sites where black carbon and elemental analysis was also carried out (sites 2, 3 and 6), the soil and combustion fractions could be further devolved into two separate origins based on their composition.

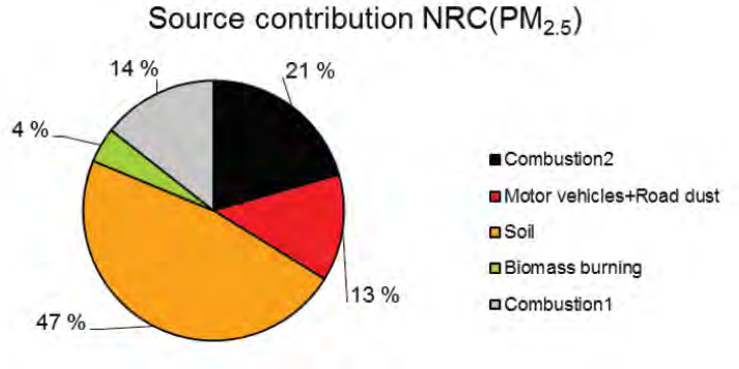
Table J.2: Source types derived for PM_{10} and $PM_{2.5}$ in Ulaanbaatar (AMHIB study)

Source types	Characteristics
Soil 1	Dominated by Al, Si, Ca, Ti and Fe (i.e. Crustal matter)
Soil 2	Contains the above elements and a significantly higher BC component (i.e. Indicates a more local origin where combustion particles/coal dust have settled into the crustal matter)
Combustion 1	Black carbon and a significant sulphur content (associated with higher combustion temperatures (i.e. CHPs)
Combustion 2	Black carbon, lower sulphur content and higher soil elements (associated with lower combustion temperatures i.e. Ger stoves)
Motor vehicles/ road dust	Contains BC, most Zn and elements typical of crustal matter. Mixture of exhaust particles ($PM_{2.5}$) and suspended road dust ($PM_{10\text{-}2.5}$)
Biomass burning	Contains black carbon and most of the K in the samples. Contributes mostly to $PM_{2.5}$.

Notes: AMHIB – Air monitoring and health impact baseline study, Al – Aluminium, Si – Silicon, Ti – Titanium, Fe - Iron

Of particular relevance to the proposed Project is the ability of this analysis to distinguish between combustion sources from Ger stoves and those from large power plants (in this case the existing CHPs and some large HOBs). This data was available for $PM_{2.5}$ measurements at sites 2 (NRC) and 3 (Zuun Ali); NRC is located in the centre of Ulaanbaatar and Zuun Alu is a Ger area to the north of the city.

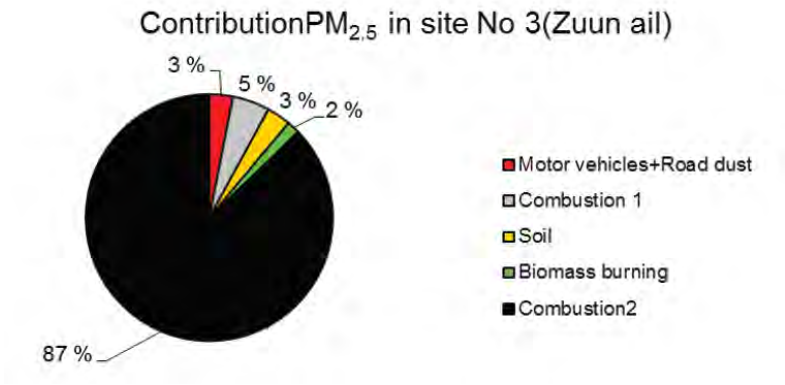
Figure J.3: Source-apportionment of PM2.5 at a city centre site in Ulaanbaatar



Source: [21]

The NRC site results show a dominance of $PM_{2.5}$ from soil suspension. The next largest contribution is from Ger-style combustion, which is assumed to be due to the location of the NRC site with respect to Ger areas and the prevailing wind direction. The results indicate that CHP combustion contributes just 14% of $PM_{2.5}$ at this site and illustrates that even in a city centre location air quality still appears to be heavily influenced by emissions from Gers.

Figure J.4: Source-apportionment of PM2.5 at a Ger site in Ulaanbaatar



Source: [21]

The Zuun Ali site is located well within a ger area. Analysis of the results show that $PM_{2.5}$ concentrations are almost entirely dominated by ger-style combustion sources. On average, ger-style combustion is estimated to contribute 293 µg/m^3 (87%) of the $PM_{2.5}$ at Zuun Ali, whereas CHP-style combustion contributes just 16 µg/m^3 (5%). The exceedances of air quality standards within ger regions such as this can therefore be assumed to be attributed almost entirely to local domestic heating in stoves. However it should be noted that data collection was interrupted at this site in July and August 2008, suggesting the peak combustion months in winter may have an overestimated influence on the annual average results. Given the location of the Zuun Ali monitoring station, it is assumed that this site is largely representative of other sites in ger areas.

J.4 Summary

The literature review has been undertaken to provide additional context for the modelling results presented within this air dispersion study. Whilst the study shows that the existing CHPs emit a large volume of pollutants into the atmosphere they have a relatively small impact on air quality compared to other sources due to their large stacks. The review has highlighted that combustion sources used for heating Gers and road traffic emissions are the dominant sources affecting ambient pollutant concentrations in Ulaanbaatar and it can be assumed that this is the case within the proposed Project's airshed.

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Appendix K. Ecology Baseline Data

K.1 Flora and vegetation study results

FLORA AND VEGETATION STUDY FOR THE PROPOSED CHP5 AREA NATURE FRIENDLY

1. Introduction

Location: Coordinates of corners of CHP5 project site

1. 47°51'44.50"N 107° 6'57.75"E
2. 47°51'45.15"N 107° 6'47.30"E
3. 47°51'46.56"N 107° 6'41.12"E
4. 47°51'48.66"N 107° 6'36.07"E
5. 47°51'52.45"N 107° 6'30.42"E
6. 47°52'0.87"N 107° 6'25.12"E
7. 47°52'6.43"N 107° 6'20.74"E
8. 47°52'12.63"N 107° 6'35.15"E
9. 47°51'50.38"N 107° 7'7.45"E

A Nature Friendly team conducted baseline survey on flora and vegetation in the proposed area of CHP-5 in October-November 2013. The plant is assumed to cover 45 hectare of area. Vegetation cover will be removed during the construction of the thermal plant and therefore, this baseline study will be useful in the restoration of vegetation cover post closure of the plant.

2. Study methodology

***Identification of plant species*.** Most species were identified in the field but some specimens were collected and sent to a laboratory for plant recording and species identification.

***Define the vegetation communities*.** Complete recording for vegetation communities were conducted along the four linear transects that were selected by considering the habitats of study area (Figure 1). Dominant, subdominant, common species and minor species were recorded. Canopy cover for each species was determined in percentage. Ramensky quadrat of 1m2 and 10*10 cm netted was used to define the grass canopy cover. Single net shows one percent of total 100% (Figure 2a and 2b). In order to define the distribution of shrubs, 10*10 m2 area selected and shrub distributed in per square meter area estimated as 1 percent. Individual counting for grassy plants were completed for each 1 sq.m area, individual counting for semi-shrubs were completed for each 2*2 sq.m area locations and individual counting for shrubs were completed for each 10*10 sq.m area at the selected locations. Habitat types for each recording location were noted. Coordinates and elevation along the linear transects were identified by using GSP tool. In other words, all plant species were recorded and added to the vegetation communities.

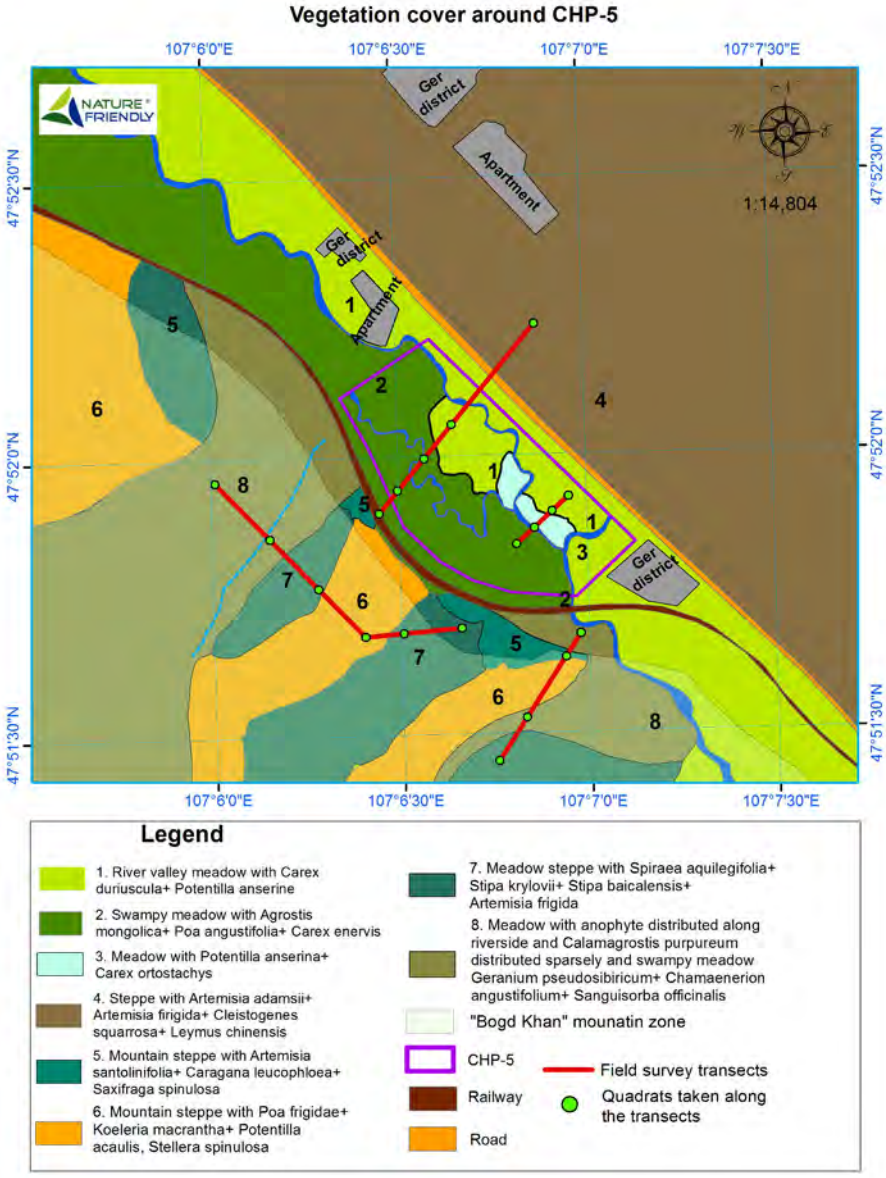

Figure 1. Vegetation cover of study area and field survey transects

Figure 2a and 2b. Vegetation sampling

***Define the biomass*.** Biomass of grassy plants were estimated for 1 sq.m area, small semi-shrubs were estimated for 2*2 sq.m area and bigger shrubs were estimated for 10*10 sq.m area at the located locations respectively.

a. After the grass individual counting and measuring, plants were cut and classified by its dominant, subdominant, and rarity status (rare, endemic and medicinal) and determined the biomass.

b. To determine the biomass of shrub, semishrubs, all individuals within the selected area were counted. Then three shrubs were selected representing medium, small and big sizes by eye orientation and annual branch, leaves were collected for drying out. Average crop for single shrub were defined by using dry weight of three shrubs. The weighted amount were multiplied

by total number of the shrubs within the selected area. If there distributed several different shrubs or specific species, individual counting and crop estimation were completed for each species same as above.
c. When estimated crop for grassy plants and shrubs, it was converted to the one hectare area and estimated the total biomass for each vegetation community. Biomass of plants with specific status also estimated equally.

Vegetation mapping. Vegetation map was drawn by using topography map and aerial image and vegetation communities were contoured in the map. To draw the vegetation map, field recordings were integrated and classified by its distribution such as dominant, subdominant and species with 70-100% occurrence.

As shown in Figure 1, the project proposed area was outlined in purple color. In the Figure 3, boundaries of project site adjacent special protected areas and national parks are shown. The vegetation study was conducted within the boundary of the proposed project area as well as the surrounding adjacent areas including the Bogdkhan mountain zone

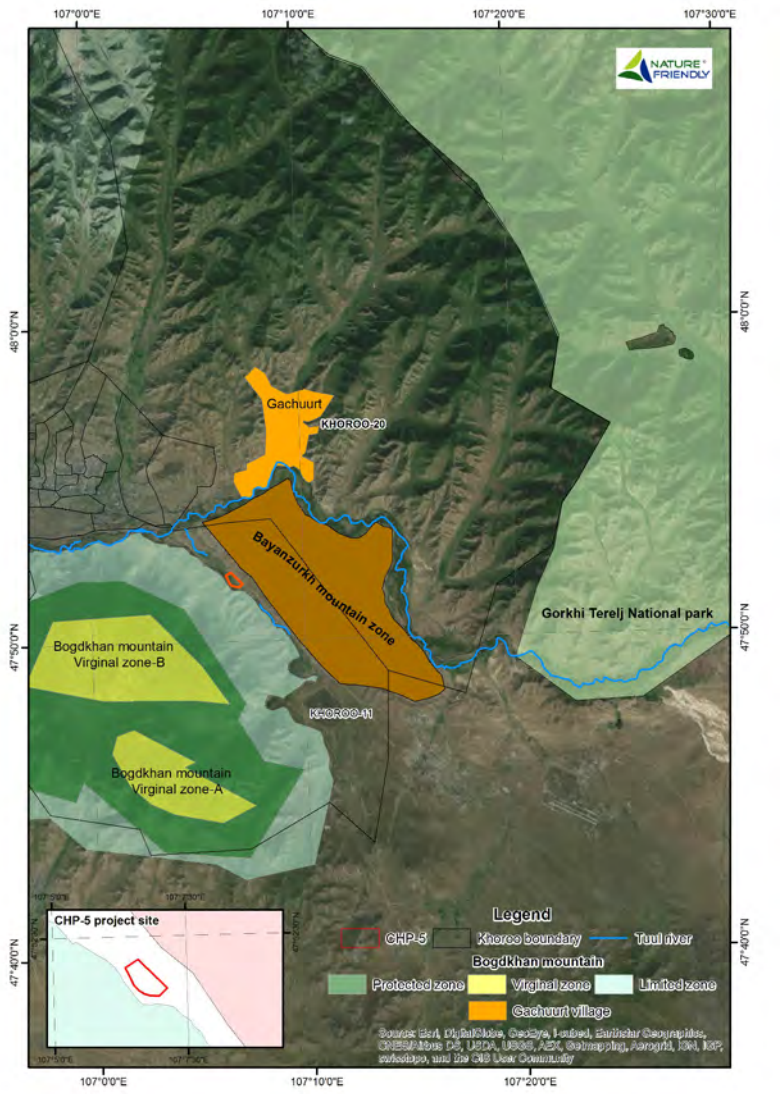

Figure 3. Boundaries of the project site and the surrounding areas

3. Regional context

Proposed area of CHP5 is located between auto road and railway in the Khul river valley that is one of Tuul river tributaries. The limitation zone of Bogd khan strictly protected area bordered in the south of the project area. The northern boundary is outlined in light green color in Figure 1.

The project site is bordered with the southern part of Gorkhi Terelj National Park in the north. Historically, Bogd khan Mountain was protected in 12-13th century by Van Khan Tooril. After that, it was formally protected at the initiative of Undendorj, one of the Khuree Minister in

1778. Bogd khan mountain was registered in the Tentative list of UNESCO World Heritage Sites in 1996.

Total territory of Bogd Khan SPA is 41651 ha and it divided into three virginal, protected and limited zones. The virginal zone covers 14 percent of total area with strict protection; protection zone covers 51 percent of total area, that intended for training, publicity and tourism activities; and limited zone covers 35 percent of total area, that activities allowed with significant limitation.

Bogd khan mountain is rich in flora and fauna species. There are 744 species of vascular plants of 302 genres and 75 families recorded in Bogd khan mountain. There are also 54 mammal species, about 200 bird species and 1160 insect species of about 270 genres and 175 families (Shar S et al, Flora and fauna of Bogdkhan mountain and surrounding area , 2008).

Vegetation communities are distributed in vertical zones: alpine zone of high mountains rising above 2000 m supporting tundra vegetation communities; below taiga forest of larch-cedar and cranberry-spruce trees distributed and extended with larch forest.

Taiga zone of Bogdkhan mountain is the southest end of Mongolian taiga forest distribution. Taiga zone distributed in the mountain top, mountain backside at about 1500 – 1600 m and mountain frontslopefrontside at about 1700-1800 m of absolute altitude. Mountain steppe is distributed in mountainside and mountain meadow steppe is distributed in the backslope backsides.

The highest elevation of Bogd khan mountain is Tsetsee gun with 2268 m ASL and Tushee gun with 2256 m ASL. For weather condition, the coldest month is January and average air temperature reaches to -19C^{o} –(24C^{o}), the warmest month is July and average air temperature reaches to +14 – (+17). The highest wind speed occur in May and calm days continues from December to January.

Regarding to its surface elevation difference, precipitation is various in amount. Annual average precipitation is about 450 mm around mountain top and 250 mm around mountain foothill. The period of permanent snow cover is about 120 days starting from mid of September and melting from end of March.

4. Flora and vegetation of the Project Area

4.1. Flora species. Plant species were recorded on the project site and surrounding areas
During this survey, a total of 113 species were recorded in the project site and the surrounding areas, including the Bogdkhan Mountain zone and nearby settlements. Among these, 44 plant species were recorded within the **proposed project area** of 42 ha in the Khul river valley.
The project area and its surroundings belong to Khentii mountain taiga zone and flora in steppe zone belongs to Khentii mountain forest steppe zone. As mentioned above, a total of 113 during the surveyThe vascular plants recorded are classified into the following life forms: 1 tree

species, 5 shrub species, 1 semi shrub species, 13 species of biannual plants, and 92 species of perennial plants. None of these species recorded are rare, endemic or/and threatened. (Mongolian RedBook, 2013). 19 species of medicinal plants have been recorded in the study area (project site itself and surrounding area), of which 8 species occur within the CHP5 proposed area.

Table 1 shows the list of plant species recorded in studies on project area and surrounding area of the project site. Nomenclature of plants was cited from Grubov V.I (1982)

Table 1. List of plant species distributed within and around the project area.

No	Species Scientific Name*	Species Mongolian name	Life Form	Importance
1	Larix sibirica	Шинэс, Хар мод	Tree	Medicinal /nut/
2	Caragana leucophloea	Алтан харгана	Shrub	
3	Cotoneaster melanocarpa	Хар үрт чаргай	Shrub	
4	Dasiphora fruticosa	Сөөгөн боролзгоно	Shrub	
5	Rosa acicularis	Өргөст нохойн хошуу	Shrub	Medicinal
6	Spiraea aquilegifolia	Удвалнавчит тавилгана	Shrub	
7	Thymus gobicus	Говийн ганга	Shrubby	Medicinal
8	Artemisia santolinifolia	Хар шаваг	Semi-shrub	
9	Agropyron cristatum	Саман ерхөг	Perennial poaceae	
10	Agrostis mongolica	Монгол улаантүрүүт	Perennial poaceae	
11	Calamagrostis purpureum	Хүрэн сорвоо	Perennial poaceae	
12	Cleistogenes squarrosa	Дэрвээн хазааргана	Perennial poaceae	
13	Elymus sibiricus	Сибирь өлөнгө	Perennial poaceae	
14	Koeleria macrantha	Томцэцэгт даагансүүл	Perennial poaceae	
15	Helictotrichon schellianum	Шеллийн бутнуур	Perennial poaceae	
16	Hordeum brevisubultatum	Ахар сорт арвай	Perennial poaceae	
17	Leymus chinensis	Нангиад хиаг	Perennial poaceae	
18	Poa angustifolia	Нарийн биелэг өвс	Perennial poaceae	
19	Poa pratensis	Нугын биелэг өвс	Perennial poaceae	
20	Stipa baicalensis	Байгаль хялгана	Perennial poaceae	
21	Stipa krylovii	Крыловын хялгана	Perennial poaceae	
22	Stipa sibirica	Сибирь хялгана	Perennial poaceae	
23	Trisetum sibiricum	Сибирь үрээнсүүл	Perennial poaceae	
24	Carex delicata	Гоёмсог улалж	Perennial carex	

25	Carex duriuscula	Ширэг улалж	Perennial carex	
26	Carex enervis	Судалгүй улалж	Perennial carex	
27	Carex ortostachys	Цэхтүрүүт улалж	Perennial carex	
28	Carex pediformis	Зогдор улалж	Perennial carex	
29	Achillea asiatica	Азийн төлөгч өвс	Perennial grass	Medicinal
30	Aconitum barbatum	Шар хорс	Perennial grass	Medicinal
31	Adenophora stenanthyna	Нарийн хонхлой	Perennial grass	
32	Alyssum lenense	Шар дэмэг	Perennial grass	
33	Allium schoenoprasum	Булцуут сонгино, хүмхээл	Perennial grass	
34	Androsace incana	Буурал далан товч	Perennial grass	
35	Androsace septentrionalis	Хоёрнаст далан товч	Biennial grass	
36	Arenaria capillaris	Хурдан цагаан	Perennial grass	
37	Artemisia adamsii	Явган шарилж	Perennial grass	
38	Artemisia commutata	Хурган шарилж	Perennial grass	
39	Artemisia dracunculus	Ишгэн шарилж	Perennial grass	
40	Artemisia frigida	Агь	Perennial grass	Medicinal
41	Artemisia laciniata	Салбант шарилж	Perennial grass	
42	Artemisia mongolica	Монгол шарилж	Perennial grass	
43	Artemisia pectinata	Үхэршүлхий шарилж	Annual grass	
44	Artemisia scoparia	Ямаан шарилж	Biennial grass	
45	Aster alpinus	Тагийн хониннүд	Perennial grass	
46	Bupleurum scorzonerifolia	Хависхананавчит бэриш	Perennial grass	
47	Carum carvi	Гонид	Perennial grass	
48	Chamaenerion angustifolium	Хөвөнтолгойт	Perennial grass	
49	Chenopodium album	Цагаан лууль	Annual grass	
50	Chenopodium acuminatum	Шоргор лууль	Annual grass	
51	Cirsium esculentum	Азаргана	Perennial grass	
52	Dianthus versicolor	Башир, юмдүйчин	Perennial grass	Medicial
53	Echinops dahuricus	Дагуур тайжийн жинс	Perennial grass	
54	Erigeron acer	Хахуун цийлэг	Perennial grass	
55	Erodium Stephanianum	Заантаваг	Biennial grass	
56	Equisetum arvense	Хөдөөгийн шивлэй	Perennial grass	
57	Equisetum pratensis	Нугын шивлэй	Perennial grass	
58	Gallium boreale	Умардын өрөмтүүл	Perennial grass	
59	Gentiana macrophylla	Том навчит дэгд	Perennial grass	
60	Geranium pseudosibiricum	Хуурамч Шимтэглэй	Perennial grass	
61	Geranium sibiricum	Сибирь шимтэглэй	Annual grass	

62	Glaux maritima	Марцны цэгээлж	Perennial grass	
63	Heteropappus altaicus	Алтайн согсоолж	Perennial grass	
64	Heteropappus hispidus	Арзгар согсоолж	Biennial grass	
65	Hyoscyamus niger	Хар лантанз	Annual grass	Medicinal
66	Inula britannica	Британи зоосонцэцэг	Perennial grass	
67	Iris lactea	Цагаалин цахилдаг	Perennial grass	
68	Iris tigrida	Бар цоохор цахилдаг	Perennial grass	
69	Leontopodium leontopodioides	Цагаан түрүү	Perennial grass	Medicinal
70	Lomatogonium carinthiacum	Каринтийн дэгдгэнэ	Annual grass	Medicinal
71	Medicago ruthenica	Орос чирэг	Perennial grass	
72	Orostachys spinosa	Өргөст үлд өвс	Biennial grass	
73	Oxytropis microphylla	Бяцханнавчит ортууз	Perennial grass	
74	Oxytropis miriophylla	Түмэннавчит ортууз	Perennial grass	
75	Oxytropis salina	Марцны ортууз	Perennial grass	
76	Parnassia palustris	Намгийн лүндэггарав	Perennial grass	
77	Patrinia rupestris	Хадны сэрхилэг	Perennial grass	
78	Phlomis tuberosa	Булцуут туйпланцар	Perennial grass	Medicinal
79	Pedicularis flava	Шар хувиланги	Perennial grass	
80	Pedicularis rubens	Улаан хувиланги	Perennial grass	
81	Peucedanum baicalense	Байгалийн жав	Perennial grass	
82	Plantago major	Том тавансалаа	Perennial grass	Medicinal
83	Polygonum aviculare	Шувуун тарна	Perennial grass	
84	Polygonum viviparum	Мэхээр	Perennial grass	Medicinal
85	Potentilla acaulis	Навтуул	Perennial grass	
86	Potentilla anserina	Галуун гичгэнэ	Perennial grass	
87	Potentilla bifurca	Имт гичгэнэ	Perennial grass	
88	Potentilla multifida	Хигмэл гичгэнэ	Perennial grass	
89	Potentilla sericea	Мөнгөлөг гичгэнэ	Perennial grass	
90	Pulsatilla bungeana	Бүнгийн яргуй	Perennial grass	
91	Ranunculus japonicus	Япон холтсон цэцэг	Annual grass	
92	Rumex acetosella	Исгэлэн хурган чих	Perennial grass	
93	Rumex thyrsiflorus	Цацган хурган чих	Perennial grass	
94	Salsola collina	Толгодын бударгана	Annual grass	
95	Sanguisorba officinalis	Эмийн сөд	Perennial grass	Medicinal
96	Saussurea amara	Амарын банздоо	Perennial grass	
97	Saussurea salicifolia	Бургаснавчит банздоо	Perennial grass	
98	Saxifraga spinulosa	Өргөст сэрдэг	Perennial grass	
99	Sedum aizoon	Могойн идээ	Perennial grass	
100	Sibbaldianthe adpressa	Налчгар хэрээнхошуу	Perennial grass	
101	Silene jeniseensis	Енисейн шээрэнгэ	Perennial grass	

102	Silene repens	Мөлхөө шээрэнгэ	Perennial grass	
103	Stellera chamaejasme	Одой далантүрүү	Perennial grass	Medicinal
104	Taraxacum collinum	Толгодын багваахай	Perennial grass	
105	Taraxacum officinale	Эмийн багваахай	Perennial grass	Medicinal
106	Thalictrum minus	Бага буржгар	Perennial grass	
107	Trientalis europea	Европ долоодой	Perennial grass	
108	Trollius asiaticus	Азийн жамьянмядаг	Perennial grass	Medicinal
109	Valeriana officinalis	Эмийн бамбай	Perennial grass	Medicinal
110	Veronica incana	Буурал гандбадраа	Perennial grass	
111	Vicia amoena	Гиш	Perennial grass	
112	Vicia cracca	Хулганын гиш	Perennial grass	
113	Urtica cannabina	Халгай	Perennial grass	Medicinal
	Moss (anophyte):			
1	Rhitidium rugosum			
2	Mnium sp			

4.2. Vegetation communities. As project area located in Khul river valley, it has river valley vegetation. Vegetation of Bogd khan mountain belongs to Khentii high mountain district of Dornod Khentii region of Khentii Ikh khosuu of South inner Baigal region and vegetation of surrounding nature belongs to mountain meadow, steppe and river valley vegetation of Tuul-barkh district. Within the project area, there are three different vegetation communites of river valley meadow, marginal meadow and river valley steppe similar to meadow. There are eight vegetation communities within the project site and the surrounding areas (See vegetation map above). The project area is crossed by Huliin river which has surface water in summer time only. It has no permanent surface water so there is no aquatic vegetation.

Description of Vegetation communities.

1. River valley meadow with ***Carex duriuscula+Potentilla anserine***

2Marginal river meadow with ***Agrostis mongolica+Poa angustifolia+Carex enervis***

3. Meadow with ***Potentilla anserina+Carex ortostachys***

4. Steppe with ***Artemisia adamsii +Artemisia frigid****a* ***+Cleistogenes squarrosa + Leymus chinensis***

5. Mountain steppe with ***Artemisia santolinifolia + Caragana leucophloea + Saxifraga spinulosa***

6. Mountain steppe with ***Poa frigidae + Koeleria macrantha + Potentilla acaulis, Stellera chamaejasme, Artemisia frigida***

7. Meadow steppe with ***Spiraea aquilegifolia + Stipa krylovii + Stipa baicalensis + Artemisia frigida***

8. Meadow with anophyte distributed along riverside and ***Calamagrostis purpureum*** distributed sparsely and marginal meadow ***Geranium pseudosibiricum + Chamaenerion angustifolium +Sanguisorba officinalis***

The composition of species, canopy cover and yield identified for each vegetation community are presented below.

1. River valley meadow with *Carex duriuscula+Potentilla anserina* (distributed along gravel area of river within project area). Canopy cover 97,4%, yield 650 kg/ha cn/ha. This community is used for livestock grazing, but is not good quality fodder.

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopy cover, %
1	Artemisia adamsii	5	8	Iris lactea	2
2	Carex enervis	1	9	Leontopodium leontopodioides	0.1
3	Carex duriuscula	50	10	Medicago ruthenica	1
4	Chenopodium album	5	11	Oxytropis microphylla	0.1
5	Chenopodium acuminatum	0.1	12	Potentilla anserina	30
6	Erodium Stephanianum	0.1	13	Salsola collina	1
7	Heteropappus hispidus	1	14	Saussurea amara	1

2. Marginal meadow with *Agrostis mongolica+Poa angustifolia+Carex enervis* (distributed within project area). Canopy cover 87.4%, yield 1400 kg/ha. This is waterlogged marginal meadow formed by soil water infiltrated and run off from mountain slope. Heavy clay and muskeg soil. Increased moisture of soil can be better for grazing.

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopycover, %
1	Agrostis mongolica	50	12	Parnassia palustris	0.1
2	Poa angustifolia	10	13	Polygonum viviparum	0.1
3	Carex enervis	7	14	Potentilla anserina	5
4	Achillea asiatica	0.1	15	Potentilla multifida	0.1
5	Allium schoenoprasum	0.1	16	Ranunculus japonicus	3
6	Artemisia laciniata	0.1	17	Rumex thyrsiflorus	0.1
7	Cirsium esculentum	3	18	Sanguisorba officinalis	5
8	Erigeron acer	0.1	19	Silene repens	0.1
9	Gentian macrophylla	0.1	20	Taraxacum mongolicum	0.1
10	Lomatogonium carinthiacum	0.1	21	Vicia amoena	3
11	Oxytropis salina	0.1	22	Vicia cracca	0.1

3. Meadow with *Potentilla anserina+Carex ortostachys* (distributed over hilly areas far from river within project area where meadow soil is rich of moisture and good for grazing). Canopy cover 70.8%. yield 1680 kg/ha.

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopy cover, %
1	Agrostis mongholica	5	10	Inula britanica	1
2	Hordium brevisubultatum	0,1	11	Iris lactea	1
3	Carex ortostachys	15	12	Leontopodium campestre	0,1
4	Carex delicata	0,1	13	Plantago major	2
5	Artemisia mongolica	1	14	Polygonum aviculare	0,1
6	Carum carvi	0,1	15	Potentilla anserina	40
7	Cirsium esculentum	1	16	Ranunculus japonicus	0,1
8	Equisetum arvense	0,1	17	Sanguisorba oficinalis	1
9	Glaux maritima	0,1	18	Saussurea amara	2
			19	Taraxacum officinale	1

4. Steppe with *Artemisia adamsii+Artemisia frigida+Cleistogenes squarrosa+Leymus chinensis* (located in the northern part of the project area and heavily degraded by livestock and human activities). Canopy cover 44,7%.

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopy cover, %
1	Agropyron cristatum	3	7	Artemisia adamsii	12
2	Cleistogenes squarrosa	4	8	Artemisia frigida	7
3	Leymus chinensis	3	9	Artemisia pectinata	2
4	Stipa krylovii	2	10	Potentilla acaulis	3
5	Carex duriuscula	3	11	Potentilla bifurca	0.5
6	Arenaria capillaris	5	12	Sibbalsianthe adpressa	0.2

5. Mountain steppe with *Artemisia santolinifolia+Caragana leucophloea+Saxifraga spinulosa* (distributed in the southern part of the project area in the rocky mountain slope 45^0) which result in increased moisture in bottom of mountain. Canopy cover 65,9

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopy cover, %
1	Artemisia dracunculus	2.5	8	Helictotrichon schellianum	1.5
2	Artemisia santolinifolia	14	9	Larix sibirica	0.1
3	Caragana leucophloea	4	10	Rosa acicularis	1.5
4	Carex pediformis	1.4	11	Saxifraga spinulosa	3.5

5	Cotoneaster melanocarpa	1	12	Stipa krylovii	1
6	Dasiphora fruticosa	1	13	Stipa sibirica	1.5
7	Spiraea aquilegifolia	3	14	Thymus gobicus	2.0

6. Mountain steppe with *Stipa krylovii + Agropyron cristatum + Koeleria macrantha + Potentilla acaulis, Stellera chamaejasme, Artemisia frigida* (in the southern part of project area, in the limitation zone of Bogd khan SPA and distributed in southeastern side). Canopy cover 24.8%.

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopy cover, %
1	Stipa krylovii	5.0	15	Heteropappus altaicus	0.1
2	Arenaria capillaris	1.5	16	Leontopodium campester	0.1
3	Agropyron cristatum	3.5	17	Orostachys malocophylla	0.1
4	Koeleria macrantha	1.5	18	Oxytropis miriophylla	0.1
5	Carex pediformis	2.0	19	Patrinia rupestris	0.1
6	Adenophora stenanthyna	0.1	20	Pedicularis rubens	0.1
7	Alyssum lenense	0.1	21	Potentilla acaulis	2.5
8	Androsace incana	0.1	22	Pulsatilla bungeana	0.1
9	Androsace septentrionalis	0.1	23	Rumex acetosella	0.1
10	Artemisia frigida	3.5	24	Sanguisorba officinalis	0.1
11	Artemisia commutata	1	25	Sedum aizoon	0.1
12	Bupleurum scorzonerifolia	0.1	26	Silene jeniseensis	0.1
13	Dianthus versicolor	0.1	27	Stellera chamaejasme	1.5
14	Echinops dahuricus	0.1	28	Thymus gobicus	1.0

7. Meadow steppe with *Spiraea aquilegifolia+Stipa krylovii+Stipa baicalensis+Artemisia frigida* (in the southern part and limitation zone of Bogd khan mountain SPA and distributed in the northwestern side of the mountain). Canopy cover 41.4 %.

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopy cover, %
1	Agropyron cristatum	1,5	13	Iris tigrida	0,1
2	Cleistogenes squarrosa	1,5	14	Phlomis tuberosa	1,5
3	Koeleria macrantha	3	15	Potentilla acaulis	1,5
4	Poa attenuata	3	16	Potentilla bifurca	0,2
5	Stipa baicalensis	1,5	17	Potentilla sericea	0,2
6	Stipa krylovii	15	18	Saussurea salicifolia	0,3
7	Carex pediformis	1.7	19	Sibbaldianthe adpressa	0,2
8	Androsace incana	0,2	20	Silene repens	0,1

9	Arenaria capillaris	1,5	21	Spiraea aquilegifolia	3
10	Artemisia frigida	3,0	22	Stellaria chamaejasme	0,5
11	Artemisia scoparia	0,3	23	Taraxacum collinum	0,1
12	Echinops dahuricus	2,0	24	Veronica incana	1,0

8. Meadow with anophyte distributed along riverside and *Calamagrostis purpureum* distributed sparsely and marginal meadow *Geranium pseudosibiricum+Chamaenerion angustifolium+Sanguisorba officinalis* (in the southern part of project area and in the limitation zone of Bogd Khan mountain SPA and mountain spring meadow between mountain sides). Canopy cover 64,2%. Lichen and moss -25%. Total cover 89.2%

No	Plant scientific name	Canopy cover, %	No	Plant scientific name	Canopy cover, %
1	Aconitum barbatum	1	11	Poa pratensis	1
2	Calamagrostis purpureum	25	12	Sanguisorba officinalis	1.5
3	Chamaenerion angustifol.	5	13	Thalictrum minus	0.1
4	Elymus sibiricus	1	14	Trientalis europea	0.1
5	Equisetum pratensis	1	15	Trisetum sibiricum	1
6	Gallium boreale	1	16	Trollus asiaticus	1
7	Geranium pseudosibiricum	7	17	Urtica cannabina	1
8	Geranium sibiricum	0.1	18	Valeriana officinalis	1
9	Hyoscyamus niger	1		Хөвд:	
10	Peucedanum baicalense	0.1		Rhitidium rugosum	70% pattern
				Mnium sp	30% pattern

Conclusion. Near the proposed project area, there are several households with many livestock including cows, sheep, goat and horses; they use the vegetation in the area as livestock pastureland. Vegetation communities are degraded because of overgrazing and increase in soil nutrients (from animal dung), which in turn favor the ruderal (weed species such as Chenopodium album and Santonica) and decline of native and original grassland species.

5. References

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K.2 Fauna Survey Results

FAUNA BASELINE STUDY OF FOR PROPESED AREA of
CENTRAL HEATING PLANT
NATURE FRIENDLY

1. Study purpose and methodology

The purpose of this fauna baseline study is to identify fauna species, distribution, location, and protection status in the project proposed area and its surrounding environment, including the North Eastern part of “Bogdkhan Mountain”, “Bayanzurkh Mountain”, and “Tuul River” basin (Figure 1).

Field observations for fauna were conducted along three main routes (transects). The first transect covered a relatively large area, started at the far western side of the project site, continued along the valley crossing project site until the eastern side of the project side, then taking a south across Bogdkhan mountain zone (Figure 1). The coordinates for starting and finishing point of the first transect is N47°52’28.75’’/E107°07’25,70’’ (starting) and N47°51’22.69’’/E107°08’21,55’’ the transect was approximately 20 km in length. 10x50 zoom binoculars and 45x60 zoom fieldscope for bird transects were used during all the field observation.

The second route was conducted along the area northeast of the project site. The coordinates of the second observation route are N47°53’57.44’’/E107°04’44,89’’ (starting point) to N47°53’37.17’’/E107°02’43,07’’ (finishing point)(Figure 1) and the length of the transect was approximately 2.8 km. A more detailed map for the Project site and surrounding areas is included in Figure 2. The third transect was conducted on the western side of the project site, from N47°53’17.81’’/E107°03’06,61’’ to N47°51’56.00’’/E107°06’06,38’’, with an approximate total length of 2.4 km.

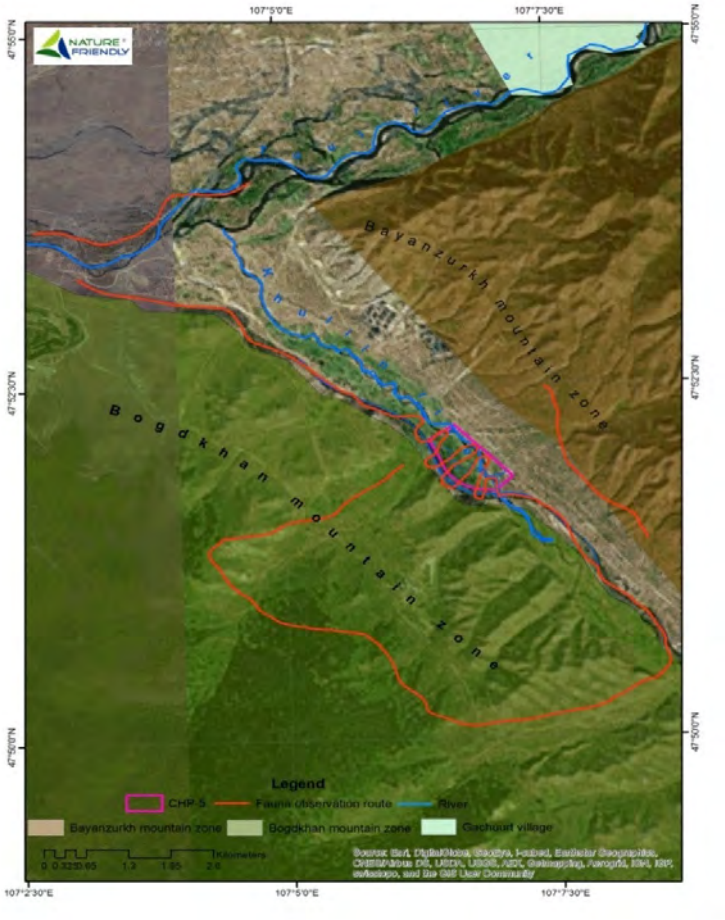


Figure 1. Fauna observation routes

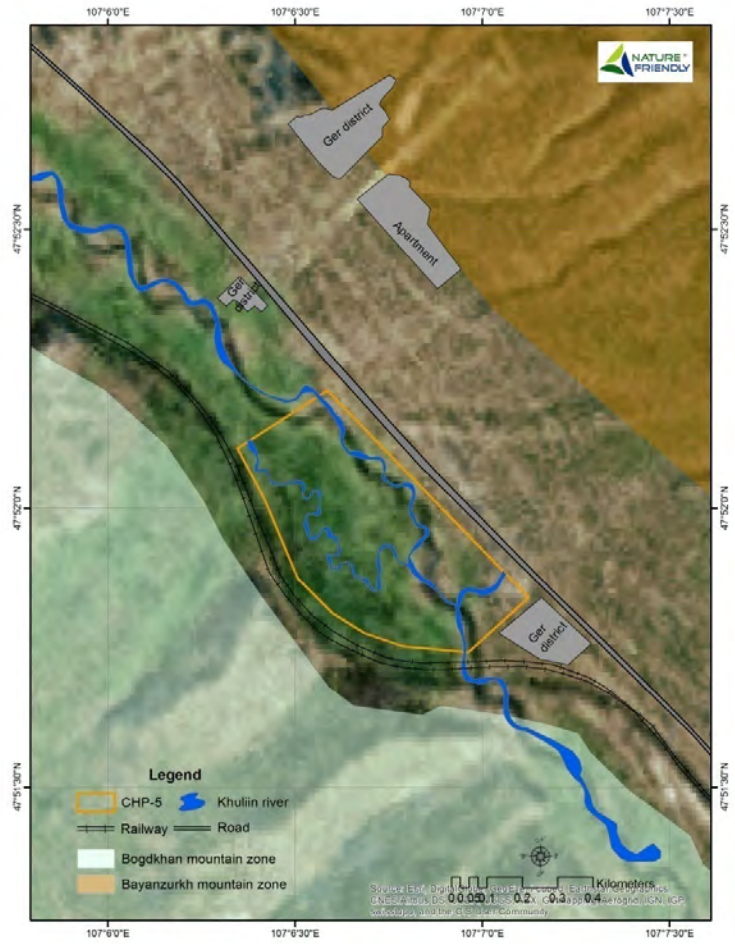


Figure 2. Project Site (zoomed in)

The field observations for fauna were conducted in October and November, 2013 and August 2014, and focused on birds and mammals. Reptiles and amphibians species were not active in October/November 2013 due to the cold weather. In August 2014, no reptiles, amphibians and fish were found in the Project site. The information on these species groups is therefore based on available literature.

The field observations were supplemented by a desktop study which included the following groups of species:

- Insects
- Fish
- Reptiles and amphibians
- Birds

- Mammals

The field study involved observation and detection for birds and mammals along transects. The study team detected and surveyed animal footprint, carrion and nests of birds (Boldbaatar 2002, Gombobaatar & Monks 2011). It is considered that additional bird surveys at a different time of year would not detect significant changes in species. Camera traps for mammals could not be used because the project site is grazed by many cattle and horses.

Data on amphibians and reptiles was based on other literature (e.g., *Munkhbayar, Terbish & Munkhbaatar,2010).*

The insect study data was drawn from "Bogdkhan Mountain" and "Tuul River" basin insect study report prepared by Insects study laboratory of the Mongolian Academy of Sciences. (*R.Enkhtuul,* 2008).

In addition to the findings of the field observations, this study used published studies conducted about Ulaanbaatar, and original study materials on the biodiversity status of "Bogdkhan Mountain". *(Batsaikhan 2010, Boldbaatar, 2002, Munkhbayar et al 2010, Tsendsuren 1987, Gombobaatar et al 2011, Uuganbayar personal notes 2010-2013).*

2. Fauna habitat

The project area is located between "Bogdkhan Mountain" Strictly Protected Area, "Gachuurt", and "Gorkhi – Terelj" National Park (Figures 3 and 4). Its biodiversity has preserved its features from both Mongolian Daurian Steppe and forest taiga of "Khan Khentii" Mountain Range. Due to enormous impacts caused by human settlement, autoroad and railway construction and operation which had been intensified since the mid of the past century, Bogdkhan mountain has been more isolated from the "Khan Khentii Mountain Range" including "Gachuurt" and "Gorkhi – Terelj" forest taiga, which has resulted in more fragmentation of the wildlife habitat.

Figure 3. Buffer zone of Study area (10 km)

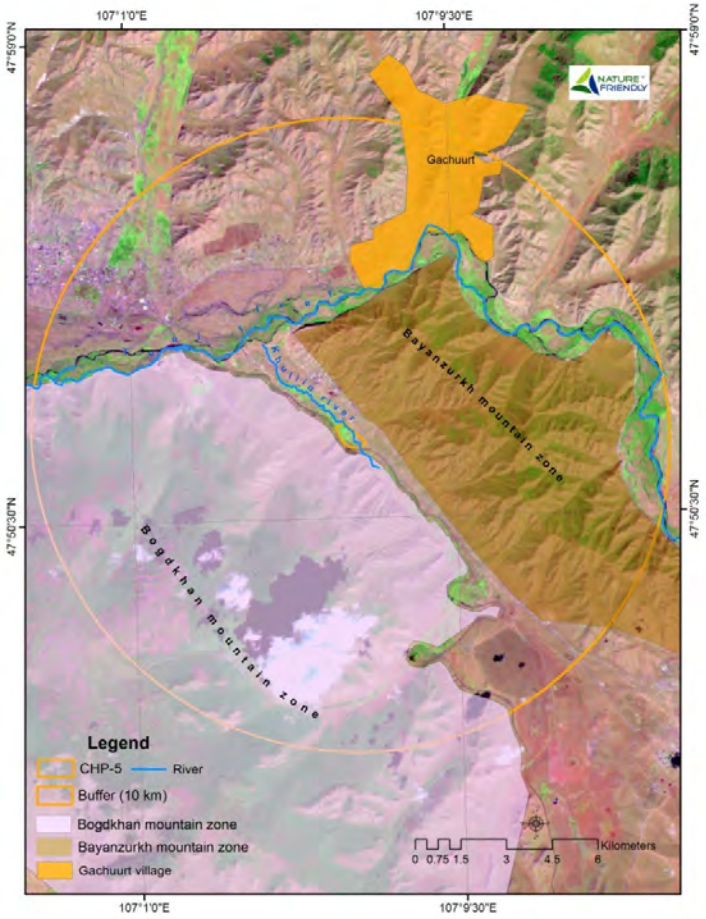
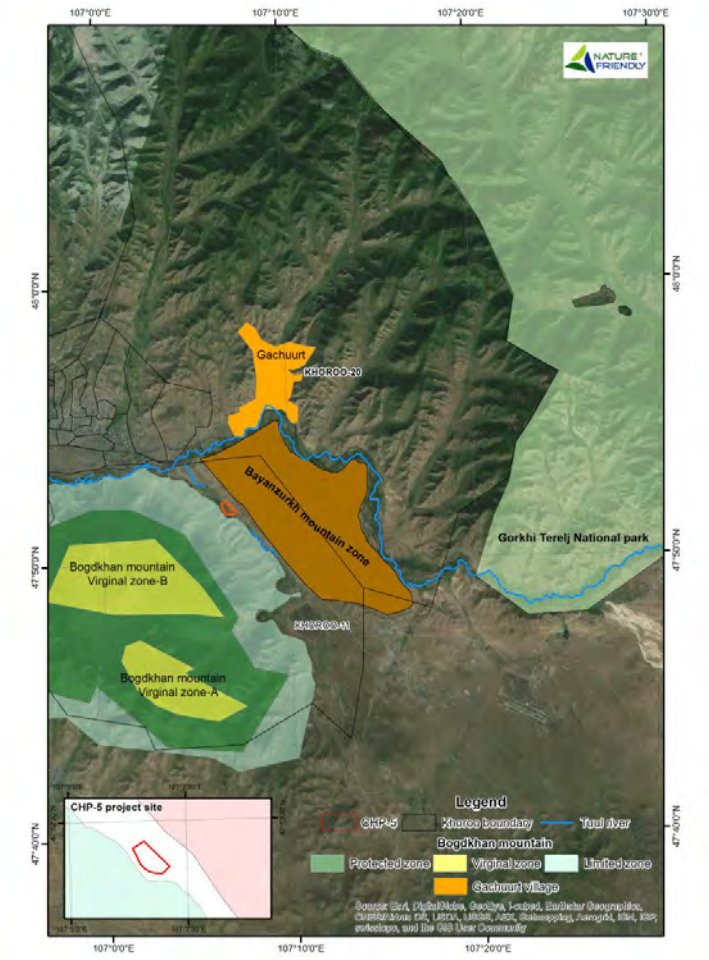


Figure 4. National Parks and SPAs in the vicinity of the project site



The project area is surrounded by auto paved roads and railway. It is located far from the “Tuul River” basin. There are no any woody or bushy plants near the project area. There is temporary open water resource called Khuliin river within the area. Therefore its biodiversity is highly dependent from that of “Bogdkhan Mountain” which is located approximately 2 km from the boundary of the nearest forest at the foot of “Bogdkhan Mountain”.

Populations of mammals, reptiles and amphibians are very few in project site. But birds are dependent on Bogd mountain. Birds seek food in project site but stay night in forest near the mountain. For instance *Corvus corax* and *Corvus dauricus* forage in open area and stay at night in forest. According to observations during this field study, bird species in the project area are also found in Bogdkhan mountain.

3. Fauna species

3.1 Fish Species

Khuliin River drains into Tuul River which is among the biggest rivers of Yenisei River basin. During field study of project site along Khuliin River in 2014, no fish species were observed.

However, it is entirely possible that some of fish species and their fry swim into Khuliin River during their growth stage. This should be taken into consideration while developing DEIA of the project.

Fish species ide (*Leuciscus idus*), common minnow (*Phoxinus phoxinus*), common roach (*Rutilus rutilus*), amur catfish (*Silurus asotus*), arctic grayling (*Thymallus arcticus*), sharp-snouted lenok (*Brachymystax lenok*), and taimen (*Hucho taimen*) are found in Tuul River (G.Baasanjav, Ya. Tsend-Ayush, Fish species of Mongolia, Ulaanbaatar, 2011). Anglers fish along Tuul River throughout the year (Figure 5).

Figure 5. Local fishing at Tuul River, August 2014

Upper fish Lenok, Tuul River X/11.2014
Under fish Arctic grayling, Tuul River X/11.2014

№	Scientific name	Mongolian name	English name	Status of Redlist Book of Mongolia
1	*Brachymystax lenok*	Зэвэг	Lenok	VU
2	*Thymallus arcticus*	Шивэр хадран	Arctic grayling	NT
3	*Barbatula toni*	Сахалт эрээлж	Siberian stone loach	LC

We captured 3 species of fishes from Tuul river at 47°53'14.76"N/106°55'23.83"E point.
Some of them possible to enter into small river of the construction site during the summer, Particularly Siberian stone Loach prefer shallow rivers, which one is Project site stream.

3.2 Insects

"Bogdkhan Mountain" strictly protected area contains 1660 insect species of 174 families and 16 orders. Out of which, 6 insect species are registered in Red Book of 2008 of "Bogdkhan Mountain". These include Apollo butterfly (*Parnassius Apollo*), Papilio xuthus (*Sinoprinceps xuthus*), swallowtail butterfly (*Papillo machaon*), elephant hawk moth (*Deilephila elpenor*), the narrow bordered bee hawk-moth (*Hemaris tityus*), and Odestus bumblebee (*Bombus modestus*).

Among the above mentioned insect species, apollo butterfly (*Parnassius Apollo*), swallowtail butterfly (*Papillo machaon*), elephant hawk moth (*Deilephila elpenor*), narrow bordered bee hawk-moth (*Hemaris tityus*) and Odestus bumblebee (*Bombus modestus)* are included as rare species in the both Redbook of Mongolia (2013) and Annex #1 of Governmental Act #7 of 2012. Moreover, Apollo butterfly (*Parnassius Apollo*) is listed in Annex 2 of CITES. However, there are limited information and regulations in Mongolia on how these species should be protected, as well as their distribution and population in the Redbook (for more information, please refer to Redbook of Mongolia, 2013).

Out of the 1660 insect species mentioned in the first paragraph, *Orthoptera, Diptera, Coleoptera,* and *Lepidoptera* are mainly found in less vegetated steppe area and therefore they

may occur in the project area. Because O*rthoptera* insects increase in abundance during warm seasons, some insectivore birds such as jackdaw, rook, and sparrows gather in the area. The project area has no habitat for rare insect species and therefore occurrences for rare species are considered to be low in the project area. Due to the active feeding of Jackdaws, Choughs and Crows, insect species and their population are considered to be very low in the Project site. Two insect species recorded on site during the surveys in August 2014 are illustrated in Figures 6A and 6B below.

Figure 6A.

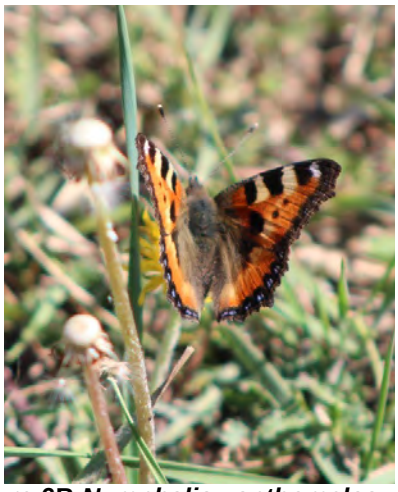


Figure 6B.*Nymphalis xanthomelas,* August 2014

3.2 Amphibians and reptiles

Mongolian toad (*Bufo raddei)*, the Mongolian racerunner (*Eremias argus)* and Halys viper (*Gloydius halys)* may inhabit in the project area (Munkhbayar, 2010). The main habitat for Mongolian toad (Bufo raddei) is water and wetland. The distribution and abundance of this species increase following breeding time and flood event. The power plant will be located 5 km south to Tuul river basin and is crossed by seasonal running riverbed fed by runoff from Bogd Mountain. Mongolian toad (*Bufo raddei)* is distributed along the river basin in wet areas in the rainy season, especially August. In other words, runoff plays a role in its distribution.

Mongolian racerunner (*Eremias argus)* and Halys viper (*Gloydius halys)* are reptiles that are adapted to different types of habitat, but prefer dry and warm slopes. The project site, on the other hand, is river meadow with high humidity, and therefore, these species might occur with accidental nature. Furthermore, these species have wide distribution and large population, and for this reason, these three species are not listed in the Redbook of Mongolia, 2013, as well as in Government Act #7 of 2012. . Furthermore, none of the species mentioned are endemic to Mongolia.

Siberian Salamander (*Salamandrella keyserlingii*) is listed as a rare species in the Redbook of Mongolia, 2013, as well as in Annex #1 of Government Act #7 of 2012. On the IUCN Redlist of Threathened Species, Siberian Salamander is listed as least concern due to its wide distribution (IUCN, 2014). Tuul river basin belongs to its distribution range. The protection measures include creation of Strictly Protected Areas and National Parks such as Khan Khentii SPA, Bogdkhan Mountain SPA, and Khuvsgul Lake National Park.

3.3 Birds

The project site is located in 5 km of distance from Tuul River" basin. Nesting, hiding and living habitat for birds lack in the project area. A small stream runs through the construction site, which provides drinking water source for birds. Habitats for birds are weak and limited. . Few species of birds found along the river basin occur in the project area. Bird species in the project area are mainly forest birds of "Bogdkhan Mountain" and "Bayanzurkh Mountain".

Depending on habitats, bird species of the project area can be classified as follow:

- Species that favor road, constructions and human settlements
- Species that favor steppe and open area
- Species from coniferous forest

Bird species were identified from observation study results conducted during October and November of 2013, researchers' private observation notes, and published sources (Boldbaatar, 2002; Gombobaatar, 2011). In total, 39 bird species are distributed in the project area, forest zone and the nearby forest in the protected area. Out of 24 resident bird species listed in Table 1, rock dove (*Columba livia*), Eurasian skylark (*Alauda arvensis*), Horned lark (*Eremophila alpestris*), Common magpie (*Pica pica*), Red-billed chough (*Pyrrhocorax pyrrhocorax*), Daurian jackdaw (*Corvus dauuricus*), The Rook (Corvus frugilegus), Carrion crow (*Corvus corone*), Corvus corax, and steppe sparrow occur in the area. The other resident birds in Table 1 are distributed in the neighboring "Bogdkhan Mountain".

Table 1. Resident bird species in and near the project area

№	Species name	Scientific name	IUCN international	Red list status in Mongolia
1	Hill Dove	*Columba livia*	LC	LC
2	Daurian Partridge	*Perdix dauurica*	LC	LC
3	Ural Owl	*Strix uralensis*	LC	LC
4	Great Spotted Woodpecker	*Dendrocopos major*	LC	LC
5	Lesser Spotted Woodpecker	*Dendrocopos minor*	LC	LC
6	Black Woodpecker	*Dryocopus martius*	LC	LC
7	Eurasian Skylark	*Alauda arvensis*	LC	LC
8	Horned Lark	*Eremophila alpestris*	LC	LC
9	Common Magpie	*Pica pica*	LC	LC
10	Nutcracker	*Nucifraga caryocatactes*	LC	LC
11	Red-billed Chough	*Pyrrhocorax pyrrhocorax*	LC	LC
12	Daurian Jackdow	*Corvus dauuricus*	LC	LC
13	The Rook Crow	*Corvus frugilegus*	LC	LC
14	Carrion Crow	*Corvus corone*	LC	LC
15	Crow	*Corvus corax*	LC	LC
16	The Great Tit	*Parus major*	LC	LC
17	Willow Tit	*Parus montanus*	LC	LC

18	Eurasian Tree Sparrow	*Passer montanus*	LC	LC
19	House Sparrow	*Passer domesticus*	LC	LC
20	The Common Rosefinch	*Carpodacus erythrinus*	LC	LC
21	The Red Crossbill	*Loxia curvirostra*	LC	LC
22	Two-barred Crossbill	*Loxia leucoptera*	LC	LC
23	Eurasian Bullfinch	*Pyrrhula pyrrhula*	LC	LC
24	Eurasian Nuthatch	*Sitta europaea*	LC	LC

Out of 15 migratory bird species which stay in summertime (Table 2), black kite (*Milvus Migrans*), Common Swift (*Apus apus*), Pacific Swift (*Apus pacificus*), Hoopoe (*Upupa epops*), White Wagtail (*Motacilla alba*), Northern Wheatear (*Oenanthe oenanthe*), and Isabelline Wheatear (*Oenanthe isabellina*) are dominant in the project area. Other bird species occur rarely during their hunting or migration period.

Table 2. Migratory birds that breed and stay during summer

№	**English name**	**Scientific name**	**Globally redlist IUCN олон улс**	**Mongolian Redlist IUCN бүс нутаг**
1	Black kite	*Milvus migrans*	LC	LC
2	Amur Falcon	*Falco amurensis*	LC	LC
3	Common kestrel	*Falco tinnunculus*	LC	LC
4	Cuckoo	*Cuculus canorus*	LC	LC
5	Common Swift	*Apus apus*	LC	LC
6	Pacific Swift	*Apus pacificus*	LC	LC
7	Hoopoe	*Upupa epops*	LC	LC
8	Blyth's Pipit	*Anthus godlewskii*	LC	LC
9	White Wagtail	*Motacilla alba*	LC	LC
10	Tree Pipit	*Anthus trivialis*	LC	LC
11	Northern Wheatear	*Oenanthe oenanthe*	LC	LC
12	Isabelline Wheatear	*Oenanthe isabellina*	LC	LC
13	Daurian Redstart	*Phoenicurus auroreus*	LC	LC
14	Dark-throated Thrush	*Turdus ruficollis*	LC	LC
15	Pine Bunting	*Emberiza leucocephalos*	LC	LC

Species such as Rock dove, Common Magpie, Red-billed Chough, Daurian Jackdow, Carrino Crow, Corvus Corax, Steppe Sparrow, Eurasian Tree Sparrow, Black Kite, Hoopoe, White Wagtail, and Isabelline Wheatear are quite synanthropic birds. They could nest in the plant facilities and constructions. No threatened or protected species (Redbook of Mongolia, 2013, Annex #1 of Government Act #7 of 2012) of birds or habitats for rare species have been recorded in the project area.

Some years experience much snow in the project area. In such condition, populations of bird species that depend on the ground for food source may decrease. Bird species including Ural Owl, Great Spotted Woodpecker, Lesser Spotted Woodpecker, Nutcracker, Marsh Tit, Common Rosefinch, Red Crossbill, Two-barred Crossbill, Eurasian Bullfinch, Eurasian Nuthatch, Falco

amurensis, Cuckoo, and Daurian Redstart inhabit in the forest area near the project site. These species are commonly distributed and are not protected or threatened.

A total 205 bird species of 14 orders have been recorded to date within the "Bogdkhan Mountain". Out of which, 51 are resident and 143 are migratory species[1].

The previous bird surveys undertaken within the Bogd Khan Mountain include**:**

1. Report of the project "Comprehensive study of ecosystem and it's protection of Bogdkhan mountain" Administation office of Bogdkhan SPA, *1995*
2. Birds conservation management of Bogdkhan mountain, Report of MNE funded project Ecosystem protection and rehabilitation management of Bogdkhan mountain*, 2004* Report of flora and fauna study of Bogdkhan mountain. *Administation office of Bogdkhan SPA and Department of Biology, National University of Mongolia, 2008*

These migratory and non-migratory bird species' structure and population of the strictly protected area are similar to those from "Khan Khentii Mountain", "Gorkhi-Terelj Area", "Gachuurt" and "Bayanzurkh Mountain". The main reason is that settlements, road or railroad transportation which primarily prevent mammals distribution have relatively lower negative impacts on birds.

The project area is located along the potential main area where bird movement may be intensive between "Bogd Mountain" and "Gachuurt" or "Gorkhi –Terelj" because this is the shortest way for birds. But there is a lack of research materials or data.

"Bogdkhan Mountain" supports threatened and rare bird species such as White-tailed eagle (*Haliaeetus albicialla*) and Tree Pipit (*Anthus trivialis*) classified as "Near Threatened" (or NT) and Bearded Vulture (*Gypaetus barbatus*) which is classified as "Vulnerable" according to the international IUCN criteria. Bearded Vulture (*Gypaetus barbatus*) is a rare species occurring in the Bogdkhan Mountain and is listed in Mongolian Redbook 2013, and the Annex #1 of Government Act #7 of 2012, and Annex 2 of CITES. The species mentioned above are distributed in Bogdkhan mountain and its surrounding areas such as valleys and rocky mountains. The project area has no habitat for nesting and breeding for the rare species but these may cross the project area during migratory time.

3.4 Mammals

Mammal species distribution is sparse along the central heating plant construction territory. During field observation, no mammal species were observed, potentially due to lack of nesting site and habitat for mammals. The project area has potential to support mammal species such as Mongolian five-toed jerboa (*Allactaga sibirica*), Narrow-headed vole (*Microtus gregalis*), and Long-tailed ground squirrel (*Spermophilus undulatus*). However, no mammal species was recorded on the Project site during the 2013 and 2014 surveys, and this is believed to be because of the lack of suitable refugia and breeding habitat.

[1] www.bogdkhanuul.mn Official administration site of BogdKhan SPA

These species have wide distribution and are classified as Least Concern according to redlisting of mammals in Mongolia. On the other hand, “Bogdkhan Mountain” is comparatively rich in mammal species. A total of 50 mammal species have been recorded on the Bogdkhan Mountain, but brown bear (Ursus arctos), wolverine (Gulo gulo) and mole-rat (*Myospalax aspalax*) went extinct due to habitat fragmentation (R. Enkhtuul, 2008). Siberian chipmunk was recorded in forest the Bogdkhan Mountain during the October/Novermber 2013 surveys.

Although mammal species distributed along the steppes of the “Bogdkhan Mountain”, river or spring valleys of the mountain pass, and coniferous forest might potentially use the project area, this is considered very unlikely because of human settlements, road traffic, railway fences, and the lack of suitable habitat.

According to the previous studies, “Bogdkhan Mountain” supports around 13 threatened species which are on the IUCN or Mongolian red lists (Table 3). Some species, for instance; Siberian ibex (Capra sibirica) has been relocated in this territory (Figure 3). Siberian musk deer is very unlikely to occur in the Project site or surrounding areas because the movement of the animals is prevented because of the railway fences (see Figure 8).

Figure 7. Reintroduction of *Siberian Ibex* in “Bogdkhan Mountain”

Source: http://www.bogdkhanuul.mn/node/65

Table 3. Threatened and rare mammal species occuring in “Bogdkhan Mountain”

№	Scientific name	English name	International redlist status	Mongolian redlist status
1	*Cervus elaphus*	Red deer	LC	CR
2	*Capreolus pygargus*	Siberian roe deer	LC	LC
3	*Moschus moschiferus*	Siberian musk deer	VU	EN
4	*Capra sibirica*	Siberian ibex	LC	NT
5	*Sus scrofa*	Wild boar	LC	NT
6	*Vulpes vulpes*	Red fox	LC	NT
7	*Vulpes corsac*	Corsac fox	LC	NT
8	*Canis lupus*	Grey wolf	LC	NT
9	*Otocolobus manul*	Palla’s cat	NT	NT
10	*Lynx lynx*	Lynx	NT	NT
11	*Sciurus vulgaris*	Eurasian red squirrel	NT	NT

12	*Marmota sibirica*	Tarbagan marmot	LC	ENin
13	*Martes zibellina*	Forest sable	LC	VU

Figure 8. Railway fences bordering southern side of the construction site

In addition, 27 mammal species which are most commonly distributed along Mongolian forest taiga region also occur in “Bogdkhan Mountain” strictly protected area (Table 4). “Bogdkhan Mountain” is considered to be an important territory for Mongolian mammal species conservation.

Table 4. Other mammal species distributed along “Bogdkhan Mountain”

№	Scientific name	Species name	IUCN international	Mongolian Red List
1	*Mustela sibirica*	Siberian weasel	LC	LC
2	*Mustela nivalis*	Least weasel	LC	LC
3	*Mustela eversmannii*	Steppe polecat	LC	LC
4	*Mustela ermine*	Stoat	LC	LC
5	*Mustela altaica*	Altai weasel	LC	LC
6	*Meles meles*	European badger	LC	LC
7	*Vespertilio murinus*	Particolored bat	LC	LC
8	*Myotis mystacinus*	Whiskered bat	LC	LC
9	*Eptesicus nilssoni*	Northern bat	LC	LC
10	*Myotis daubentonii*	Daubenton’s bat	LC	LC
11	*Mesechinus dauuricus*	Daurian hedgehog	LC	LC
12	*Lepus tolai*	Tolai hare	LC	LC
13	*Lepus timidus*	Mountain hare	LC	LC
14	*Ochotona hyperborean*	Northern pika	LC	LC
15	*Ochotona dauurica*	Daurian pika	LC	LC
16	*Apodemus peninsulae*	Korean field mouse	LC	LC
17	*Microtus gregalis*	Narrow-headed vole	LC	LC

18	*Lasiopodomys brandti*	Brandt vole	LC	LC
19	*Clethrionomys rutilus*	Northern red-backed vole	LC	LC
20	*Clethrionomys rufocanus*	Grey red-backed vole	LC	LC
21	*Alticola semicanus*	Mongolian silver vole	LC	LC
22	*Phodopus campbelli*	Campbelli's hamster	LC	LC
23	*Cricetulus longicaudatus*	Long-tailed dwarf hamster	LC	LC
24	*Cricetulus barabensis*	Striped dwarf hamster	LC	LC
25	*Allactaga sibirica*	Mongolian five toed jerboa	LC	LC
26	*Tamias sibiricus*	Siberian chipmunk	LC	LC
27	*Spermophilus undulates*	Long-tailed ground squirrel	LC	LC

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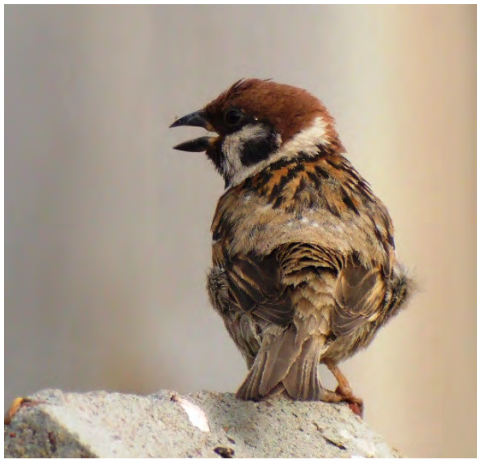
APPENDIX I

1.1 Bird species observed at the project area

Horned Lark (*Eremophila alpestris*)



Tree Sparrow (*Passer montanus*)

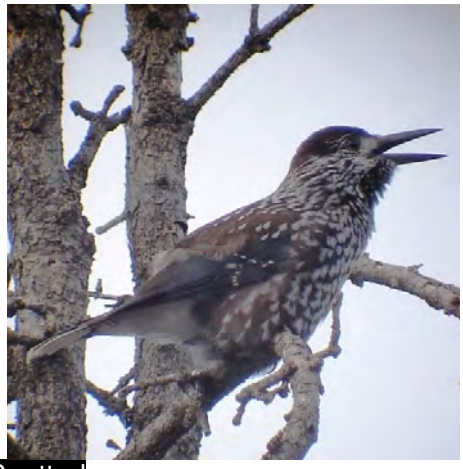
Hill Pegion (*Columba livia*)

Daurian Jackdaws (*Corvus dauuricus*)

1.2 Bird species recorded along the borders of "Bogdkhan Mountain" (diurnal) upper part of the project implementing territory

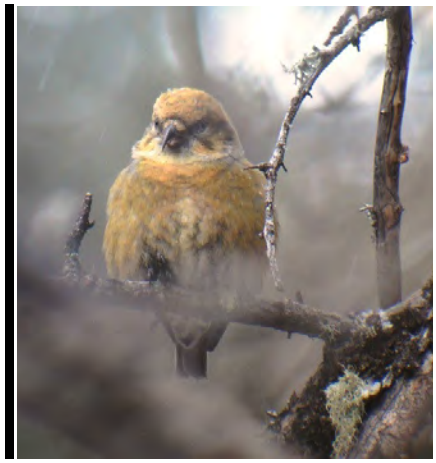
Black Kite (*Milvus migrans*)

Great Spotted Woodpecker (*Dendrocopos major*)



Spottod

Spotted Nutcraker (*Nucifraga caryocatacte*



Female Crossbill (*Loxia curvirostra*)

Willow Tit (*Parus montanus*)

1.3 Observed birds in the construction site, August 16 2014

Red billed Chough (*Pyrrhocorax pyrrhocorax)*

Thousands of Daurian Jackdaws was feeding during midday

Black Kite (*Milvus migrans*)

Northern Wheatear (*Oenanthe oenanthe)*

Domestic animals grazing in the construction site

Horses at the construction site

Appendix L. Mongolian Water Laws and Standards

L.1 Law on Water (2012, amended 2015)

The purpose of this law is to regulate the relations associated with protection, proper utilisation and restoration of water resources and their basins. It enshrines the Integrated Water Resources Management approach in law and obliges the Mongolian government to manage water in an equitable, economical and sustainable manner. The law also provides for the oversight regarding water resources exploitation, permitting and enforcement including liabilities for breaching the law.

The law gives the powers and obligations of the State Administrative Central Body in charge of Environment, the Ministry of Environment and Green Development (MEGD) in regards to overseeing the implementation of the law.

Article 11 states that the Citizen's Representatives Khural of Aimags, Capital City, Soums and Districts also have powers related to water management. These include discussing and endorsing plans and programs with regards to protection and effective use of water resources, restoration of water resource areas, and prevention from water disaster; to make decisions over taking water sources under local protection based on the governor's request, and to delineate boundary of protection zones; and to establish special and common protection zones and sanitary zones of water fund areas and water sources, and boundary of feed zone of water supply sources.

The Aimag and Capital City governors also have powers related to the management of water as do the Soum and District governors and the Citizen's Representatives Khural of Baghs and Khoroos Bagh and Khoroo governors, although the latter is to a lesser extent. The law provides for the establishment of Basin Administrations for each designated river basin to coordinate planning and implementation of the law and for the Environmental Department of the Capital city and Aimags regarding administration and enforcement; and Soum and Bagh Environmental Rangers regarding local enforcement.

The law makes it clear that it is the MEGD that shall make the decision regarding the primary water use permit for the Project, as under Article 28.4 it has jurisdiction over water use permits of more than 100m^3 per day for the purposes of energy and water transport. The Basin Administration issues the permits for uses over 100m^3 a day following the decision of the Ministry. The Basin Administration decides on permits from 50 up to 100m^3/d, and the Aimag and Capital City Environment Department decides on permits up to 50m^3/d and the establishment of ponds and water catchments accumulating rain and snow water, and building of trenches and channels.

A water use permit is granted to citizens, entities and organizations for up to 10 years, and it can be extended for up to 5 years. To obtain a permit, project proponents (such as the CHP5 operator) must submit the following documents:

- A map of water source to use, or source of mineral water, and their location
- A report of exploration and research identified quality and compound of water and mineral water, and conclusion on the potential usable reserve
- A quantity and purpose of daily water use
- A drawing of construction and facility

- A production capacity, and technical and economic parameters
- A report and conclusion of environmental impact assessment.

Foreign citizens, entities and organizations are prohibited to conduct research and survey related to water and water resource areas without authorization of the state administrative body in charge of water. Exploration and research to determine water resources and potential usable reserve are to be conducted with state budget funding.

Article 10 states that the State Administrative Central Body in charge of Environment shall exercise powers in relation decision making over changing river courses as it is prohibited under the law to change the natural course of rivers without the central body's permission.

Of particular relevance for any development in a valley or near a water source, are the provisions under Article 22 that provide for the establishment of Special Protection Zones (SPZs), Common Protection Zones and Sanitary Zones. The Protection Zones shall consist of prohibition zones and restriction zones determined by the distance from the water sources. Amongst other activities it is prohibited to construct any building or infrastructure facility in SPZs (with the exception of power plants, water supply facilities, sewage treatment facilities, bridges, roads, transmission lines, drinking water pipelines).

L.2 Law on Water Pollution Fees (2012)

The Law on Water Pollution Fees regulates the fees to be paid by the water polluter to the State budget in the event of water pollution, depending on the polluting substance, quantity and the ecological-economic assessment for the water basin.

L.3 Mongolian Standards

The Mongolian standards considered to be relevant to the water aspects of the Project are summarised in Table L.1.

Table L.1: List of Relevant Standards

Mongolia Standard	Year
MNS 4586: Indicator of water environment quality. General requirements	1998
MNS (ISO) 4867: Water quality. Sampling third part. Recommendation for storage and protection	1999
MNS 3342: General requirements for protection of groundwater	1982
MNS 4943: Water quality. Effluent standard.	2011

The effluent wastewater quality standards are defined in MNS 4943: 2011 and are summarised in Table L.2. The effluent wastewater quality standards issued in 2000 have now been superseded by the 2011 effluent wastewater quality standards.

Table L.2: Effluent discharge standards

Indicator	Unit	Limits
Water temperature	C^o	20
pH	-	6-9
Odour	Sense	No smell
Total Suspended Solids (TSS)	mg/l	50
BOD	mg O_2/l	20
COD	mg O_2/l	50
Permanganate oxidizing capacity	mg O_2/l	20
Total Dissolved Solids (TDS)	mg/l	1,000 *
Ammoniacal Nitrogen (NH_4)	mg N/l	6
Total Nitrogen (TN)	mg/l	15
Total phosphorous (TP)	mg/l	1.5
Organic phosphorous (DOP)	mg/l	0.2
Hydrogen sulphide (H_2S)	mg/l	0.5
Total iron (Fe)	mg/l	1
Aluminium (Al)	mg/l	0.5
Manganese (Mn)	mg/l	0.5
Total Chromium (Cr)	mg/l	0.3
Hexavalent chromium (Cr^{6+})	mg/l	Absent
Total cyanide (CN)	mg/l	0.05
Free cyanide	mg/l	0.005
Copper (Cu)	mg/l	0.3
Boron (B)	mg/l	0.3
Lead (Pb)	mg/l	0.1
Zinc (Zn)	mg/l	1
Cadmium (Cd)	mg/l	0.03
Antimony (Sb)	mg/l	0.05
Mercury (Hg)	mg/l	0.001
Molybdenum (Mo)	mg/l	0.5
Total Arsenic (As)	mg/l	0.01
Nickel (Ni)	mg/l	0.2
Selenium (Se)	mg/l	0.02
Beryllium (Be)	mg/l	0.001
Cobalt (Co)	mg/l	0.02
Barium (Ba)	mg/l	1.5
Strontium (Sr)	mg/l	2
Vanadium (V)	mg/l	0.1
Uranium (U)	mg/l	0.05
Oil and grease	mg/l	1

Indicator	Unit	Limits
Fat	mg/l	5
Surface active agents	mg/l	2.5
Phenol (C_6H_5OH)	mg/l	0.05
Trichloroethylene (C_2HCl_3)	mg/l	0.2
Tetrachloroethylene	mg/l	0.1
Chlorine remains (Cl)	mg/l	1
Bacteria triggering water-borne disease	-	Absent in 1mg of water

Source: MNS 4943:2011
Note: * - Level can be higher depending on primary mineralization of source water. It is allowed to be up to 20% of the natural content in case if the source water is polluted by mineral.

Effluent from the plant will be discharged into the sewerage system controlled by Sewerage Authority of Ulaanbaatar City (USUG). Effluent limits specified by USUG are presented in Table L.3.

Table L.3: USUG standard on maximum acceptable composition level of industrial wastewater is released to the sewage system

Indicator	Unit	Limits
Suspended solids	mg/l	407
Biochemical oxygen demand	mg O_2/l	200-400
Chemical oxygen demand	mg O_2/l	400-800
Copper (Cu)	mg/l	0.5-1.0
Petroleum and Petrochemicals	mg/l	0.07-0.1
Sulfate	mg/l	1355-1500
Hydrogen sulphide (H2S)	mg/l	10
Nickel (Ni)	mg/l	0.5-0.65
Lead (Pb)	mg/l	0.07
Chromium with hexavalence (Cr6+)	mg/l	0.27-0.5
Total chromium (Cr)	mg/l	2.5-5
Zinc (Zn)	mg/l	1
All kind of detergents	mg/l	5-10
Phenol (C6H5OH)	mg/l	0.5-1
Cadmium (Cd)	mg/l	0.032-0.1
Cyanide	mg/l	0.08-1.5
Ammonia	mg/l	10-15
Total nitrogen	mg/l	30
pH	-	6.5-8.5
Chloride	mg/l	905-1000
Iron (Fe)	mg/l	0.27-1.0
Hydroquinone	mg/l	0.2

Indicator	Unit	Limits
Blue vat dyes (synthetic)	mg/l	25
Brown vat dyes (sulphur)	mg/l	0.45
Temperature	o C	15-40
Arsenic (As)	mg/l	0.1
Mercury	mg/l	0.005
Cobalt (Co)	mg/l	0.1
Plants oil and animal oil	mg/l	10-25
Silver (Ag)	mg/l	2
Selenium (Se)	mg/l	0.1
Organic phosphorus compounds	mg/l	0.4
Chlorinated hydrocarbon	mg/l	0.04
Aluminium (Al)	mg/l	0.5

Source: USUG

The Mongolian Standard outlining the general requirements for protection of groundwater (MNS 3342, 1982) indicates that the contamination of groundwater with industrial raw materials, products and municipal wastes during transportation and storage is prohibited. Relevant requirements in the standard include:

1. Raw materials and products for industrial and municipal waste storage tanks with potential to contaminate groundwater resources should comply with following:
    a. Geological - hydrogeological investigations of the storage tank construction, potential soil infiltration estimates of geological materials, groundwater protection measures to be developed based on the amount and characteristics of the chemicals stored.
    b. Storage tanks to be tested for leakage prior to use.
    c. For areas at the base of mountains, loops of rivers, river beds and highly fractured parts of geological sediments which are used for drinking water, storage tanks cannot be established in these regions.
2. In case of ground water contamination due to accidents, the damaged area should be protected, spill gathered without further distribution, the prohibition of drinking water collection from this area, and quick organisation and removal of traces of contamination.
3. In the event of ground water pollution or when the contamination reaches dangerous levels, the method of observation and control will depend on the ground water quality, its intended use and the potential consequences of the pollution.

Appendix M. Air quality standards in the Asia region

Table M.1: Summary of existing air quality standards in the Asia region

	$PM_{2.5}$		PM_{10}		TSP		SO_2			NO_2		
Countries	24 hr	Annual	24 hr	Annual	24 hr	Annual	1 hr	24 hr	Annual	1 hr	24 hr	Annual
Afghanistan	-	-	-	-	-	-	-	-	-	-	-	-
Bangladesh	65	15	150	50	-	-	-	365	80	-	-	100
Bhutan (Mixed)	-	-	100	60	200	140	-	80	60	-	80	60
Brunei Darussalam	-	15	150	40	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	330	100	500	300	100	300	100	-
PR China: Grade I[1]	35	15	50	40	120	80	150	50	20	200	80	40
PR China: Grade II[1]	75	35	150	70	300	200	500	150	60	200	80	40
Fiji			50				350			200		
Hong Kong SAR	75	35	100	50	-	-	-	125	-	200	-	40
India[2]	60	40	100	60	-	-	-	80	50	-	80	40
India[3]	60	40	100	60	-	-	-	80	20	-	80	30
Indonesia	65	15	150	-	230	90	900	365	60	400	150	100
Iran	25	10	50	20				96.94	18.34			39.48
Japan	35	15	100*	-	-	-	261.6	104.64	-	-	75-113	-
Lao PDR	-	-	120	50	330	100	780	300	100	320	-	-
Malaysia[4]	-	35	150	50	260	90	350	105	-	320	75	-
Mongolia	**50**	**25**	**150**	**50**	**150**	**100**	**-**	**20**	**10**	**85**	**40**	**30**
Myanmar	-	-	-	-	-	-	-	-	-	-	-	-
Nepal	40	-	120	-	230	-	-	70	50	-	80	40
Pakistan	35	15	150	120	500	360	-	120	80	-	80	40
Philippines	75	35	150	35	230	90	-	180	80	-	150	-
Philippines[5]	50	25	150	60	230	90	-	180	80	-	150	-
Republic of Korea	50	25	100	50	-	-	392	131	52	188	113	56
Singapore[6]	37.5	12	50	20	-	-	-	50	15	200	-	40
Singapore[7]	25	10	50	20	-	-	-	20	-	200	-	40
Sri Lanka	50	25	100	50	-	-	200	80	-	250	100	-
Thailand	50	25	120	50	330	100	780 (0.3	300 (0.12	100 (0.04 ppm)	320 (0.17	-	57 (0.03 ppm)

Countries	$PM_{2.5}$		PM_{10}		TSP		SO_2			NO_2		
	24 hr	Annual	24 hr	Annual	24 hr	Annual	1 hr	24 hr	Annual	1 hr	24 hr	Annual
							ppm)	ppm)		ppm)		
Vietnam	50	25	150	50	200	140	350	125	50	200	-	40

Note: Units are in $\mu g/m^3$, unless otherwise stated

SAR = Special Administrative Region; PDR = People's Democratic Republic; Pb = lead; PM_{10} = Particles with aerodynamic particle diameters of 10 µm or less; $PM_{2.5}$ = Particles with aerodynamic particle diameters of 2.5 µm or less; China: Grade I = Special protection areas, nature reserves and scenic areas Grade II = applies to residential areas, mixed commercial/residential areas, cultural, industrial, and rural areas; [1]= GB3095-2012 | National implementation in 2016; [2] = NAAQS for Industrial, Residential, Rural, and Other Areas; [3] = NAAQS for Ecologically Sensitive Areas (notified by Central Government); [4] = Interim target for 2015 [5] = DAO 2013-13 | $PM_{2.5}$ strengthened in 2016; [6] = Singapore targets by 2020; [7] = long term targets.

*Defined as airborne particles that pass through a size-selective inlet with a 100 percent efficiency cut-off at 10 µm aerodynamic diameter.

Sulfur dioxide (SO_2) Conversion factor for ppb to $\mu g/m^3$: 2.616

Nitrogen dioxide (NO_2) Conversion factor for ppb to $\mu g/m^3$: 1.880

Source: Clean Air Asia, 2015 [collected from various sources].