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Introduction

The Alberta Energy Regulator (AER) ensures the safe, efficient, orderly, and environmentally responsible development of hydrocarbon resources over their entire life cycle. This includes allocating and conserving water resources, managing public lands, and protecting the environment while providing economic benefits for all Albertans.

In January 2014, a panel of AER hearing commissioners conducted an inquiry into odours and emissions from heavy oil and bitumen operations in the Peace River area of Alberta, referred to in this report as the Peace River proceedings. On March 31, 2014, the panel released *Decision 2014* ABAER 005: Report of Recommendations on Odours and Emissions in the Peace River Area (Alberta Energy Regulator, 2014).

One of the panel's findings was that there was insufficient data with respect to the geology and petroleum chemistry of the heavy oil and bitumen in this area, resulting in the following recommendation:

That the AER conduct or require operators in the Peace River area to submit a geochemical analysis of the volatile compounds from the heavy oil from the Gordondale-sourced bitumen at surface prior to processing

In addition to identifying a need for new data, the panel put forward a hypothesis: increased odours in the Peace River Oil Sands (PROS)

area could be directly related to "higher levels of sulphur and volatile components" (Alberta Energy Regulator, 2014) in the oils, likely related to the contribution of Gordondale-sourced hydrocarbons.

The present study was initiated to help determine how and where such geochemical analyses would take place. This includes determining what components to analyze for, the methodologies of the analytical tests, sample collection methodology, the number of samples to collect, and the location of the samples. The study also tests the panel's hypothesis. To accomplish this, we did the following:

- created a three-dimensional (3-D) geological model of the PROS area to delineate the subsurface geology and identify complex geological characteristics that might separate the oils in this area,
- designed and implemented a fluid petroleum sampling program to identify both the source-rock contributions and the compounds which may contribute to the odours and emissions, and
- determined the geological extent of plays and heavy oil and bitumen deposit boundaries to aid regulatory response in the area.

For more information about the Peace River proceeding visit www.aer.ca/applications-and-notices/hearings/proceeding-1769924.

Location

Alberta is a province in Canada (Figure 1). The southern part of the province shares a border with the United States (Montana). The province covers an area of approximately 660 000 km² (~255 000 square miles). The oil sands deposits are located in the northern part of the province, and the administrative areas for oil sands deposits are shown in Figure 2. This study focuses on the PROS area, specifically the smaller recommendation areas defined by the hearing panel (Figure 3). The 3-D geological model area is shown on Figures 2 and 3.



Figure 2. Map of the oil sands areas in Alberta and the 3-D model area. There are three oil sands areas (OSAs) defined by the AER: the Peace River Oil Sands (PROS) Area, the Athabasca Oil Sands (AOS) Area, and the Cold Lake Oil Sands (CLOS) Area. These defined areas are used to regulate and administrate heavy oil and bitumen deposits in the province. A 3-D geological model was used to visualize the complex arrangement of geological units and to analyze data in 3-D space in the PROS area. The model area was chosen based on the geographic extent of the PROS area with a buffer on each side



Figure 3. Map of the recommendation areas within the 3-D model area. The Peace River proceedings introduced four smaller recommendation areas defined within the PROS area: Three Creeks, Walrus, Seal Lake, and Reno.

Using a 3-D Geological Model and Petroleum Data Analyses to Help Mitigate Environmental Impacts of Heavy Oil and Bitumen Production

Terminology

Geological Play

A set of known or postulated oil or gas accumulations (pools and deposits) within a petroleum system sharing similar geochemical, geological, geographic, and temporal properties. These properties can include reservoir lithology and facies and trapping mechanisms. Geological plays occur below the ground surface and can be represented at the surface by geographic boundaries, which represent the lateral extent of the geological elements that define it in the subsurface. In this study, the geological plays are approximately equivalent to the geological formation.

Heavy Oil and Bitumen Deposit

The area within a play where known or postulated heavy oil and bitumen accumulations have similar characteristics and have the potential to be an economic resource now or in the near future. Heavy oil and bitumen deposits are determined using log analysis based on current technology and can therefore change over time.

Heavy Oil and Bitumen Scientific Definitions

- Natural bitumen have densities >1000 kg/m³ (<10 API gravity) and viscosities >10 000 cP (Kashirtsev and Hein, 2012).
- Heavy oils and extra-heavy oils have densities >934 kg/m³ (<20 API gravity) and viscosities between 1000 and 10 000 cP (Kashirtsev and Hein, 2012).

Heavy Oil and Bitumen Regulatory Definitions

- Crude oil with a density greater than or equal to 900 kilograms per cubic metre (kg/m³) is classified as "heavy."
- Crude bitumen is extra-heavy oil that will not flow to a well in its natural state.
- Any heavy oil or crude bitumen found within designated oil sands geological formations and within the oil sands areas is designated as "oil sands" for administrative purposes.

Heavy Oil and Bitumen Definitions for This Study

- "Heavy oils" have densities between 900 and 950 km/m³.
- "Oil sands designated heavy oil and bitumen" have densities \geq 950 kg/m³ and viscosities ≥1000 cP.

Odour

A compound in a gaseous concentration strong enough to be detected by olfactory receptors lining the nose. Odours are often expelled from solids or liquids through sublimation, evaporation, or boiling.

Odour Threshold

The concentration at which a compound may be detected by olfactory receptors and become odorous. Odour thresholds can be determined by different methods, resulting in a broad range of thresholds (Ruth, 1986). For consistency, this study uses mostly the threshold values listed in Nagata (2003) (Table 1).

Observations About Odourous Compounds

Observations about the potential for a sample to be more odorous are based on the number of times the measured compounds exceeded the odour threshold. It is assumed here that the more times the compound concentration was over the threshold, the more likely it was to remain odorous when diluted in air. Odour thresholds are not available for all compounds tested.

Table 1. Odour thresholds (Nagata, 2003) for compounds analyzed in this study. Compounds without measured thresholds or that are odourless are not included in the table. RSC is reduced sulphur compound. VOC is volatile organic compound. (* Odour thresholds are for single-bonded (alkane) hydrocarbons only)

| 1-blane 0.36 ponv C1-C4 n-Ryane 1200 ponv C1-C4 n-Popare 1600 ponv C1-C4 ICS 0.000 frac C1-C4* CS 0.000 frac C1-C7* C6 0.000 frac C1-C7* C4 0.001 frac C1-C7* C3 0.002 frac C1-C7* C3 0.001 frac C1-C7* C3 0.002 frac C1-C7* C3 0.002 frac C1-C7* C3 0.001 frac C1-C7* C3 0.002 frac FRC Bayrencaptan 0.013 pabv RSC Hardin mecaptan 0.023 pabv RSC Trippine 0.56 pabv RSC Cattorn singhtindi 210 pabv RSC Trippine 0.55 pabv TSA Edyt mecaptan 0.017 <th>Compound</th> <th>Odour Threshold</th> <th>Unit of Measure</th> <th>Compound Group</th> | Compound | Odour Threshold | Unit of Measure | Compound Group |
|--|------------------------|------------------------------|---------------------------|----------------|
| Properie 13 ppmv C1-C4 n-Progane 1600 ppmv C1-C4 C5 0.000 frac C1-C7-* C6 0.000 frac C1-C7-* C6 0.000 frac C1-C7-* C6 0.001 frac C1-C7-* C6 0.001 frac C1-C7-* C4 0.011 frac C1-C7-* C4 0.012 frac C1-C7-* C4 0.013 ppbv RSC Bayri mercaplan 0.013 ppbv RSC Ehyrimcaplan 0.029 ppbv RSC Hydragan sulphide 2.2 ppbv RSC Carbond sulphide 5.5 ppbv RSC Carbond sulphide 5.5 ppbv RSC Carbond sulphide 0.003 ppbv TSA Sinbuly mercaplan 0.019 ppbv TSA Sinbuly mercaplan 0.019 ppbv TSA | 1-Butene | 0.36 | ppmv | C1-C4 |
| n-Bulane 1200 pmv C1-C4 n-Propane 1500 pmv C1-C4 C5 0.000 fac C1-C7+* C6 0.000 fac C1-C7+* C2 0.001 fac C1-C7+* C3 0.022 fac C1-C7+* C3 0.026 pabr RSC Exply mercaptan 0.038 ppbv RSC Exply mercaptan 0.029 ppbv RSC Popt mercaptan 0.029 ppbv RSC Hely mercaptan 0.029 ppbv RSC Thoprine 0.86 ppbv RSC Thoprine 0.86 ppbv RSC Carbon sinphide 210 pbv RSC Carbon sinphide 210 pbv RSC Carbon sinphide 1003 pbv TSA Sopropy marcaptan 0.013 pbv TSA Ehy mercaptan 0.029 pbv TSA | Propylene | 13 | ppmv | C1-C4 |
| n.Progane 1500 ppmv C1-CA* CS 0.000 frac C1-CA* CS 0.001 frac C1-CA* CS 0.001 frac C1-CA* C3 0.002 frac C1-CA* C4 0.001 frac C1-CA* C3 0.002 frac C1-CA* C4 0.001 frac C1-CA* C4 0.002 frac C1-CA* C4 0.001 frac C1-CA* C4 0.002 pb/r RSC Ehytmecaptan 0.023 opb/r RSC Methy mecaptan 0.023 opb/r RSC Dambry sulphide S5 opb/r RSC Carbond sulphide S0 opb/r TSA Sapporty mecaptan 0.006 opb/r TSA Sapporty mecaptan 0.006 opb/r TSA Sapporty mecaptan 0.006 opb/r TSA Sa | n-Butane | 1200 | ppmv | C1-C4 |
| ICS 0.000 frac C1-C7-* CS 0.000 frac C1-C7-* C2 0.011 frac C1-C7-* C3 0.002 frac C1-C7-* C4 0.003 opb/r RSC BegrapyImercaptan 0.006 opb/r RSC ElyInmercaptan 0.007 opb/r RSC ElyInmercaptan 0.013 opb/r RSC PagM marcaptan 0.013 opb/r RSC ElyInmercaptan 0.017 opb/r RSC ElyInmercaptan 0.017 opb/r RSC Carbon sign/pide 3 opb/r RSC Carbon sign/pide 3 opb/r RSC Carbon sign/pide 0.007 opb/r TSA BoptapyImercaptan 0.007 opb/r TSA BoptapyImercaptan 0.007 opb/r TSA BoptapyImercaptan 0.007 opb/r TSA BoptapyImercaptan 0.007 | n-Propane | 1500 | ppmv | C1-C4 |
| CS 0.000 fac C1-C2+* C6 0.001 fac C1-C2+* C4 0.001 fac C1-C2+* C4 0.002 fac C1-C2+* Budy Increagian 0.003 ppbv RSC Enyinecroptan 0.0013 ppbv RSC Enyinecroptan 0.013 ppbv RSC Enyinecroptan 0.013 ppbv RSC Enyinecroptan 0.029 ppbv RSC Herbidy mercagian 0.029 ppbv RSC Demathy sulphide 0.41 ppbv RSC Demathy sulphide 2.2 ppbv RSC Carbon disulphide 2.3 ppbv RSC Carbon disulphide 2.03 ppbv TSA Enyi mercagian 0.006 ppbv TSA Enyi dimercagian 0.007 ppbv TSA Enyi dimercagian 0.003 ppbv TSA Enyi dimercagian 0.029 ppbv | iC5 | 0.000 | frac | C1-C7+* |
| C6 0.000 fac C1-C7+* C2 0.001 fac C1-C7+* C3 0.002 fac C1-C7+* C3 0.003 ppb/* RSC Isoproof merceptan 0.006 ppb/* RSC Isoproof merceptan 0.003 ppb/* RSC Isoproof merceptan 0.013 ppb/* RSC Isoproof merceptan 0.07 ppb/* RSC Isoproof merceptan 0.07 ppb/* RSC Dimethy disuptinde 2 ppb/* RSC Dimethy disuptinde 2 ppb/* RSC Carban disuptinde 3 pb/* RSC Carban disuptinde 1006 ppb/* TSA Isspanof merceptan 0.006 ppb/* TSA Isspanof merceptan 0.007 ppb/* TSA Isspanof merceptan 0.013 ppb/* TSA Isspanof merceptan 0.016 ppb/* TSA Isspanof merceptan | C5 | 0.000 | frac | C1-C7+* |
| C2 0.001 fac C1-C7-* C4 0.002 fac C1-C7-* Buly mercaplan 0.003 ppbv RSC Buly mercaplan 0.009 ppbv RSC Eny mercaplan 0.019 ppbv RSC Eny mercaplan 0.029 ppbv RSC Herbsy mercaplan 0.029 ppbv RSC Trophene 0.56 ppbv RSC Dimethy disubidie 2.2 ppbv RSC Dimethy disubidie 2.0 ppbv RSC Carborn disubidie 2.0 ppbv TSA Bidgroppi mercaplan 0.003 ppbv TSA Bidgroppi mercaplan 0.017 ppbv TSA Enyt mercaplan 0.017 ppbv TSA Enyt mercaplan 0.027 | <u>C6</u> | 0 000 | frac | C1-C7+* |
| CA DOD Tac. C1-C7-* C3 D002 frac. C1-C7-* C3 D002 frac. C1-C7-* Exproprime:captan D.002 ppbv RSC Esproprime:captan D.009 ppbv RSC Eryth mercaptan D.013 ppbv RSC Methy mercaptan D.02 ppbv RSC Methy mercaptan D.07 ppbv RSC Dimethy disuphide 2.2 ppbv RSC Dimethy disuphide 2.2 ppbv RSC Dimethy disuphide 2.2 ppbv RSC Cathon suphide 2.10 ppbv RSC Dimethy disuphide 2.10 ppbv TSA Storyd mercaptan 0.003 ppbv TSA Storyd mercaptan 0.013 ppbv TSA Diefhy disuphide 2.5 ppbv TSA Diefhy disuphide 2.6 ppbv TSA Diefhy disuphide 3 | C2 | 0.001 | frac | C1-C7+* |
| Color Loc Chart Bufy macaplan 0.003 pbbv RSC Bufy macaplan 0.009 pbbv RSC Elvy macaplan 0.013 pbbv RSC HerBufy macaplan 0.029 pbbv RSC HerBufy macaplan 0.07 pbbv RSC Hydrogen subinica 0.41 pbbv RSC Tacpherie 0.56 pbbv RSC Dimethy disulphica 2.2 pbbv RSC Carbon subinida 35 pbbv RSC Carbon subinida 2.0 pbbv RSC Carbon subinida 0.003 pbbv TSA Soprogry macaptan 0.006 pbbv TSA Elvy macaptan 0.007 pbbv TSA Datity subphide 0.029 pbv TSA Elvy macaptan 0.0029 pbv TSA Datity subphide 0.013 pbv TSA Datity subphide 0.029 pbv | | 0.001 | frac | C1_C7+* |
| Column Control Column Control Column Control Boyrney merceptan 0.006 pbbv RSC Etryl merceptan 0.007 pbbv RSC Prage merceptan 0.073 pbbv RSC Mettyr merceptan 0.079 pbbv RSC Mettyr merceptan 0.07 pbbv RSC Mettyr merceptan 0.07 pbbv RSC Thighnem 0.56 pbbv RSC Denethyr disuphide 2 pbbv RSC Carbon suphide 3 pbbv RSC Carbon suphide 10 pbbv TSA Bisbuckyr merceptan 0.003 pbbv TSA Bisbuckyr merceptan 0.013 pbbv TSA Bisbuckyr merceptan 0.03 pbbv TSA Bisbuckyr merceptan 0.33 pbbv TSA Derfwr suphide 0.56 pbbv TSA Derfwr suphide 2.2 pbbv TSA Derfwr suphide | C3 | 0.001 | frac | |
| Buly miccipal 0.006 pbb RSC Ehy mecapian 0.006 pbb RSC Ehy mecapian 0.007 pbb RSC Methy mecapian 0.07 pbb RSC Her Bauty mecapian 0.07 pbb RSC Hydrogen subpidie 0.41 pbb RSC Dimethy disulphide 2.2 pbb RSC Dimethy disulphide 3 pbb RSC Carbon disulphide 2.1 pbb RSC Carbon disulphide 2.01 pbb TSA Soprocy mecapian 0.005 pbb TSA Ehy mecapian 0.0013 pbb TSA Ehy mecapian 0.029 pbb TSA Dathy sulphide 0.41 pbb TSA Ehy mecapian 0.029 pbb TSA Dathy disulphide 2.2 pbb TSA Dathy disulphide 3 pbb TSA Dathy disulphide 3 | Dutul moreorten | 0.002 | | |
| Böpröp/mercaptan 0.009 ppbv RSC Proy/mercaptan 0.013 ppbv RSC Methy/mercaptan 0.029 ppbv RSC Methy/mercaptan 0.029 ppbv RSC Methy/mercaptan 0.029 ppbv RSC Methy/mercaptan 0.029 ppbv RSC Methy/mercaptan 0.06 ppbv RSC Dimethy/subpide 210 ppbv RSC Stopopy/mercaptan 0.006 ppbv TSA Isopopy/mercaptan 0.006 ppbv TSA Isopopy/mercaptan 0.006 ppbv TSA Isopopy/mercaptan 0.007 ppbv TSA Isopopy/mercaptan 0.006 ppbv TSA Isopopy/mercaptan 0.013 ppbv TSA Isopopy/mercaptan 0.013 ppbv TSA Isopopy/mercaptan 0.023 ppbv TSA Isopopy/mercaptan 0.233 ppbv TSA De | Butyr mercaptan | 0.003 | pppv | RSC |
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| Propy RESC Herbory RSC Methy mercaptan 0.07 ppbv RSC Methy mercaptan 0.07 ppbv RSC Highymercaptan 0.08 ppbv RSC Thiophere 0.56 ppbv RSC Dimethyl sulphide 2 ppbv RSC Carbon disulphide 210 ppbv RSC Stoppoty mercaptan 0.006 ppbv TSA Isobucty mercaptan 0.007 ppbv TSA Isobucty mercaptan 0.007 ppbv TSA Isobucty mercaptan 0.007 ppbv TSA Isobucty mercaptan 0.013 ppbv TSA Isoppoty TSA TSA TSA Hydrogen subphide 0.41 ppbv TSA Dimethyl subphide 2.2 ppbv TSA Dimethyl subphide 5.5 ppbv TSA Dimethyl subphide 3.8 ppbv VOC | Ethyl mercaptan | 0.009 | ppbv | RSC |
| terl-Buty mercaptan 0.029 ppbv RSC Hydrogen sulphide 0.41 ppbv RSC Tincyhene 0.56 ppbv RSC Dimethyl disulphide 2.2 ppbv RSC Carbon slaphnide 3.5 ppbv RSC Carbon slaphnide 2.0 ppbv RSC Carbon slaphnide 2.00 ppbv TSA Isoprogn (mercaptan 0.003 ppbv TSA Isoptogn (mercaptan 0.007 ppbv TSA Ehyl mercaptan 0.013 ppbv TSA Debdry increaptan 0.013 ppbv TSA Deffy disulphide 0.33 ppbv TSA Dimethyd sulphide 2.2 ppbv TSA Dimethyd sulphide 3.6 ppbv TSA Dimethyd sulphide 3.6 ppbv TSA Dimethyd sulphide 3.6 ppbv VOC Arcolein 3.6 ppbv VOC Dipdethylbearene <td>Propyl mercaptan</td> <td>0.013</td> <td>ppbv</td> <td>RSC</td> | Propyl mercaptan | 0.013 | ppbv | RSC |
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| Hydrogen subplide 0.41 pbbv RSC Directhyl disulphide 2.2 ppbv RSC Directhyl disulphide 3 ppbv RSC Carbonyl subplide 5.6 ppbv RSC Carbonyl subplide 210 ppbv RSC Soptogyl mercaptan 0.003 ppbv TSA Isoptogyl mercaptan 0.009 ppbv TSA Isoptogyl mercaptan 0.001 ppbv TSA Isoptogyl mercaptan 0.013 ppbv TSA Diethyl subphide 0.013 ppbv TSA Hydrogen subphide 0.41 opbv TSA Hydrogen subphide 0.41 opbv TSA Direthyl subphide 2.2 ppbv TSA Direthyl disulphide 2.3 ppbv TSA Direthyl subphide 5.5 ppbv VOC Acroian 3.6 ppbv VOC Acroian 3.6 ppbv VOC Stoprophylen | Methyl mercaptan | 0.07 | ppbv | RSC |
| Tingshere 0.56 ppbv RSC Dmethyl sulphide 3 ppbv RSC Dmethyl sulphide 3 ppbv RSC Cathorn sulphide 210 ppbv RSC Stabush sulphide 210 ppbv RSC Stabush werceptan 0.006 ppbv TSA Isobush werceptan 0.007 ppbv TSA Isobush werceptan 0.013 ppbv TSA Isobush werceptan 0.023 ppbv TSA Herl-Sulphine 0.13 ppbv TSA Herl-Sulphine 0.56 ppbv TSA Methyl merceptan 0.057 ppbv TSA Diethyl disulphide 2 ppbv TSA Diethyl disulphide 3 ppbv TSA Diethyl disulphide 3 ppbv VOC Acroisin 3.6 ppbv VOC Acroisin 3.6 ppbv VOC Spopolyberzene 3.8 < | Hydrogen sulphide | 0.41 | ppbv | RSC |
| Dimethyl disulphide 2 2 ppbv RSC Dimethyl sulphide 3 ppbv RSC Carbon sulphide 210 ppbv RSC Carbon sulphide 210 ppbv RSC Isoprogin mercaptan 0.003 ppbv TSA Isoprogin mercaptan 0.007 ppbv TSA Ethyl mercaptan 0.003 ppbv TSA Ethyl mercaptan 0.013 ppbv TSA Dethyl sulphide 0.033 ppbv TSA Methyl mercaptan 0.029 ppbv TSA Hydrogen sulphide 0.41 ppbv TSA Dethyl sulphide 2 ppbv TSA Dimethyl disulphide 3 ppbv TSA Dimethyl disulphide 3 ppbv TSA Dimethyl sulphide 3 ppbv VOC Acardin 3.6 ppbv VOC Politylbenzane 8.3 ppbv VOC Styrene 3.5 </td <td>Thiophene</td> <td>0.56</td> <td>ppbv</td> <td>RSC</td> | Thiophene | 0.56 | ppbv | RSC |
| Dimethyl sulphide 3 ppbv RSC Catboryl sulphide S5 ppbv RSC Acton of sulphide 210 opbv RSC Subuly Mercaptan 0.006 ppbv TSA Isopotyl mercaptan 0.006 ppbv TSA Isopotyl mercaptan 0.013 opbv TSA Isobutyl mercaptan 0.029 opbv TSA Iert-Butyl mercaptan 0.029 opbv TSA Mettyl mercaptan 0.029 opbv TSA Mettyl mercaptan 0.056 ppbv TSA Dimethyl disulphide 2.2 opbv TSA Dimethyl disulphide 3.5 opbv TSA Dimethyl disulphide 3.6 ppbv VOC Actoron sulphide 3.8 ppbv VOC n-Porgutenzene 3.8 ppbv VOC n-Entylbulyl ketone 3.5 ppbv VOC systeme 3.5 ppbv VOC systeme </td <td>Dimethyl disulphide</td> <td>2.2</td> <td>vdqq</td> <td>RSC</td> | Dimethyl disulphide | 2.2 | vdqq | RSC |
| Carbon dsubilde 55 ppbv RSC Carbon dsubilde 210 ppbv RSC Nebuly Mercaptan 0.003 ppbv TSA Isoproprimercaptan 0.007 ppbv TSA Ethyl mercaptan 0.007 ppbv TSA Ethyl mercaptan 0.013 ppbv TSA Ethyl mercaptan 0.029 ppbv TSA Methyl mercaptan 0.029 ppbv TSA Dethyl subhide 0.033 ppbv TSA Hydrogen subhide 0.41 ppbv TSA Dimethyl dsubhide 2 ppbv TSA Dimethyl dsubhide 2 ppbv TSA Carbonyl subhide 3 ppbv VOC Acrobin 3.6 ppbv VOC Acrobin 3.8 ppbv VOC Supproprimer.en 8.4 ppv VOC Supproprimer.en 7.4 ppbv VOC Supproprimer.en 7.4 | Dimethyl sulphide | 3 | ppby | RSC |
| Catalon displinite 210 pdbv RSC N-butyl Mercaptan 0.003 pdbv TSA Isobutyl mercaptan 0.007 pdbv TSA Isobutyl mercaptan 0.009 pdbv TSA Isobutyl mercaptan 0.009 pdbv TSA Ethyl mercaptan 0.029 pdbv TSA Iterl Sulphreit 0.033 pdbv TSA Methyl mercaptan 0.029 pdbv TSA Methyl mercaptan 0.07 pdbv TSA Methyl mercaptan 0.07 pdbv TSA Methyl mercaptan 0.07 pdbv TSA Catalon sisulphide 2.2 pdbv TSA Diethyl sisulphide 3.6 pdbv VOC Acroian sisulphide 3.6 pdbv VOC Acroian is an ison ison ison ison ison ison ison iso | | 55 | nnhy | RSC |
| Online Studyinger 210 ppbv TSA Isoprogrimercaptan 0.003 ppbv TSA Isoprogrimercaptan 0.007 ppbv TSA Etry Imercaptan 0.008 ppbv TSA Isoprogrimercaptan 0.013 ppbv TSA Tare Bury Imercaptan 0.029 ppbv TSA Direthy Sulphide 0.033 ppbv TSA Direthy Sulphide 0.41 ppbv TSA Direthy Sulphide 2 ppbv TSA Direthy Sulphide 2 ppbv TSA Direthy Sulphide 3 ppbv TSA Direthy Sulphide 3 ppbv TSA Carbony Sulphide 3.6 ppbv VOC Arcolein 3.6 ppbv VOC Arcolein 3.8 ppbv VOC Stoprene 3.8 ppbv VOC Stoprene 3.8 ppbv VOC Stoprene 3.8 ppbv | Carbon disulphide | 210 | nphy | |
| N=000000000000000000000000000000000000 | | | ppbv ppbv | |
| Isopopy mercapian 0.00 ppbv TSA Ethy Imercaptan 0.007 ppbv TSA Propoymercapian 0.013 ppbv TSA InterBuly Imercaptan 0.029 ppbv TSA Diethy sulphide 0.033 pobv TSA Diethy sulphide 0.06 ppbv TSA Diethy disulphide 2 ppbv TSA Diethy disulphide 2 ppbv TSA Dimethy disulphide 3 ppbv TSA Dimethy disulphide 3.6 ppbv VOC Acratein 3.6 ppbv VOC Acratein 3.6 ppbv VOC PEntytolence 8.3 ppbv VOC Isopopytenzene 8.4 ppbv VOC Stoptene 44 ppbv VOC Stoptene 44 ppbv VOC Stoptene 100 ppbv VOC 1.2.4-Tinmethytoptenzene 170 ppbv <td>N-butyl Mercaptan</td> <td>0.003</td> <td></td> <td>TSA</td> | N-butyl Mercaptan | 0.003 | | TSA |
| Isobuty mercaptan 0.007 ppbv TSA n-Proprimercaptan 0.013 ppbv TSA tert-Buty mercaptan 0.029 ppbv TSA Dethyl suphide 0.13 ppbv TSA Dethyl suphide 0.141 ppbv TSA Diethyl disulphide 2 ppbv TSA Diethyl disulphide 2.2 ppbv TSA Dimethyl disulphide 3.2 ppbv TSA Dimethyl subhide 5.5 ppbv TSA P.Diethyl benzene 3.6 ppbv VOC n-Propylbenzene 8.4 ppbv VOC n-Propylbenzene 8.4 ppbv VOC n-Ethyldouene 74 ppbv VOC sigerene 35 ppbv VOC n-Dethylbenzene 70 ppbv VOC sigrene 35 ppbv VOC sigrene 110 ppbv VOC n-Dethylbenzene 70 p | Isopropyl mercaptan | 0.006 | ppbv | ISA |
| Elty/mercaptan 0.009 ppbv TSA n-Propymercaptan 0.013 ppbv TSA Dietry/suphide 0.029 ppbv TSA Methyl mercaptan 0.07 ppbv TSA Methyl mercaptan 0.7 ppbv TSA Thiophene 0.56 ppbv TSA Dinettyl disulphide 2 ppbv TSA Dinettyl disulphide 2 ppbv TSA Carbonyl sulphide 3.6 ppbv VOC Acrolein 3.6 ppbv VOC N-Propylbenzene 8.4 ppbv VOC Isoprapylbenzene 8.4 ppbv VOC Isoprapylbenzene 70 ppbv VOC Styrene 35 ppbv VOC Styrene 100 ppbv VOC -Protylhylpeptane 110 ppbv VOC -Dettrylbourene 120 ppbv VOC -Larimethylbenzene 170 ppbv </td <td>Isobutyl mercaptan</td> <td>0.007</td> <td>ppbv</td> <td>TSA</td> | Isobutyl mercaptan | 0.007 | ppbv | TSA |
| n-Program EAA brtPsButyImercaptan 0.029 ppbv TSA Dethyl subphide 0.013 ppbv TSA MettyImercaptan 0.07 ppbv TSA MettyImercaptan 0.06 ppbv TSA DirettyI disubhide 2.2 ppbv TSA DirettyI disubhide 3.2 ppbv TSA DirettyI disubhide 5.5 ppbv TSA CarbonyI subphide 5.6 ppbv VOC Acrolein 3.6 ppbv VOC -Progrybenzene 3.8 ppbv VOC Isoprogrybenzene 8.4 ppbv VOC Isoprogrybenzene 7.4 ppbv VOC Sigrene 48 ppbv VOC Isoprogrybenzene 7.0 ppbv VOC I-Pertene 100 ppbv VOC I-Sprine 100 ppbv VOC I-Pertene 100 ppbv VOC | Ethyl mercaptan | 0.009 | ppbv | TSA |
| tert-Butyl mercaptan 0.029 ppbv TSA Dettryl sulphide 0.033 ppbv TSA Hydrogen sulphide 0.41 ppbv TSA Diettryl disulphide 2 ppbv TSA Diettryl disulphide 2 ppbv TSA Dinettryl disulphide 2 ppbv TSA Dinettryl disulphide 3 ppbv TSA Carboniy sulphide 3.6 ppbv VOC Acrobkin 3.6 ppbv VOC Isoprophenzene 3.8 ppbv VOC Styrene 3.5 ppbv VOC Styrene 3.5 ppbv VOC methyl houzine 70 ppbv VOC Styrene 3.5 ppbv VOC Styrene 100 ppbv VOC Izoptene 48 ppbv VOC 1.24-Trimethylbenzene 110 ppbv VOC 1.24-Trimethylbenzene 110 ppbv | n-Propylmercaptan | 0.013 | ppbv | TSA |
| Diethyl sulphide 0.033 ppbv TSA Methyl mercaptan 0.07 ppbv TSA Hydrogen sulphide 0.41 ppbv TSA Thiophene 0.56 ppbv TSA Direthyl disulphide 2 ppbv TSA Dirnethyl sulphide 3 ppbv TSA Dirnethyl sulphide 55 ppbv TSA p-Diethylbenzene 0.38 ppbv VOC Acrolein 3.6 ppbv VOC herbryloluene 8.3 ppbv VOC Isopropylbenzene 8.4 ppbv VOC Herbryloluene 18 ppbv VOC Styrene 35 ppbv VOC Styrene 35 ppbv VOC -Ehryloluene 74 ppbv VOC -Diethylbenzene 70 ppbv VOC -Dodecane 110 ppbv VOC -I-Pentene 100 ppbv VOC | tert-Butyl mercaptan | 0.029 | ppbv | TSA |
| Methyl mecaptan DO7 ppbv TSA Hydrogen sulphide 0.41 ppbv TSA Diethyl disulphide 2 ppbv TSA Diethyl disulphide 2 ppbv TSA Dimethyl sulphide 3 ppbv TSA Dimethyl sulphide 3 ppbv VOC Acrolein 3.6 ppbv VOC Acrolein 3.6 ppbv VOC P-Diethylbenzene 8.3 ppbv VOC Stoprotybenzene 8.4 ppbv VOC Stoprotybenzene 8.4 ppbv VOC Stoprotybenzene 70 ppbv VOC Styrene 35 ppbv VOC Styrene 100 ppbv VOC -Pentene 100 ppbv VOC -Pentene 100 ppbv VOC -LA-Timethylbenzene 170 ppbv VOC -LA-Timethylbenzene 170 ppbv VOC <td>Diethyl sulphide</td> <td>0.033</td> <td>vdqq</td> <td>TSA</td> | Diethyl sulphide | 0.033 | vdqq | TSA |
| Instruction Instruction Instruction Hydrogen sulphide 0.56 ppbv TSA Dimethyl disulphide 2 ppbv TSA Dimethyl disulphide 3 ppbv TSA Dimethyl disulphide 3 ppbv TSA Carboryl sulphide 55 ppbv VOC Acrolein 3.6 ppbv VOC -Piethylbuene 8.3 ppbv VOC Isoproylbenzene 8.4 ppbv VOC Isoproylbenzene 8.4 ppbv VOC Isoproylbenzene 70 ppbv VOC Isoprene 4.8 ppbv VOC Isoprene 74 ppbv VOC 1-Pentane 100 ppbv VOC 1-Arrinethylbenzene 170 ppbv VOC 1-Arrinethylbenzene 170 ppbv VOC 1-Arrinethylbenzene 170 ppbv VOC 1-Arrinmethylbenzene 170 ppbv | Methyl mercantan | 0.07 | ppby | TSA |
| Thisphene U-T1 pp/W TSA Dieftyl disulphide 2 ppbv TSA Dimethyl disulphide 3 ppbv TSA Dimethyl disulphide 3 ppbv TSA Carbonyl sulphide 55 ppbv VOC Acrolein 3.6 ppbv VOC Acrolein 3.6 ppbv VOC P-Ethylobuene 8.3 ppbv VOC Sygrene 3.6 ppbv VOC Sygrene 3.6 ppbv VOC Sygrene 3.5 ppbv VOC Sygrene 3.5 ppbv VOC Sygrene 4.8 ppbv VOC -1-Pentene 100 ppbv VOC -1-Pontene 100 ppbv VOC -1-Bottylbenzene 170 ppbv VOC -1-Bottylbenzene 170 ppbv VOC -1-Bottylbenzene 170 ppbv VOC < | Hydronen sulnhide | 0.41 | nnhv | ТЅА |
| Integrate U.30 PDV TSA Dimethyl disulphide 2 ppbv TSA Dimethyl sulphide 3 ppbv TSA Cartoryl sulphide 55 ppbv VOC Acrolein 3.6 ppbv VOC n-Propylbenzene 3.8 ppbv VOC n-Propylbenzene 8.4 ppbv VOC sporocylbenzene 8.4 ppbv VOC sporocylbenzene 8.4 ppbv VOC styrene 35 ppbv VOC Styrene 35 ppbv VOC styrene 10 ppbv VOC -Ethytoluene 74 ppbv VOC 2-Methylbenzene 110 ppbv VOC 1-A-Inmethylbenzene 120 ppbv VOC 1-A-Inmethylbenzene 170 ppbv VOC 1-A-Strimethylbenzene 170 ppbv VOC 1-A-Inmethylbenzene 170 ppbv <t< td=""><td></td><td>יד.ט 0 56</td><td>n n h v</td><td></td></t<> | | יד.ט 0 56 | n n h v | |
| uneuty assuprive 2 ppbv TSA Dimethyl sulphide 3 ppbv TSA Dimethyl sulphide 55 ppbv TSA Dimethyl sulphide 55 ppbv VOC Acrolein 3.6 ppbv VOC Acrolein 3.6 ppbv VOC P-Propylbanzene 3.4 ppbv VOC Styrene 3.5 ppbv VOC Isopropylbenzene 8.4 ppbv VOC Styrene 35 ppbv VOC Isoprene 48 ppbv VOC Isoprene 70 ppbv VOC -Ethylbluene 74 ppbv VOC -Podecane 100 ppbv VOC -I-Podecane 100 ppbv VOC -I-Podecane 100 ppbv VOC -I-Horne 100 ppbv VOC -I-Podecane 100 ppbv VOC -I-Horene | | 0.00 | hhna hhna | |
| µmetry disulphate 2.2 ppbv TSA Carbony sulphide 3 ppbv TSA Carbony sulphide 55 ppbv VOC Acrolein 3.6 ppbv VOC n-Propylbenzene 3.8 ppbv VOC p-Etrytoluene 8.3 ppbv VOC Isoprosylbenzene 8.4 ppbv VOC Styrene 35 ppbv VOC Styrene 35 ppbv VOC Styrene 70 ppbv VOC styrene 70 ppbv VOC -Etrytoluene 74 ppbv VOC -Pentene 100 ppbv VOC -Pentene 101 ppbv VOC 1-Pentene 12.4-Timethylberzene 170 ppbv VOC 1-A-timethylberzene 170 ppbv VOC 13.3-Simmethylberzene 170 ppbv VOC 1.3-Simmethylberzene 170 ppbv VOC | | 2 | l han | |
| Dimethyl sulphide 3 ppbv TSA Carbonyl sulphide 55 ppbv VOC Acrolein 3.6 ppbv VOC Acrolein 3.6 ppbv VOC Propylbenzene 3.8 ppbv VOC Isopropylbenzene 8.4 ppbv VOC Isopropylbenzene 8.4 ppbv VOC Syrene 35 ppbv VOC Syrene 35 ppbv VOC Isopropylbenzene 70 ppbv VOC n-Ethyltoluene 74 ppbv VOC 1-Pentene 100 ppbv VOC 1-Hextene 110 ppbv VOC 1-Hextene 140 ppbv VOC 1-Hextene 160 ppbv VOC 1-Hextene 170 ppbv VOC 1-Hextene 170 ppbv VOC 1-Hextene 170 ppbv VOC 1-Butarene </td <td>Dimethyl disulphide</td> <td>2.2</td> <td>ppbv</td> <td>TSA</td> | Dimethyl disulphide | 2.2 | ppbv | TSA |
| Carbonyl sulphide SS ppbv TSA p-Diettybberzene 0.39 ppbv VOC n-Progliberzene 3.8 ppbv VOC p-Ethytkolene 8.3 ppbv VOC issporoylberzene 8.4 ppbv VOC m-Ethytkolene 18 ppbv VOC Syrene 35 ppbv VOC Syrene 35 ppbv VOC Isoprore 48 pbv VOC syrene 10 pbv VOC -Pentene 100 pbv VOC 2-Methytheptare 110 ppbv VOC 1-Areane 100 pbv VOC 1-Areane 140 ppbv VOC 1-Areane 170 ppbv VOC 1-Areane 170 ppbv VOC 1.3.5-trainethybenzene 170 ppbv VOC 1.3.5-trainethybenzene 380 ppbv VOC <td< td=""><td>Dimethyl sulphide</td><td>3</td><td>ppbv</td><td>TSA</td></td<> | Dimethyl sulphide | 3 | ppbv | TSA |
| p-Diethylbenzene 0.39 ppbv VOC Acrolein 3.6 ppbv VOC n-Progylbenzene 3.8 ppbv VOC p-Ethyltoluene 8.3 ppbv VOC Isoprogylbenzene 8.4 ppbv VOC Methyl butyl ketone 24 ppbv VOC Methyl butyl ketone 24 ppbv VOC Styrene 35 ppbv VOC Styrene 35 ppbv VOC -Ethyltoluene 70 ppbv VOC 2-Methylbeptare 100 ppbv VOC 1-Portene 100 ppbv VOC 1-Astrimethylbenzene 170 ppbv VOC 1-Astrimethylbenzene 170 ppbv VOC 1-Sitrimethylbenzene 170 ppbv VOC 1-Sitrimethylbenzene 170 ppbv VOC Carbon disulide 210 ppbv VOC 1-Sitrimethylbenzene 230 <t< td=""><td>Carbonyl sulphide</td><td>55</td><td>ppbv</td><td>TSA</td></t<> | Carbonyl sulphide | 55 | ppbv | TSA |
| Acrolein 3.6 ppbv VOC n-Progyberzene 3.8 ppbv VOC lsopropyberzene 8.4 ppbv VOC lsopropyberzene 8.4 ppbv VOC lsopropyberzene 18 ppbv VOC Styrene 35 ppbv VOC Styrene 35 ppbv VOC lsoprene 48 ppbv VOC -Distryblenzene 70 ppbv VOC -Pentene 100 ppbv VOC 1-Pentene 100 ppbv VOC n-Dodecane 110 ppbv VOC 1.2.4-Timethybenzene 120 ppbv VOC 1.3.5-Timethybenzene 170 ppbv VOC 1.3.5-Timethybenzene 170 ppbv VOC 1.3.5-Timethybenzene 170 ppbv VOC Aethylexene 120 ppbv VOC 1.3.5-Timethybenzene 170 ppbv VOC | p-Diethylbenzene | 0.39 | ppbv | VOC |
| n-Propylbenzene 3.8 ppbv VOC p-Ethyltoluene 8.3 ppbv VOC isopropylbenzene 8.4 ppbv VOC m-Ethyltoluene 18 ppbv VOC Methyl butyl ketore 24 ppbv VOC Styrene 35 ppbv VOC Isoprene 48 ppbv VOC m-Diethylbenzene 70 ppbv VOC 1-Pentene 100 ppbv VOC 2-Methylbeptane 110 ppbv VOC 1-Pentene 100 ppbv VOC 1-Hexene 140 ppbv VOC 1-Hexene 140 ppbv VOC 1-Hexene 100 ppbv VOC 1-Hexene 170 ppbv VOC 1-Hexene 170 ppbv VOC 1-Batane 360 ppbv VOC 1-Batadene 230 ppbv VOC 1-Batadene | Acrolein | 36 | ppby | VOC |
| In Dybolic Display VOC Isopropybenzene 8.3 ppbv VOC Isopropybenzene 8.4 ppbv VOC m-Ethylloluene 18 ppbv VOC Methyl buly letone 24 ppbv VOC Styrene 35 ppbv VOC Isopropybenzene 70 ppbv VOC -Ethyltoluene 74 ppbv VOC 0-Ethyltoluene 74 ppbv VOC 1-Pentene 100 ppbv VOC 2-Methylteptare 110 ppbv VOC 1-Americ 100 ppbv VOC 1-Americ 140 ppbv VOC 1-Hexene 140 ppbv VOC Methyl botylchexane 150 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Methyl botylk letone 170 ppbv VOC Carbon disulfide 210 ppbv VOC | n-Pronylbenzene | 3.8 | nnhy | VOC |
| presnytower 0.3 pp/0/ VOC isoprogybenzene 8.4 ppbv VOC m-Ethyltoluene 18 ppbv VOC Mettryl butyl ketone 24 ppbv VOC Isoprene 48 ppbv VOC Isoprene 48 ppbv VOC -Ethyltoluene 74 ppbv VOC 1-Pentene 100 ppbv VOC 1-Pentene 100 ppbv VOC 1.2.4-Trimethyltoptane 110 ppbv VOC 1.2.4-Trimethyltoptane 120 ppbv VOC 1.4-Rexene 140 ppbv VOC 1.4-Trimethyltoptane 170 ppbv VOC 1.4-Strimethyltoptane 170 ppbv VOC 1.3-Butadiene 170 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 380 ppbv VOC 2.3-Dimethylbutane 420 ppbv | | 0.0 | | |
| Isoprograding 8.4 ppbv VOC Methyl butyl katone 18 ppbv VOC Methyl butyl katone 24 ppbv VOC Styrene 35 ppbv VOC Isoprene 48 pptv VOC n-Diethylbenzene 70 ppbv VOC 2-Hethylhoptane 110 ppbv VOC 1-Pentene 100 ppbv VOC 2-Methylhoptane 120 ppbv VOC 1-Attrimethylbenzene 120 ppbv VOC 1-Attrimethylbenzene 170 ppbv VOC 1-Hexene 140 ppbv VOC 1-Attrimethylbenzene 170 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC 1.3.5-Trimethylbenzene | | 0.3 | pppv | VUC |
| m-Ethylbutuene 18 ppbv VOC Methyl butyl ketone 35 ppbv VOC Isoprene 35 ppbv VOC Isoprene 48 ppbv VOC Ethyltoluene 70 ppbv VOC 2-Methylteptane 100 ppbv VOC 2-Methylteptane 110 ppbv VOC 1.2-Arrimethylteptane 110 ppbv VOC 1.2-Arrimethylteptane 120 ppbv VOC 1.4-Framethylteptane 150 ppbv VOC 1.3-Strimethylteptane 170 ppbv VOC 1.3-Strimethylteptane 170 ppbv VOC 1.3-Strimethylteptane 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 230 ppbv VOC 2.3-Dimethyltetane 420 ppbv VOC 2.3-Dimethyltetane | Isopropylbenzene | 8.4 | ppbv | VOC |
| Methyl butyl ketone 24 ppbv VOC Styrene 35 ppbv VOC Isogrene 48 ppbv VOC m-Diethylbenzene 70 ppbv VOC 0-Ethylloune 74 ppbv VOC 1-Pentene 100 ppbv VOC 2-Methylheptane 110 ppbv VOC 1-Pentene 120 ppbv VOC 1.4.Timethylbenzene 120 ppbv VOC 1.4.Timethylbenzene 170 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Ethylbenzene 170 ppbv VOC Aethylerkene 130 ppbv VOC Associatione 130 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Butaciene 330 ppbv VOC Butene 360 ppbv VOC Butene 360 ppbv VOC < | m-Ethyltoluene | 18 | ppbv | VOC |
| Styrene 35 ppbv VOC Isoprene 48 ppbv VOC m-Diethylbenzene 70 ppbv VOC C-Ethyltoluene 74 ppbv VOC 1-Pentene 100 ppbv VOC 2-Methylheptane 110 ppbv VOC n-Dodecane 110 ppbv VOC 1.4.Frimethylbenzene 120 ppbv VOC 1.4.Frimethylbenzene 150 ppbv VOC 1.3.Firimethylbenzene 170 ppbv VOC Hethyl (sobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC Methyl methacrylate 210 ppbv VOC 1.3-Butadiene 360 ppbv VOC 1.3-Butadiene 360 ppbv VOC 2.3-Direnthylbutane 420 ppbv VOC 2.3-Unenthylberane 670 ppbv VOC 2.4-Hitylexane 440 < | Methyl butyl ketone | 24 | ppbv | VOC |
| Isoprene 48 ppby VOC m-Diethylbenzene 70 ppbv VOC c-Ethylbuene 74 ppbv VOC 1-Pentere 100 ppbv VOC 1-Pentere 100 ppbv VOC 1-Mexene 110 ppbv VOC 1.2.4-Trimethylbenzene 120 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Methyl resolucyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 360 ppbv VOC 1-Butene 360 ppbv VOC 2.3-Dimethylbentane 420 ppbv VOC 2.3-Dimethylbentane 670 ppbv VOC 2.3-Timethylpentane 670 ppbv VOC Pactarin 670 ppbv | Styrene | 35 | ppbv | VOC |
| m-Diethylbenzene 70 ppbv VOC o-Ethylboluene 74 ppbv VOC 1-Pentene 100 ppbv VOC 2-Methylheptane 110 ppbv VOC 1.2.4-Trimethylbenzene 120 ppbv VOC 1.2.4-Trimethylbenzene 120 ppbv VOC 1.1-Hexene 140 ppbv VOC 1.3.Firmethylbenzene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 380 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 670 ppbv VOC 2.3-Dimethylbentane 670 ppbv VOC 2.4-Timethylpentane | Isoprene | 48 | ppbv | VOC |
| o-Ethyltoluene 74 ppbv VOC 1-Pentene 100 ppbv VOC 2-Methylheptane 110 ppbv VOC n-Dodecane 110 ppbv VOC 1.2.4-Trimethylbenzene 120 ppbv VOC 1.3.5-Trimethylbenzene 150 ppbv VOC 1.4.5-trimethylbenzene 170 ppbv VOC Ethylborizene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Strimethylbenzene 330 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 330 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.4-Trimethylpentane 670 ppbv VOC 2.4-Trimethylpentane 670 ppbv VOC 2.4-Trimethylpentan | m-Diethylbenzene | 70 | ppbv | VOC |
| 1-Pertine 100 ppbv VOC 2-Methylheptane 110 ppbv VOC n-Dodecane 110 ppbv VOC 1.4-Trimethylbenzene 120 ppbv VOC 1.Hexene 140 ppbv VOC 1.Hexene 140 ppbv VOC 1.s.Frimethylbenzene 170 ppbv VOC Methylcyclohexane 170 ppbv VOC Ethylbenzene 170 ppbv VOC Carbon disulfide 210 ppbv VOC Carbon disulfide 210 ppbv VOC Toluene 330 ppbv VOC 1.Butene 360 ppbv VOC 2.ADimethylbutane 420 ppbv VOC 2.ADimethylbutane 420 ppbv VOC 2.4.Trimethylpentane 670 ppbv VOC 2.4.Trimethylpentane 670 ppbv VOC 2.4.Trimethylpentane 840 ppbv <td>o-Ethyltoluene</td> <td>74</td> <td>vdqq</td> <td>VOC</td> | o-Ethyltoluene | 74 | vdqq | VOC |
| 2-Methylineptane 110 ppbv VOC n-Dodecane 110 ppbv VOC 1.2.4-Trimethylbenzene 120 ppbv VOC 1.1-Hexene 140 ppbv VOC Methylcyclohexane 150 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Ethylbenzene 170 ppbv VOC Carbon disulfide 210 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 360 ppbv VOC 1.3-Butadiene 360 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbexane 420 ppbv VOC 2.3-Dimethylbentane 670 ppbv VOC 2.4-Trimethylpentane 670 ppbv VOC 2.4-Trimethylpentane 870 ppbv VOC 2.4-Trimethylpentane | 1-Pentene | 100 | ppby | VOC |
| Z Indentifyinplation Ind ppbv VOC In-Dodecane 110 ppbv VOC 1.2,4-Trimethylbenzene 120 ppbv VOC 1.4texene 140 ppbv VOC Methylcyclohxane 150 ppbv VOC 1.3,5-Trimethylbenzene 170 ppbv VOC Ethylbenzene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 330 ppbv VOC 1.3-Butadiene 330 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbertane 420 ppbv VOC 2.4-Trimethylpertane 670 ppbv VOC 1.4-Letanel 670 ppbv VOC 2.4-Trimethylpertane 670 ppbv VOC 1.4-Dimethylpentane | 2-Methylbentane | 110 | nnhv | VOC |
| In-Docesarie In-Docesarie ppbv VOC 12.4-Trimethylbenzene 140 ppbv VOC Methylcyclohexane 150 ppbv VOC Methylcyclohexane 170 ppbv VOC Ethylbenzene 170 ppbv VOC Ethylbenzene 170 ppbv VOC Carbon disulfide 210 ppbv VOC Carbon disulfide 210 ppbv VOC Altyl methacrylate 210 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Butadiene 360 ppbv VOC 1.3-Butadiene 380 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylberane 440 ppbv VOC Ethyl ketone 440 ppbv VOC 2.4-Irimethylpentane 670 ppbv VOC 1.4-Leptane 670 ppbv VOC 2.4-Irimethylpentane < | | 110 | | |
| 1.2.4 - InfiniterryIderIzene 120 ppbv VOC 1Hexene 140 ppbv VOC 1.Aspectobexane 150 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Methylicobbexane 170 ppbv VOC Ethylbenzene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC Methyl isobutyl ketone 230 ppbv VOC 1Butene 360 ppbv VOC -Sylene 380 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.4-Hittylitexane 420 ppbv VOC Pecare 620 ppbv VOC 1Heptane 670 ppbv VOC 1Heptane 670 ppbv VOC 1Heptane 840 ppbv VOC 2.4-Dimethylpentane 840 <td< td=""><td></td><td>110</td><td>h h h h</td><td>V0C</td></td<> | | 110 | h h h h | V0C |
| 1-Hexne 140 ppbv VOC Methylcyclohexane 150 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Ethylbenzene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC Methyl methacrylate 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC Toluene 330 ppbv VOC 1.Butene 360 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 620 ppbv VOC 2.4-Tirmethylpentane 670 ppbv VOC 1.2.4-Tirmethylpentane 670 ppbv VOC 2.4-Tirmethylpentane 840 ppbv VOC 2.4-Tirmethylpentane 870 ppbv VOC 1.4.100 pp | 1,2,4-1rimetnyibenzene | 120 | l ppbv | VOC |
| Methylcyclohexane 150 ppbv VOC 1.3.5-Trimethylbenzene 170 ppbv VOC Ethylbenzene 170 ppbv VOC Carbon disulfide 210 ppbv VOC Carbon disulfide 210 ppbv VOC Methyl isobutyl ketone 230 ppbv VOC Toluene 330 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1Butene 360 ppbv VOC 0-Xylene 380 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbetane 420 ppbv VOC 2.4-Trimethylpentane 670 ppbv VOC 1Butene 670 ppbv VOC 2.4-Trimethylpentane 670 ppbv VOC 2.4-Trimethylpentane 870 ppbv VOC 2.4-Trimethylpentane 870 ppbv VOC 1.1-Hetane 1300 | 1-Hexene | 140 | ppbv | VOC |
| 1,3.5-Trimethylbenzene 170 ppbv VOC Ethylbenzene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC Methyl methacrylate 210 ppbv VOC 1,3-Butadiene 230 ppbv VOC 1,3-Butadiene 330 ppbv VOC 1-Butene 360 ppbv VOC 2,3-Dimethylbutane 420 ppbv VOC 2,3-Dimethylbutane 420 ppbv VOC 2,4-Trimethylbentane 670 ppbv VOC 2,2,4-Trimethylpentane 670 ppbv VOC 1Heptane 670 ppbv VOC 2,4-Trimethylpentane 870 ppbv VOC 1Heptane 870 ppbv VOC 1Heptane 1300 ppbv VOC 1Pertane 1400 ppbv VOC 1Pentane 1400 | Methylcyclohexane | 150 | ppbv | VOC |
| Ethylbenzene 170 ppbv VOC Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC Carbon disulfide 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC 1.3-Butadiene 330 ppbv VOC 1-Butene 360 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Limethylbexane 440 ppbv VOC Methyl ethyl ketone 440 ppbv VOC 2.4-Antrijhexane 670 ppbv VOC 2.2.4-Trimethylpentane 670 ppbv VOC 3-Methylhexane 840 ppbv VOC 2.4-Dimethylpentane 870 ppbv VOC 1-Heptane 1300 ppbv VOC 2.4-Dimethylpentane 1400 ppbv VOC 2.4-Dimethylpentane | 1,3,5-Trimethylbenzene | 170 | ppbv | VOC |
| Methyl isobutyl ketone 170 ppbv VOC Carbon disulfide 210 ppbv VOC Methyl methacrylate 210 ppbv VOC 1,3-Butadiene 230 ppbv VOC 1,3-Butadiene 330 ppbv VOC 1-Butene 360 ppbv VOC 0-Xylene 380 ppbv VOC 2,3-Dimethylbutane 420 ppbv VOC 2.Aethylnexane 420 ppbv VOC 2.Methyl hexane 420 ppbv VOC 2.Aethylnexane 420 ppbv VOC 2.4-Trimethylpentane 670 ppbv VOC n-Decane 670 ppbv VOC 2.4-Trimethylpentane 870 ppbv VOC 3-Methylhexane 840 ppbv VOC 1-Heptane 1300 ppbv VOC 1-Undecane 870 ppbv VOC 2.4-Dimethylpentane 1500 ppbv< | Ethylbenzene | 170 | ppbv | VOC |
| Carbon disulfide 210 ppbv VOC Methyl methacrylate 210 ppbv VOC 1.3-Butadiene 230 ppbv VOC Toluene 330 ppbv VOC 1-Butene 360 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.4-Methylhexane 420 ppbv VOC 2.4-Methylbethyl ethyl ketone 440 ppbv VOC 2.2.4-Trimethylpentane 670 ppbv VOC n-Decane 620 ppbv VOC 1.4-Heptane 670 ppbv VOC n-Heptane 770 ppbv VOC 3-Methylhexane 840 ppbv VOC 1.4-Dimethylpentane 870 ppbv VOC 1.4-Dimethylpentane 1300 ppbv VOC 1.4-Dimethylpentane 1500 | Methyl isobutyl ketone | 170 | ppbv | VOC |
| Methyl methacrylate 210 ppbv VOC 1,3-Butadiene 230 ppbv VOC 1,3-Butadiene 230 ppbv VOC Toluene 330 ppbv VOC 1-Butene 360 ppbv VOC 2,3-Dimethylbutane 420 ppbv VOC 2,3-Dimethylbutane 420 ppbv VOC 2,Methylhexane 420 ppbv VOC Methyl ethyl ketone 440 ppbv VOC Ethanol 520 ppbv VOC n-Decane 620 ppbv VOC 2,4-Trimethylpentane 670 ppbv VOC n-Heptane 670 ppbv VOC Tetrachloroethylene 770 ppbv VOC a-Methylihexane 840 ppbv VOC Isopentane 1300 ppbv VOC n-Undecane 870 ppbv VOC a-Methyliheptane 1500 ppbv | Carbon disulfide | 210 | vdqq | VOC |
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| Instruct Instruct Instruct Instruct Instruct Toluene 330 ppbv VOC I-Butene 360 ppbv VOC o-Xylene 380 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2.Methylhexane 420 ppbv VOC Ethanol 520 ppbv VOC n-Decane 620 ppbv VOC n-Leptane 670 ppbv VOC n-Heptane 670 ppbv VOC 1.4-trimethylpentane 840 ppbv VOC 1.4-trimethylpentane 840 ppbv VOC 1.4-trimethylpentane 840 ppbv VOC 2.4-Dimethylpentane 870 ppbv VOC 1.4-triane 1300 ppbv VOC 1.4-Dimethylpentane 1500 ppbv VOC 1.4-Dimethylpentane 1500 ppbv VOC n-Hexane 1500 | 1.3-Butadiene | 230 | ppby | VOC |
| I-Butene 360 ppbv VOC 1-Butene 360 ppbv VOC o-Xylene 380 ppbv VOC 23-Dimethylbutane 420 ppbv VOC 2Methylhexane 420 ppbv VOC Methyl ethyl ketone 440 ppbv VOC Ethanol 520 ppbv VOC n-Decane 620 ppbv VOC 2.2.4-Trimethylpentane 670 ppbv VOC n-Heptane 670 ppbv VOC 3-Methylhexane 840 ppbv VOC Ethyl acetate 870 ppbv VOC 1-Jdecane 870 ppbv VOC 2.4-Dimethylpentane 940 ppbv VOC 1-Jeane 1300 ppbv VOC 3-Methylheptane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Nonane 2200 ppbv VOC | | 330 | nnhy | |
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| uxyterie 380 ppbv VOC 2.3-Dimethylbutane 420 ppbv VOC 2-Methylhexane 420 ppbv VOC Methyl ethyl ketone 440 ppbv VOC Ethanol 520 ppbv VOC n-Decane 620 ppbv VOC 2.2.4-Trimethylpentane 670 ppbv VOC n-Heptane 670 ppbv VOC 1etrachloroethylene 770 ppbv VOC 3-Methylhexane 840 ppbv VOC 1etrachloroethylene 870 ppbv VOC n-Undecane 870 ppbv VOC 2.4-Dimethylpentane 940 ppbv VOC 1sopentane 1300 ppbv VOC 1sopentane 1400 ppbv VOC n-Hexane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Nonane 2200 ppbv VOC | | 200 | hhn. | VUU |
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| z-Methylnexane 420 ppbv VOC Methyl ethyl ketone 440 ppbv VOC Ethanol 520 ppbv VOC n-Decane 620 ppbv VOC 2.2.4-Trimethylpentane 670 ppbv VOC n-Heptane 670 ppbv VOC Tetrachloroethylene 770 ppbv VOC 3-Methylhexane 840 ppbv VOC Ethyl acetate 870 ppbv VOC 1-Undecane 870 ppbv VOC 2,4-Dimethylpentane 940 ppbv VOC 1sopentane 1300 ppbv VOC n-Pentane 1400 ppbv VOC n-Hexane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Nonane 2200 ppbv VOC n-Nonane 2200 ppbv VOC Chloroform 3800 ppbv VOC | 2,3-Dimethylbutane | 420 | אממק <u>-</u> יממק | VUC |
| Methyl ethyl ketone 440 ppbv VOC Ethanol 520 ppbv VOC n-Decane 620 ppbv VOC 2,2,4-Trimethylpentane 670 ppbv VOC n-Heptane 670 ppbv VOC n-Heptane 670 ppbv VOC Tetrachloroethylene 770 ppbv VOC 3-Methylhexane 840 ppbv VOC Ethyl acetate 870 ppbv VOC n-Undecane 870 ppbv VOC 2,4-Dimethylpentane 940 ppbv VOC 2,4-Dimethylpentane 1300 ppbv VOC 1sopentane 1400 ppbv VOC 3-Methylheptane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Hexane 1700 ppbv VOC n-Nonane 2200 ppbv VOC chloroform 3800 ppbv VOC | 2-Methylhexane | 420 | ppbv | VOC |
| Ethanol 520 ppbv VOC n-Decane 620 ppbv VOC 2,2,4-Trimethylpentane 670 ppbv VOC n-Heptane 670 ppbv VOC n-Heptane 670 ppbv VOC 1-Heptane 670 ppbv VOC 2,2,4-Trimethylpentane 670 ppbv VOC 1-Heptane 670 ppbv VOC 3-Methylhexane 840 ppbv VOC 2-Methylacetate 870 ppbv VOC n-Undecane 870 ppbv VOC 2,4-Dimethylpentane 1300 ppbv VOC Isopentane 1300 ppbv VOC -Pentane 1400 ppbv VOC 3-Methylheptane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Ctane 1700 ppbv VOC n-Nonane 2200 ppbv VOC | Methyl ethyl ketone | 440 | ppbv | VOC |
| n-Decane 620 ppbv VOC 2,2,4-Trimethylpentane 670 ppbv VOC n-Heptane 670 ppbv VOC Tetrachloroethylene 770 ppbv VOC 3-Methylhexane 840 ppbv VOC Ethyl acetate 870 ppbv VOC n-Undecane 870 ppbv VOC 2,4-Dimethylpentane 940 ppbv VOC 1sopentane 1300 ppbv VOC n-Pentane 1400 ppbv VOC 3-Methylheptane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Hexane 1700 ppbv VOC n-Nonane 2200 ppbv VOC n-Nonane 2500 ppbv VOC Cyclohexane 2500 ppbv VOC Chloroform 3800 ppbv VOC Trichloroethylene 3900 ppbv VOC <td>Ethanol</td> <td>520</td> <td>ppbv</td> <td>VOC</td> | Ethanol | 520 | ppbv | VOC |
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| 3-Methylhexane 840 ppbv VOC Ethyl acetate 870 ppbv VOC n-Undecane 870 ppbv VOC 2,4-Dimethylpentane 940 ppbv VOC Isopentane 1300 ppbv VOC Isopentane 1300 ppbv VOC n-Pentane 1400 ppbv VOC 3-Methylheptane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Hexane 1700 ppbv VOC n-Octane 1700 ppbv VOC n-Nonane 2200 ppbv VOC cyclohexane 2500 ppbv VOC Benzene 2700 ppbv VOC Chloroform 3800 ppbv VOC 2,3-Dimethylpentane 4500 ppbv VOC 2-Methylpentane 7000 ppbv VOC 2-Methylpentane 8900 ppbv VOC | Tetrachloroethvlene | 770 | ppbv | VOC |
| Ethyl acetate 870 ppbv VOC n-Undecane 870 ppbv VOC 2,4-Dimethylpentane 940 ppbv VOC Isopentane 1300 ppbv VOC n-Pentane 1400 ppbv VOC 3-Methylheptane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Hexane 1500 ppbv VOC n-Hexane 1700 ppbv VOC n-Octane 1700 ppbv VOC n-Nonane 2200 ppbv VOC cyclohexane 2500 ppbv VOC Benzene 2700 ppbv VOC Chloroform 3800 ppbv VOC z,3-Dimethylpentane 4500 ppbv VOC 2,3-Dimethylpentane 7000 ppbv VOC 2-Methylpentane 8900 ppbv VOC 2-Methylpentane 8900 ppbv VOC | 3-Methvlhexane | 840 | vdqq | VOC |
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| Isopropyl alcohol26000ppbvVOCAcetone42000ppbvVOC | 2,2-Dimethylbutane | 20000 | ppbv | VOC |
| Acetone 42000 ppbv VOC | Isopropyl alcohol | 26000 | ppbv | VOC |
| | Acetone | 42000 | ppbv | VOC |
| n-Butane 1200000 ppbv VOC | n-Butane | 1200000 | ppbv | VOC |
| | | 1 | I I - | |

Geology

The reservoirs containing designated oil sands deposits (designated by the AER) in the PROS area centre around and are controlled by the paleotopography of the sub-Cretaceous angular unconformity (Sub-K). This unconformity separates the lower, but older, passive margin succession from the upper, but younger, foreland basin succession in the Western Canada Sedimentary Basin (WCSB). An important feature to the oil sands designated heavy oil and bitumen in the PROS area is the Red Earth Highlands (Figure 4). This feature was a paleotopographic high during early Cretaceous sedimentation, discussed in Hubbard et al. (1999). The tectonostratigraphic history of the WCSB, as it applies to the oil and gas deposits in the PROS area, is summarized by Berbesi et al. (2012).

Summary of Relevant Geological Units and Surfaces Upper Devonian to Lower Mississippian Exshaw Formation –

source rock that has contributed hydrocarbons to the oil sands deposits in the PROS area. It consists primarily of black shale deposited in a deep marine environment. The Exshaw Formation subcrop area is located on the northeastern edge of the Red Earth Highlands (Figure 4).

Mississippian Pekisko and Debolt Formations – secondary hosts of oil sands deposits in the PROS area. In this area, both formations are primarily composed of marine limestone that has undergone intensive dolomitization near the Sub-K, resulting in vuggy carbonate reservoirs. The Debolt Formation can be subdivided into an upper, middle, and lower unit. The upper Debolt is composed of limestone and dolostone overlying a regional anhydrite bed that pinches out to the northeast (Figure 5). The middle and lower Debolt are composed of argillaceous and clean carbonates, respectively. The Pekisko and Debolt formations both have subcrop areas within the Red Earth Highlands area, where they come into contact with the Bluesky and Gething formations (Figures 4 and 5).

Permian Belloy Formation – secondary host of the oil sands deposit in the PROS area, primarily composed of sandstone deposited in a shallow marine environment. The Belloy subcrop area is located at the southwestern edge of the Red Earth Highlands, putting it in direct contact with the Bluesky and Gething formations (Figures 4 and 5).

Jurassic Gordondale Member (Historically the Nordegg Member Shale) of the Fernie Formation – a source rock that has contributed hydrocarbons to the PROS area, including the oil sands deposits (Creaney and Allan, 1992). It consists of variously phosphatic limestones including calcitic mudstone, calcilutite, and calcarenite, deposited in a marine environment (Asgar-Deen et al., 2004). The Gordondale Member is partially overlain by the other shales of the Fernie Formation and by the Gething Formation fluvial deposits in the PROS area. The Gordondale Member subcrops at the Sub-K in the Reno area and the southwest corner of the Three Creeks area (Figure 4).

Together, the Gordondale Member and Exshaw Formation are considered to be the main source rocks for the oil sands deposits in the PROS area. The contribution of both of these strata to the oil sands deposits has been in debate for many years. Complications with determining source-rock contribution stem from the influence of biodegradation on the geochemical signature of heavy oil and bitumen.

Sub-Cretaceous Unconformity (Sub-K) – divides Cretaceous rocks from older rocks, as mentioned above. Due to the angular nature of this unconformity, a number of underlying formations are in contact with Cretaceous units at this unconformity surface (Figure 5).

Lower Cretaceous Gething Formation – secondary host of oil sands deposits in the PROS area. It consists of sandstone and mudstone deposited in a fluvial environment. The Gething Formation is overlain by Wilrich Member shale of the Spirit River Formation where the overlying Bluesky Formation is absent. The Gething is underlain in some areas by the Cadomin Formation or is in direct contact with the Sub-K, where it overlies several older geological units. Gething Formation deposition was controlled by the Red Earth Highlands.

Lower Cretaceous Bluesky Formation – the primary host of the oil sands designated heavy oil and bitumen in the PROS area. It consists of sandstone and mudstone deposited in a shoreline to shallow shelf environment, with the main reservoir sands deposited in a wavedominated estuarine environment. The Bluesky is overlain by Wilrich Member shale of the Spirit River Formation (within the Fort St. John



Figure 4. Map showing the subcrop areas of the geological units on the sub-Cretaceous unconformity, derived from the 3-D geological model



geological model.





Figure 5. Map showing the subcrop areas of the geological units on the sub-Cretaceous unconformity, derived from the 3-D

Group) and underlain by Gething Formation fluvial deposits. Deposition of the Bluesky was controlled by the Red Earth Highlands, separating deposition in the northeast from the southwest (Figure 5). Oil sands production is currently occurring mainly in the southwest, with only minor exploration occurring in the northeast.

Bluesky-Gething – Oil sands deposits contained in the Bluesky and Gething formations are often referred to together in literature as the Bluesky-Gething deposits, and this is the terminology used in this report. A gross isopach map of the Bluesky-Gething shows thinning to complete absence of the unit in the area of the Red Earth Highlands, highlighting the influence of this paleotopographic feature on deposition (Figure 6). A net pay map displays the thickness of bitumen-saturated sands using a \geq 6% mass bitumen cut-off (Figure 7). The sands range in character from relatively clean and homogeneous to finely laminated. Homogeneous sands may also be separated by several metres of shale.

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Bluesky-Gething Bitumen Pay (m)
 1.5 - 5
 10 - 15
 20 - 25
 30 - 35
 Area Earth Highlands

 5 - 10
 15 - 20
 25 - 30
 35 - 40
 Image: Comparison of the second 0 30 60 120 Alberta Energy Regulator

Figure 6. Gross isopach map of the Bluesky-Gething and its relationship to the Red Earth Highlands, derived from the 3-D geological model.

Figure 7. Bitumen pay thickness map for the Bluesky-Gething deposits using a $\geq 6\%$ mass bitumen cut-off.