Quantitative Evaluation and Population Statistics of Point Bar Dimensions, McMurray Formation, Northeastern Alberta*

Elinda Dehari[1] and Michael Webb[2]

Search and Discovery Article #80576 (2017)**
Posted February 6, 2017

*Adapted from extended abstract based on poster presentation given at AAPG Annual Convention & Exhibition, Calgary, Alberta, Canada, June 19-22, 2016

[1]University of Calgary (elinda.dehari@gmail.com)
[2]Suncor Energy Inc.

Abstract

This study establishes population statistics of point bar dimensions from a collection of multiple point bars that occur on multiple 3D seismic surveys. Point bars of the Middle McMurray Formation are the main reservoir for heavy oil (bitumen) in the Athabasca oil sands region, where heavy oil is extracted through the Steam Assisted Gravity Drainage (SAGD) process (Figure 1). Reservoir heterogeneity within a single ancient point bar is mainly governed by the predictable distribution of inclined heterolithic stratification (IHS), which increases from upstream to downstream parts of the bar. When several point bar fragments are amalgamated laterally, heterogeneity increases with the presence of abandoned channel fills, and the predictable distribution of facies within point bars is less relevant. Understanding the geometry and spatial distribution of the point bar deposits is essential for constructing the character of the reservoir (Figure 2).

Methods

Point bar scrolls and abandoned channel fills were interpreted on 3D seismic slices on multiple seismic surveys that span five study areas. The study areas represent diverse localities across the vast Athabasca oil sands region, and are located both north and south of the city of Fort McMurray, and west and east of the Athabasca River. After scroll bar outlines were interpreted, dipmeter and borehole image data was integrated to confirm point bar geometries. Measurements for point bars and abandoned channels included length, width, and area. In most cases, point bars and abandoned channels were fragmentary due to erosion by younger channels, so most measurements of point bars are to be considered minimum values. In a few other cases, bars were larger than the 3D seismic survey, so their complete dimensions could not be measured. In contrast, there appear to be no issues obtaining valid widths of seismically-defined abandoned channels.

Results

Across all five study areas, measurements were collected for 43 point bars and point bar fragments and 23 abandoned channel fill deposits. Study area A contained 15 seismically-interpreted point bar deposits and 10 associated abandoned channel fills (Figure 3 and Figure 4). The average area of point bars was 1.6 km^2, while the average area of abandoned channel fills was 1.0 km^2. The average width of abandoned channel fills was 303 m. At study area B, 8 point bars and 4 abandoned channel fills were interpreted (Figure 5 and Figure 6). Point bars were slightly larger in this area, with an average area of 3.1 km^2. Abandoned channel fills at study area B have an average width of 303 m. Over all five study areas, the average area of point bars was 3.8 km^2 and average width of abandoned channels of 313 m (Figure 7 and Figure 8).

Conclusions

Despite the diverse location of the seismic surveys, the range of point bar sizes and areas are just as variable within a single study area as they are across the Athabasca oil sands region. However, the average width of abandoned channel fills was remarkably consistent across the region. This data set can provide an analogue for exploration areas with low well density, so that general trends in point bar and abandoned channel size can be estimated. In a development setting, these data speak to the level of inter-point bar heterogeneity that will be encountered at the SAGD pad scale.

Acknowledgements

The authors of this poster would like to thank Suncor Energy Inc. for providing the data set required to complete this project, as well as the geophysicists involved including: Sylvestre Charles, Emily Duncan, Shannon Hiebert, Karen Primrose, and Frank Sun. Geologists Stacy Johnson and Andres Altosaar are also thanked for their support. We thank Nexen Inc. for approval to present a portion of the data.

Figure 1. Map of Alberta denoting the location of the Athabasca Oil Sands.

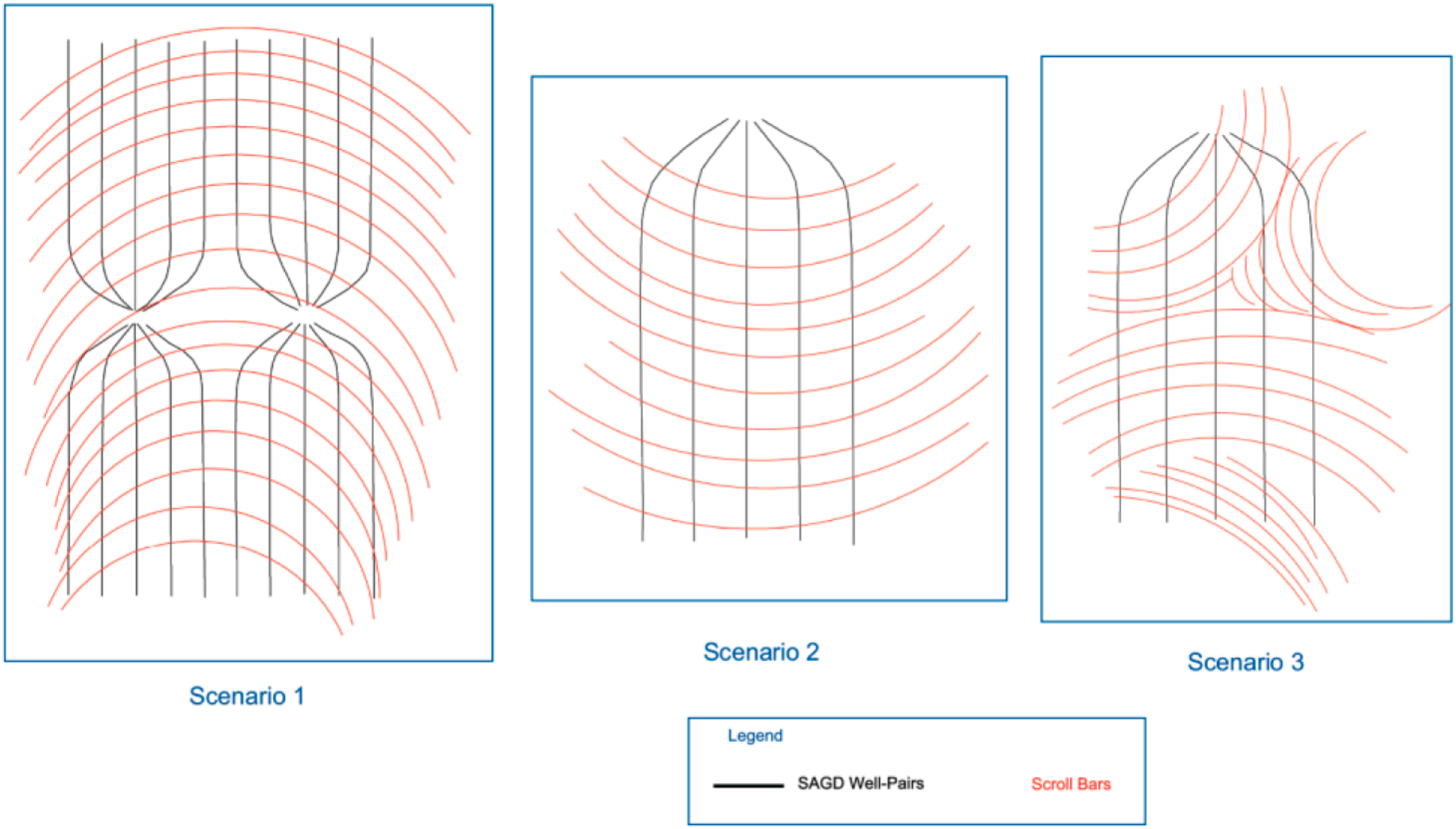

Figure 2. Possible scenarios that could be encountered during SAGD well drilling. The most predictable reservoir quality would be in scenarios 1 and 2, where one point bar fits multiple wells and only intra-bar reservoir heterogeneity would need to be considered. Scenario 3 would be least predictable as one well encounters multiple point bars and bar fragments, which would increase the level of heterogeneity and complexity during production. By understanding the dimensions of these point bars, we can assess subsurface heterogeneity during well planning.

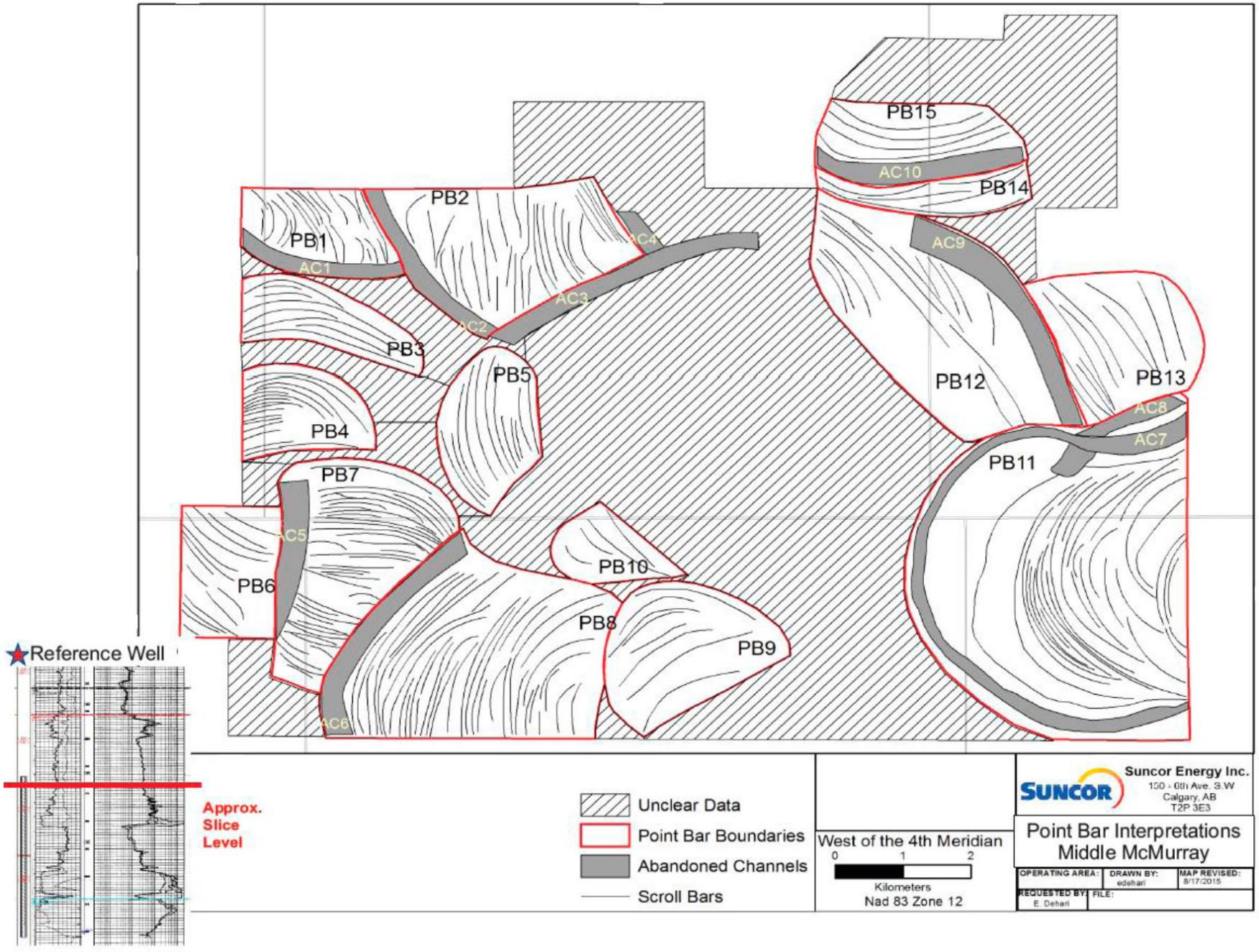

Figure 3. Interpretation of 15 seismically interpreted point bars and 10 abandoned channel fills in Study Area A.

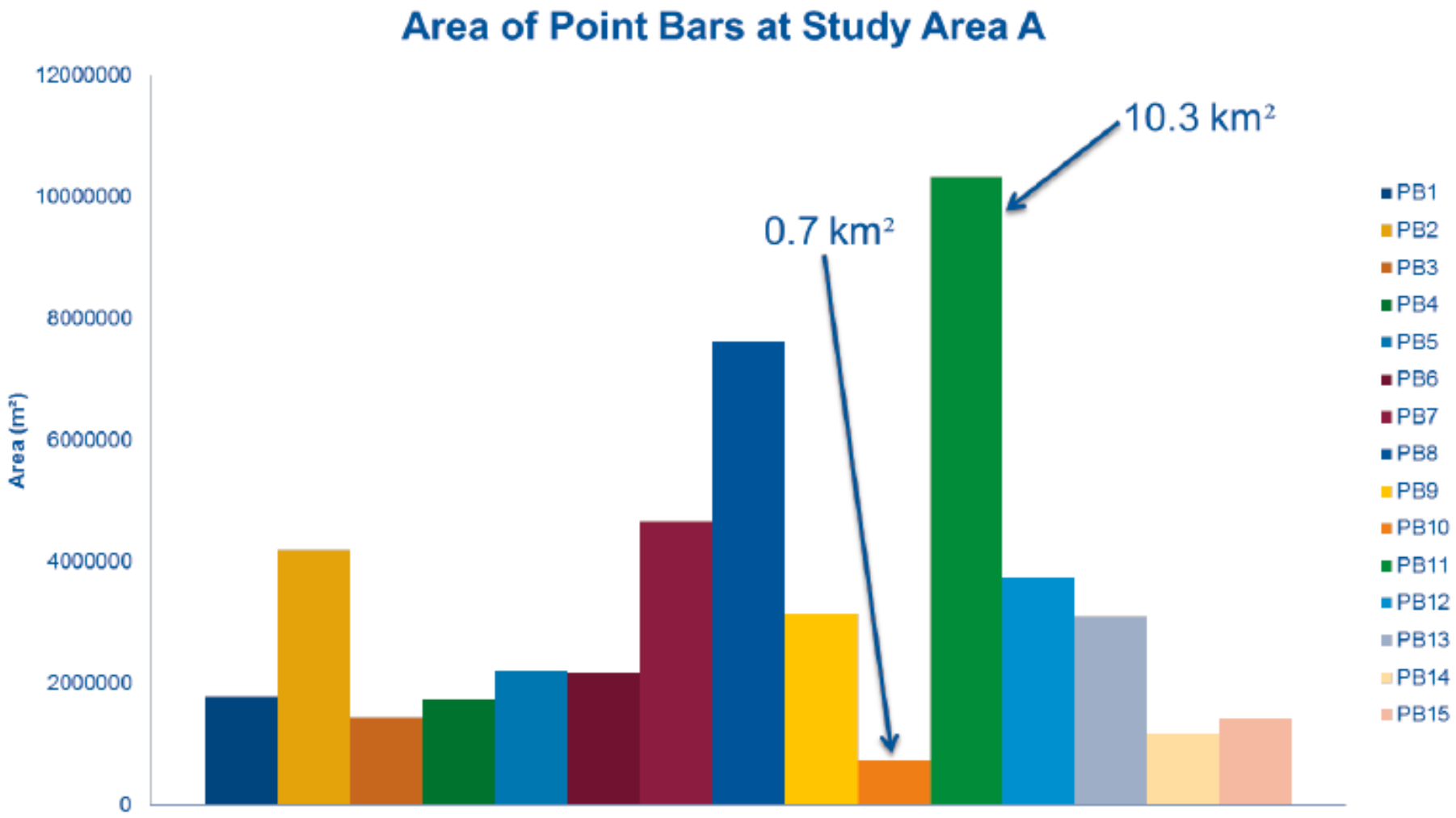

Figure 4. Statistics of dimensions collected at Study Area A. The average area of point bars was 1.6 km^2 while maximum values exceeded 10 km^2. The average width of abandoned channel fills was 303 m.

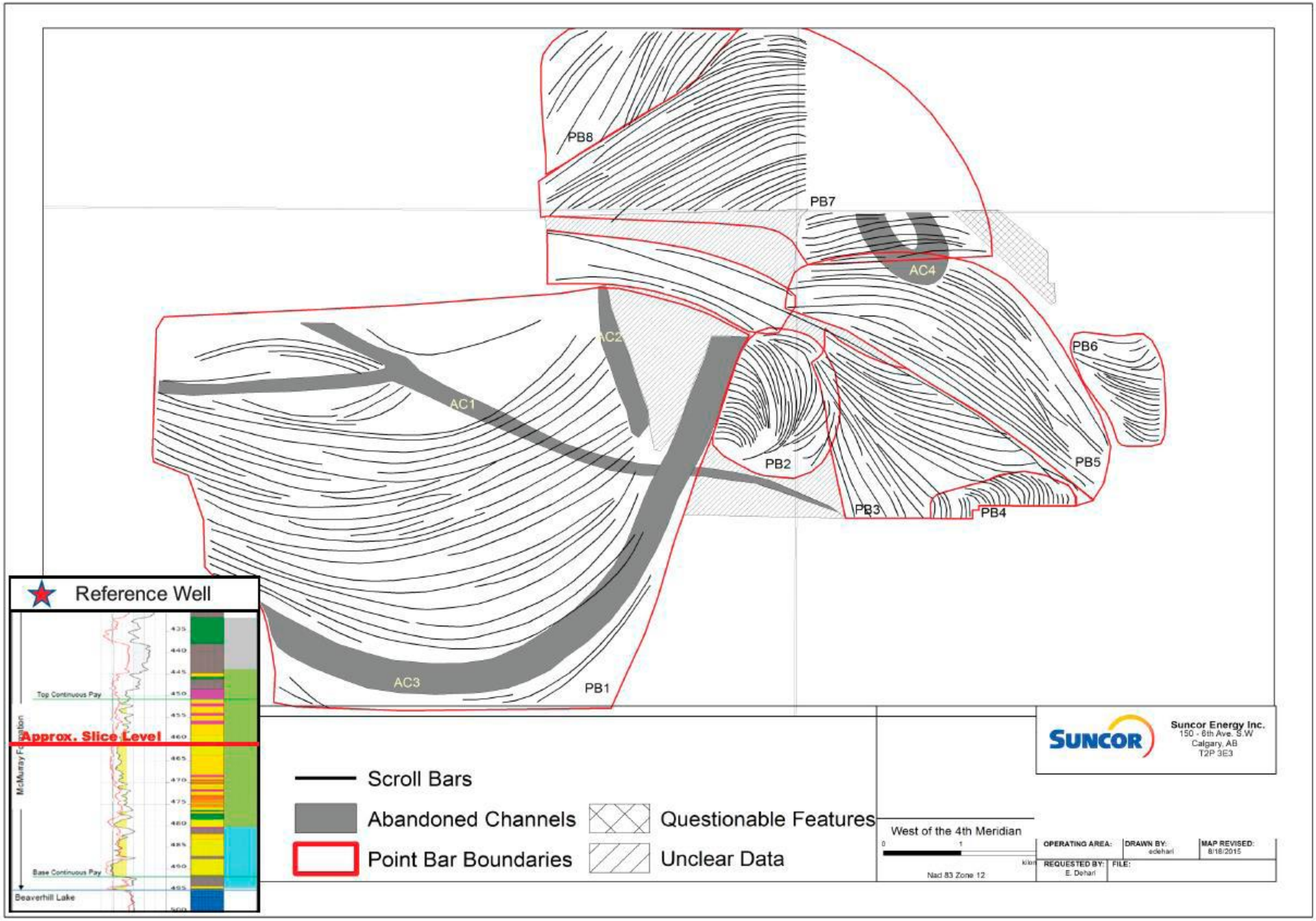

Figure 5. Interpretation of 8 seismically interpreted point bars and 4 abandoned channel fills in Study Area B.

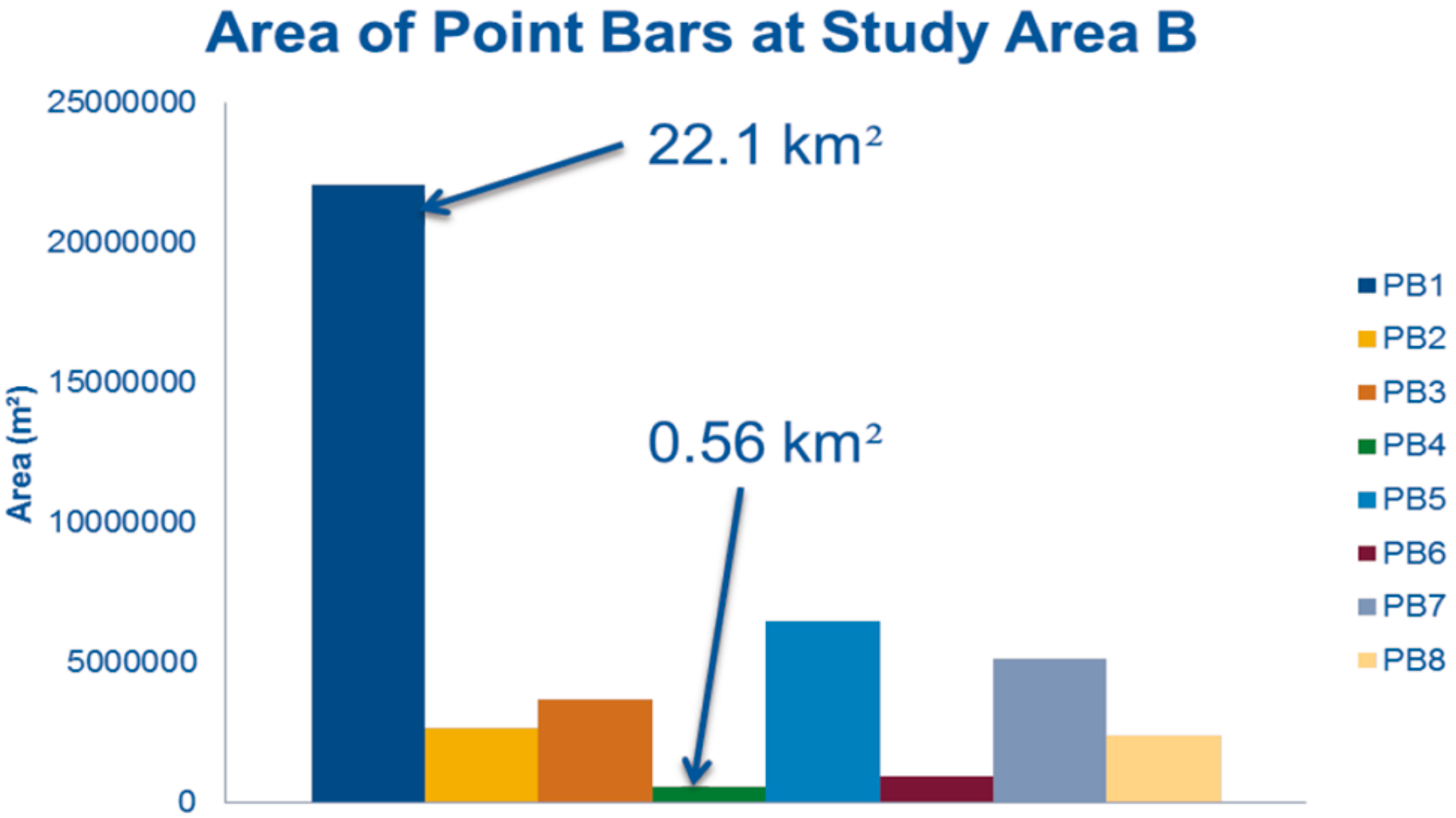

Figure 6. Statistics of dimensions collected at Study Area B. The point bars were slightly larger in this area, with an average of 3.1 km^2. Like Study Area A, the abandoned channel fills at Study B also had an average width of 303 m.

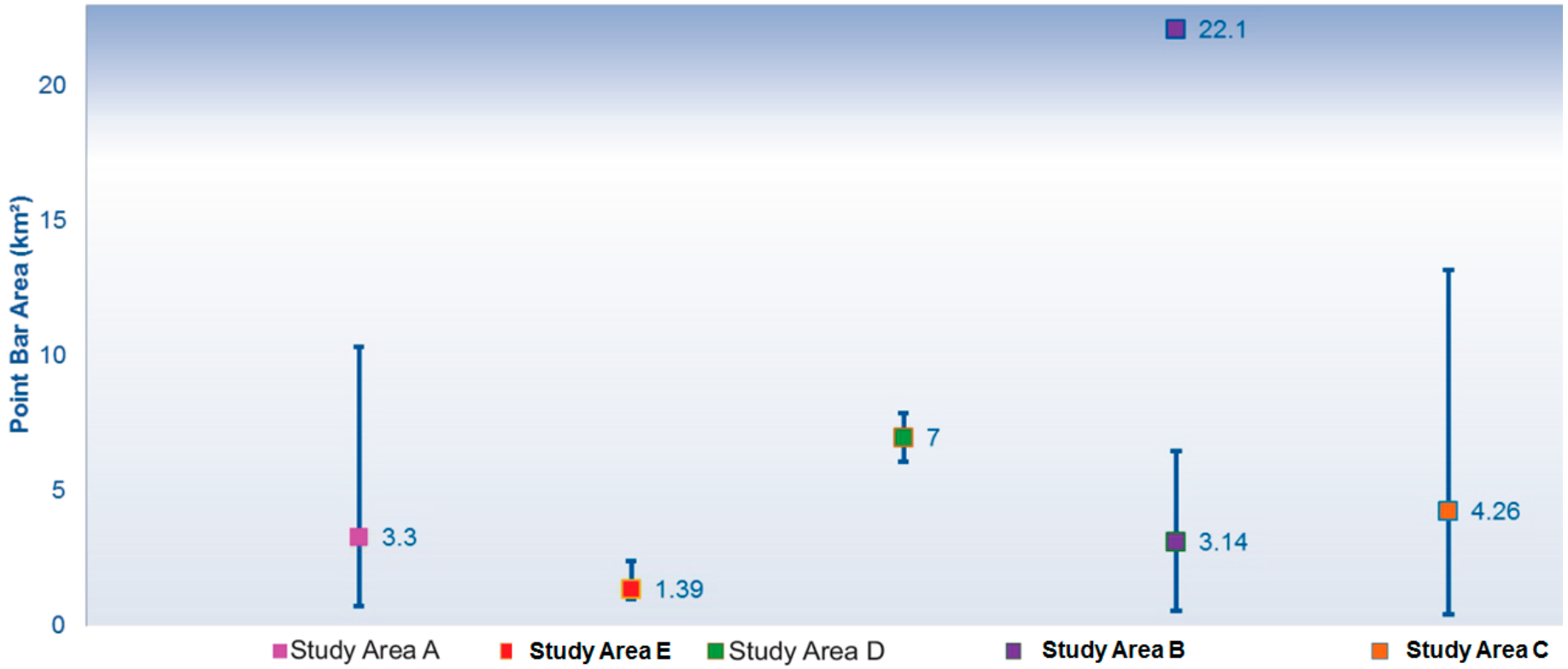

Figure 7. The average area of the 43 seismically-defined point bars among all the study areas was 3.82 km^2.

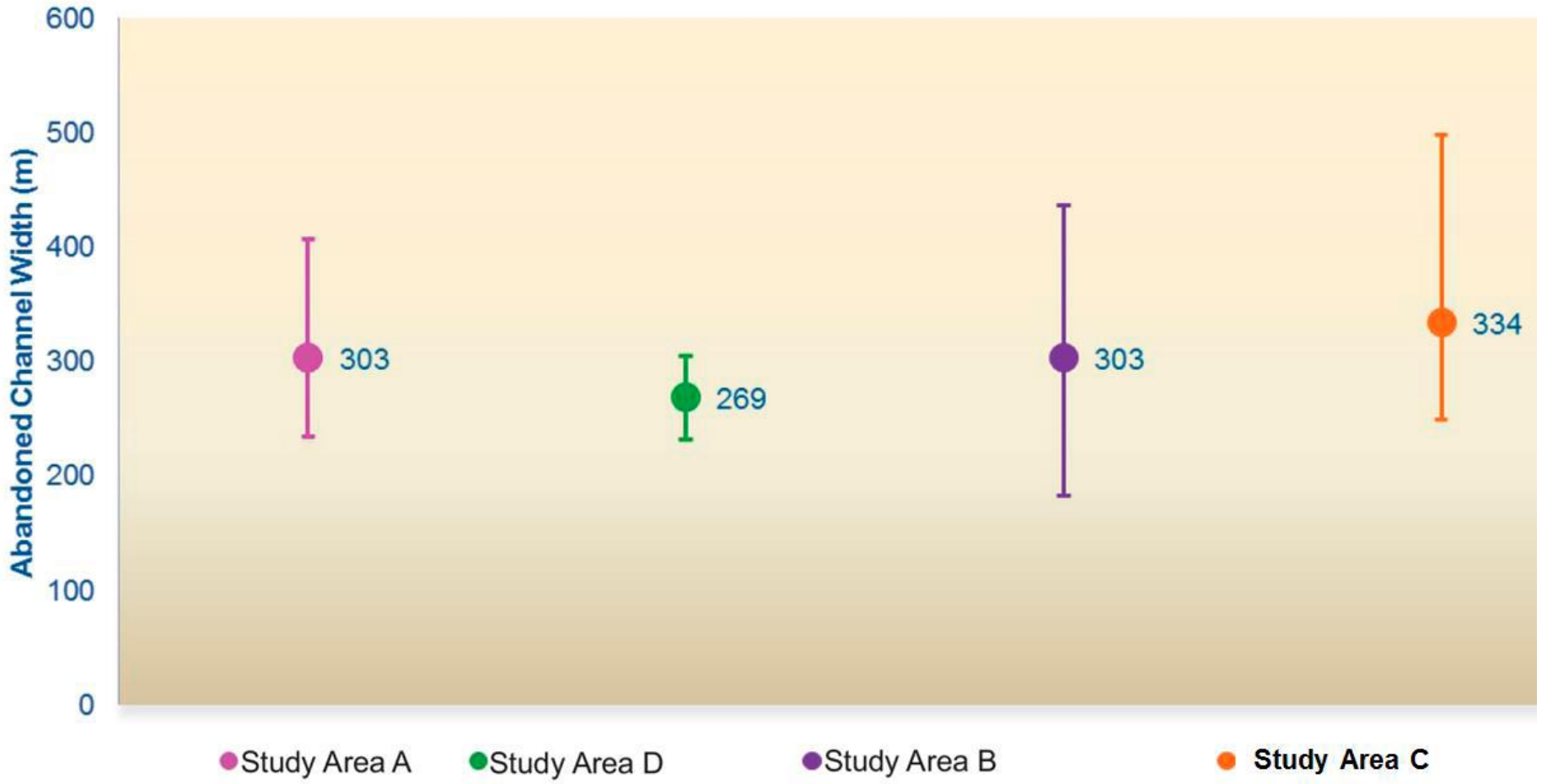

Figure 8. The average width of the 23 seismically-defined abandoned channels among all the study areas was 323 m.