

## SURVEY REPORT

<b>For:</b>	<a href="#">Bacchus Resources</a>	<b>Report Date:</b>	05/06/2017
		<b>Our Job #:</b>	2017-0071
<b>Attn:</b>	<a href="#">David Ward</a>	<b>Your Ref:</b>	
<b>Project Description:</b>	Woolwonga Bathymetric Survey		<b>Survey Brief Completed</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Project Manager:</b>	Jim Walker	<b>Project Surveyors:</b>	MW, AO, JPG
<b>Start Date:</b>	03/05/2017	<b>End Date:</b>	05/06/2017
<b>Equipment Used:</b>	<input checked="" type="checkbox"/> Differential GPS <input checked="" type="checkbox"/> Digital Level <input type="checkbox"/> Scanner <input type="checkbox"/> Static GPS <input checked="" type="checkbox"/> Hydro Vessel <input type="checkbox"/> Other: <input type="checkbox"/> Total Station <input type="checkbox"/> UAV		
<b>Deliverables:</b>	<input checked="" type="checkbox"/> Drawings <input checked="" type="checkbox"/> Plots <input type="checkbox"/> Site Images <input checked="" type="checkbox"/> Reports		
<b>Project Datum:</b>	<b>Horizontal:</b> MGA Z52	<b>Vertical:</b> AHD	

### Methodology

- New Survey Control was established using AUSPOS static observations (two days) and RTK GPS. Level run between control point to the third order was done.
- Spoil stockpiles and photogrammetry data conformation was done with RTK GPS
- Bathymetric Survey was completed from the boat with RTK GPS and echo sounder. Bench tests of transducer was performed on daily basis and checked against known depth
- Topographic land survey conducted over exposed areas not measurable from NTGS photogrammetry survey
- All survey data combined to produce final surface model of pit unexposed during photogrammetry survey
- Areas not covered by bathymetric or land survey due to access restrictions, are interpolated from survey and photogrammetry data

### Survey Control

Based on original AUSPOS observations MGA Z52, AHD

5000	776515.762	8516281.404	90.806	STN 5000 SIP
5001	776488.981	8516132.532	89.702	STN 5001 SIP
5002	776561.453	8516175.401	88.319	STN 5002 SIP

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### Photogrammetry DTM Verification

Attached to current report

### Volume reports

1. TOTAL WATER VOLUME

Base Surface	Bathymetric Survey
Comparison Surface	Water Level 80.77
Volume	4,487,590 Cu. M.

Note: Total water volume calculations boundary defined by current bathymetric survey limits.

2. VOLUME BETWEEN TOP OF CURRENT FLOOR AND ORIGINAL AS\_BUILT SURVEY

Original DTM coordinates transformation was based on two set of coordinates

	Local	GDA
X1	9,731.7	776,415.9
Y1	11,850.0	8,516,383.0
X2	9,770.1	775,772.0
Y2	12,798.5	8,517,081.0

Original DTM height datum is unknown, all volumes provided below can be treated as informational only. There are two options when original DTM height datum was adjusted.

Note: Volume calculations boundary defined by current bathymetric survey limits.

A. Original Height Datum was shifted by -1003.064 m to best fit existing surface outside flooded pit

#### Point to Surface Comparison

Using Surface Original Surface

Pt.Num	Easting	Northing	Pt.Z	Surf.Z	Diff
1705058001	776363.538	8516719.874	87.474	1090.433	-1002.959
1705058002	776335.553	8516750.869	88.112	1090.573	-1002.461
1705058005	775776.294	8517078.226	95.246	1100.981	-1005.735
1705058006	775790.722	8516991.056	89.107	1092.268	-1003.161
1705058007	775798.081	8516952.167	84.162	1087.293	-1003.131
1705058008	775836.764	8516781.552	92.191	1094.169	-1001.978
1705058010	776059.023	8516607.849	93.510	1095.530	-1002.020
				AVERAGE	-1003.064

Base Surface	Bathymetric Survey
Comparison Surface	Original Pit Surface -1003.064 m
Cut volume	143,749 Cu. M.
Fill volume	2,302,440 Cu. M.
Net volume	2,158,691 Cu. M. <FILL>
Mean elevation	9.393m

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B. Original Height Datum was shifted by -1000

Base Surface	Bathymetric Survey
Comparison Surface	Original Pit Surface -1000 m
Cut volume	399,229 Cu. M.
Fill volume	1,853,743 Cu. M.
Net volume	1,454,514 Cu. M.<Cut>
Mean elevation	6.329m

**Underground Services**

Not detected as a part of the survey

**Omissions**

None

Additional Information has been attached for your reference: **No**

**Survey Report and Deliverables have been prepared and approved by the following:**

<b>Prepared by Project Surveyor:</b>	Igor Fomin & J Piper-Green	<b>Approved by Project Manager/Supervisor:</b>	Jim Walker
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**APPENDIX A**

*Surveyed Points to Photogrammetry Surface Comparison*  
*Using Surface Photogrammetry external*  
*Coordinate system MGA94, AHD height Datum*

Pt.Num	Easting	Northing	RL	Surface RL	Difference,m
1705043057	776227.830	8516480.932	93.789	93.821	0.032
1705043058	776232.044	8516475.098	92.431	92.444	0.013
1705043059	776234.639	8516472.337	91.665	92.001	0.336
1705043060	776237.357	8516467.350	91.881	91.978	0.097
1705043061	776241.433	8516461.211	92.122	91.994	-0.128
1705043062	776244.904	8516455.987	92.162	92.377	0.215
1705043063	776248.686	8516450.455	92.767	92.602	-0.165
1705043064	776256.231	8516439.438	93.636	93.197	-0.439
1705043065	776259.634	8516433.816	93.701	93.220	-0.481
1705043066	776270.626	8516425.809	93.742	93.477	-0.265
1705043067	776285.829	8516413.262	93.694	93.696	0.002
1705043068	776300.731	8516401.288	93.269	93.133	-0.136
1705043069	776314.498	8516390.133	93.075	93.003	-0.072
1705043070	776324.852	8516381.414	93.025	93.028	0.003
1705043071	776334.139	8516373.443	92.940	92.948	0.008
1705043102	776249.274	8516597.663	81.449	82.309	0.860
1705043103	776242.924	8516596.967	81.595	82.255	0.660
1705043104	776234.086	8516597.894	81.863	82.219	0.356
1705043105	776225.758	8516598.600	82.319	82.523	0.204
1705043106	776217.234	8516599.299	82.884	83.083	0.199
1705043107	776209.125	8516600.311	83.543	83.564	0.021
1705043108	776200.867	8516600.869	84.220	84.209	-0.011
1705043109	776192.034	8516601.100	85.010	84.987	-0.023
1705043110	776184.401	8516600.039	85.751	85.850	0.099
1705043111	776177.953	8516597.802	86.156	86.480	0.324
1705043126	776210.415	8516621.618	81.722	82.586	0.864
1705043127	776217.804	8516621.847	81.465	82.372	0.907
1705043128	776220.949	8516620.804	81.335	82.281	0.946
1705043129	776225.539	8516617.958	81.356	82.141	0.785
1705043130	776232.043	8516611.757	81.214	81.939	0.725
1705043131	776238.545	8516606.832	81.312	81.840	0.528
1705043132	776245.333	8516601.196	81.474	82.068	0.594
1705043133	776253.715	8516594.062	81.593	82.499	0.906
1705043134	776261.471	8516594.243	81.693	82.573	0.880
1705043135	776268.810	8516594.823	82.000	82.825	0.825
1705043136	776277.763	8516596.641	82.544	82.994	0.450
1705043137	776267.810	8516548.753	83.391	83.377	-0.014
1705053000	776272.575	8516529.996	83.234	83.048	-0.186
1705053001	776278.866	8516535.522	82.867	82.898	0.031
1705053002	776286.328	8516543.361	82.864	83.018	0.154

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1705053003	776293.778	8516550.342	82.979	83.633	0.654
1705053004	776299.671	8516553.922	82.956	83.194	0.238
1705053005	776304.624	8516560.004	82.526	82.833	0.307
1705053006	776312.567	8516565.047	82.447	82.493	0.046
1705053007	776314.324	8516574.600	82.430	82.515	0.085
1705053008	776316.019	8516581.715	82.270	82.433	0.163
1705053009	776316.455	8516587.077	82.211	82.381	0.170
1705053010	776311.028	8516592.260	82.354	82.445	0.091
1705053011	776307.718	8516597.643	82.496	82.545	0.049
1705053012	776298.286	8516597.228	81.927	82.606	0.679
1705053013	776289.553	8516598.627	82.111	82.758	0.647
1705053014	776290.285	8516595.287	81.795	82.696	0.901
1705053015	776294.900	8516592.447	82.217	82.626	0.409
1705053016	776304.178	8516589.822	82.258	82.569	0.311
1705053017	776305.692	8516582.335	82.419	82.705	0.286
1705053018	776303.227	8516573.875	82.620	82.950	0.330
1705053019	776299.087	8516565.832	82.732	83.534	0.802
1705053020	776298.665	8516558.362	82.586	83.544	0.958
1705053021	776287.784	8516550.999	83.074	83.539	0.465
1705053022	776288.457	8516559.233	83.314	83.866	0.552
1705053023	776287.850	8516567.972	83.396	83.723	0.327
1705053024	776286.658	8516577.368	83.237	83.050	-0.187
1705053025	776289.921	8516583.371	82.901	82.862	-0.039
1705053026	776284.945	8516589.421	82.550	82.798	0.248
1705053027	776277.233	8516587.099	82.761	82.858	0.097
1705053028	776273.145	8516585.268	82.731	82.860	0.129
1705053029	776270.699	8516583.258	82.524	82.869	0.345
1705053030	776272.524	8516578.946	82.948	82.971	0.023
1705053031	776275.597	8516571.078	83.272	83.146	-0.126
1705053032	776277.622	8516563.236	83.220	83.327	0.107
1705053033	776278.962	8516555.739	83.219	83.317	0.098
1705053034	776278.730	8516547.718	83.118	83.097	-0.021
1705053035	776273.129	8516541.353	83.216	83.013	-0.203
1705053036	776269.234	8516530.086	83.341	83.237	-0.104
1705053037	776271.229	8516522.396	83.393	83.318	-0.075
1705053038	776268.878	8516511.118	84.575	84.586	0.011
1705053061	776348.573	8516398.945	82.729	82.789	0.060
1705053062	776356.925	8516395.137	82.567	82.416	-0.151
1705053063	776357.630	8516388.498	82.521	82.216	-0.305
1705053064	776366.269	8516379.720	82.334	82.407	0.073
1705053065	776372.224	8516379.253	82.239	82.543	0.304
1705053066	776368.335	8516390.404	82.448	81.899	-0.549
1705053067	776367.323	8516399.238	82.585	81.698	-0.887
1705053068	776359.743	8516395.230	82.540	82.068	-0.472
1705053069	776353.783	8516402.849	82.590	81.995	-0.595
1705053070	776365.270	8516403.987	82.583	81.770	-0.813
1705053071	776359.545	8516410.428	82.483	81.719	-0.764

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1705053072	776352.627	8516407.752	82.660	82.032	-0.628
1705053073	776352.797	8516416.942	82.349	81.867	-0.482
1705053074	776345.595	8516413.848	82.659	82.338	-0.321
1705053075	776339.598	8516418.648	82.575	82.668	0.093
1705053076	776342.314	8516424.885	82.047	82.230	0.183
1705053077	776333.457	8516433.243	82.025	82.180	0.155
1705053103	776325.355	8516441.226	82.108	81.685	-0.423
1705053104	776318.111	8516447.377	82.158	81.662	-0.496
1705053105	776311.768	8516452.334	82.098	81.887	-0.211
1705053106	776288.929	8516471.719	82.308	82.242	-0.066
1705053107	776280.622	8516477.240	82.412	82.401	-0.011
1705053108	776274.587	8516484.674	82.656	82.288	-0.368
1705053127	776241.134	8516469.672	91.255	91.283	0.028
1705053128	776248.275	8516476.292	89.700	89.787	0.087
1705053129	776252.313	8516483.395	88.529	88.678	0.149
1705053130	776255.696	8516491.910	87.352	87.486	0.134
1705053131	776260.042	8516502.277	85.961	86.207	0.246
1705053132	776263.721	8516510.222	84.995	85.054	0.059
1705053133	776266.886	8516516.383	84.068	84.272	0.204
1705053144	776270.641	8516562.367	83.409	83.184	-0.225
1705053145	776272.584	8516553.661	83.326	83.147	-0.179
1705053146	776272.172	8516542.756	83.270	83.036	-0.234
1705053147	776270.120	8516536.103	83.302	83.131	-0.171
1705053148	776268.012	8516564.765	83.436	83.170	-0.266
1705053149	776264.171	8516571.662	83.203	83.052	-0.151
1705053150	776265.545	8516580.697	82.636	82.844	0.208
1705053151	776256.158	8516578.312	82.505	82.768	0.263
1705053152	776247.987	8516582.810	82.146	82.891	0.745
1705053153	776256.433	8516586.714	82.050	82.756	0.706
1705053154	776264.733	8516584.431	82.347	82.766	0.419
1705053155	776270.424	8516586.772	82.224	82.833	0.609
1705053156	776267.286	8516590.427	82.040	82.776	0.736
1705053157	776260.057	8516589.306	81.941	82.604	0.663
1705053158	776252.321	8516589.015	81.812	82.731	0.919
1705053159	776246.623	8516588.194	81.886	82.733	0.847
1705053160	776247.281	8516593.318	81.663	82.463	0.800
1705053161	776237.040	8516602.747	81.641	81.975	0.334
1705053162	776229.655	8516601.235	82.127	82.191	0.064
1705053163	776226.246	8516604.433	82.111	82.274	0.163
1705053164	776223.061	8516598.876	82.469	82.721	0.252
1705053165	776219.273	8516609.263	82.171	82.635	0.464
1705053166	776214.951	8516613.408	82.438	82.788	0.350
1705053167	776208.475	8516612.186	82.975	83.135	0.160
1705053168	776211.400	8516607.656	83.040	83.144	0.104
1705053169	776214.793	8516602.723	82.997	83.037	0.040
1705053170	776204.131	8516603.386	83.760	83.797	0.037
1705053171	776199.363	8516608.872	83.945	83.850	-0.095

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1705053172	776195.498	8516604.232	84.426	84.374	-0.052
1705053218	776146.793	8516565.221	94.631	94.638	0.007
1705053219	776153.989	8516557.465	94.701	94.870	0.169
1705053220	776163.235	8516549.640	94.645	94.658	0.013
1705053221	776174.895	8516537.157	94.725	94.351	-0.374
1705053222	776180.094	8516531.770	94.727	94.499	-0.228
1705053223	776189.322	8516521.870	94.796	94.664	-0.132
1705053224	776199.195	8516514.230	94.875	94.449	-0.426
1705053225	776208.539	8516504.005	94.964	94.415	-0.549
1705053226	776215.988	8516496.707	94.770	94.451	-0.319
1705053227	776222.275	8516491.545	94.562	94.523	-0.039
1705053228	776225.172	8516498.881	94.840	94.623	-0.217
1705053229	776225.733	8516507.851	94.637	94.676	0.039
1705053230	776226.868	8516516.845	94.476	94.683	0.207
1705053231	776228.655	8516525.056	94.439	94.642	0.203
1705053232	776230.742	8516533.496	94.450	94.642	0.192
1705053233	776232.719	8516541.058	94.499	94.682	0.183
1705053234	776229.555	8516546.708	94.432	94.649	0.217
1705053235	776226.367	8516540.633	94.467	94.574	0.107
1705053236	776223.536	8516530.691	94.366	94.564	0.198
1705053237	776222.355	8516520.749	94.285	94.632	0.347
1705053238	776220.249	8516509.451	94.477	94.646	0.169
1705053239	776212.058	8516510.366	94.555	94.508	-0.047
1705053240	776212.106	8516518.666	94.246	94.434	0.188
1705053241	776214.382	8516526.597	94.302	94.366	0.064
1705053242	776217.037	8516536.297	94.409	94.237	-0.172
1705053243	776219.548	8516545.486	94.255	94.109	-0.146
1705053244	776222.055	8516551.953	94.300	94.178	-0.122
1705053245	776212.456	8516554.601	94.151	94.007	-0.144
1705053246	776210.425	8516547.294	94.163	93.948	-0.215
1705053247	776207.806	8516540.285	94.311	93.982	-0.329
1705053248	776205.308	8516531.831	94.253	94.107	-0.146
1705053249	776202.145	8516524.450	94.240	94.272	0.032
1705053250	776194.228	8516528.493	94.397	94.388	-0.009
1705053251	776196.917	8516537.783	94.303	94.180	-0.123
1705053252	776199.494	8516546.221	94.278	94.166	-0.112
1705053253	776203.185	8516556.627	94.127	94.491	0.364
1705053254	776197.474	8516562.098	94.243	94.645	0.402
1705053255	776192.918	8516555.333	94.099	94.398	0.299
1705053256	776188.415	8516546.735	94.330	94.210	-0.120
1705053257	776184.849	8516540.121	94.285	94.270	-0.015
1705053258	776174.345	8516544.373	94.416	94.281	-0.135
1705053259	776176.415	8516551.968	94.397	94.181	-0.216
1705053260	776179.775	8516560.240	94.288	94.041	-0.247
1705053261	776182.726	8516564.276	94.291	94.160	-0.131
1705053262	776187.522	8516561.558	94.150	94.368	0.218
1705053263	776171.749	8516563.523	94.463	94.398	-0.065

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1705053264	776169.577	8516558.117	94.479	94.472	-0.007
1705053265	776168.504	8516552.862	94.629	94.465	-0.164
1705053266	776160.541	8516561.542	94.604	94.740	0.136
1705053267	776152.696	8516562.863	94.637	94.733	0.096
1705053294	776148.557	8516584.153	91.474	91.692	0.218
1705053295	776157.382	8516587.810	89.512	89.828	0.316
1705053296	776166.799	8516587.961	88.704	88.805	0.101
1705053297	776166.784	8516594.166	87.262	87.375	0.113
1705053298	776176.943	8516587.480	88.692	88.851	0.159
1705053299	776184.977	8516586.724	89.162	88.986	-0.176
1705053300	776199.251	8516585.036	88.806	88.942	0.136
1705053301	776209.651	8516583.415	88.017	88.216	0.199
1705053302	776220.014	8516581.208	87.615	87.569	-0.046
1705053303	776231.527	8516575.007	87.680	87.862	0.182
1705053304	776238.671	8516566.998	88.593	88.802	0.209
1705053305	776249.580	8516560.942	87.842	87.909	0.067
1705053306	776252.819	8516551.581	88.631	88.898	0.267
1705053307	776255.547	8516547.175	87.900	88.194	0.294
1705058000	776345.068	8516642.218	89.183	89.659	0.476
1705058001	776363.538	8516719.874	87.474	87.319	-0.155
1705058002	776351.257	8516770.566	88.112	88.211	0.099
1705058003	776168.665	8516989.970	101.757	101.886	0.129
1705058004	775977.974	8517083.681	94.366	94.189	-0.177
1705058005	775776.626	8517082.485	95.246	95.507	0.261
1705058006	775790.722	8516991.056	89.107	89.061	-0.046
1705058007	775798.081	8516952.167	84.162	84.270	0.108
1705058008	775831.130	8516775.317	92.191	92.220	0.029
1705058009	775871.663	8516692.159	91.543	91.394	-0.149
1705058010	776055.837	8516583.607	93.510	93.990	0.480
1705058011	776304.065	8516584.949	82.329	82.668	0.339
1705058012	776303.291	8516603.223	82.076	83.005	0.929
1705058013	776313.322	8516605.284	82.083	82.867	0.784
1705058014	776319.316	8516581.585	82.138	82.339	0.201
1705058015	776328.801	8516581.926	81.856	82.103	0.247
1705058016	776322.153	8516608.131	82.473	82.948	0.475
1705058017	776333.955	8516609.084	82.515	83.037	0.522
1705058018	776338.001	8516582.982	81.899	81.894	-0.005
1705058019	776348.032	8516580.140	81.483	81.726	0.243
1705058020	776350.259	8516602.700	82.237	82.137	-0.100
1705058021	776344.092	8516601.650	82.439	82.029	-0.410
1705058022	776342.273	8516606.656	82.645	82.756	0.111
1705058023	776344.054	8516609.414	82.588	83.189	0.601
1705058024	776346.995	8516605.243	84.566	82.469	-2.097
1705058025	776352.713	8516605.521	82.953	82.233	-0.720
1705058026	776352.438	8516606.401	82.150	82.362	0.212
1705058027	776357.282	8516603.034	81.989	82.362	0.373
1705058028	776355.483	8516589.535	81.663	81.743	0.080



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1705058029	776352.967	8516571.576	81.314	81.723	0.409
1705058030	776352.291	8516553.955	81.124	81.632	0.508
1705058031	776352.010	8516542.346	80.772	81.594	0.822
1705058032	776362.473	8516543.664	80.763	81.489	0.726
1705058033	776361.553	8516557.301	81.126	81.554	0.428
1705058034	776361.241	8516569.689	81.148	81.648	0.500
1705058035	776363.691	8516582.569	81.314	81.825	0.511
1705058036	776364.356	8516597.481	81.696	82.159	0.463
1705058038	776368.334	8516589.101	81.442	82.167	0.725
1705058039	776369.622	8516573.051	81.210	81.726	0.516
1705058040	776370.830	8516559.520	81.034	81.529	0.495
1705058041	776371.689	8516547.286	80.817	81.435	0.618
1705058042	776381.422	8516549.574	80.872	81.450	0.578
1705058043	776380.753	8516563.439	81.010	81.599	0.589
1705058044	776381.507	8516577.940	81.401	82.092	0.691
1705058045	776392.776	8516574.207	81.207	82.113	0.906
1705058046	776391.894	8516562.413	81.173	81.645	0.472
1705058047	776389.006	8516547.870	80.771	81.462	0.691
1705058048	776399.372	8516541.636	80.876	81.480	0.604
1705058049	776403.185	8516557.255	81.160	81.656	0.496
1705058050	776404.919	8516568.456	81.635	82.173	0.538
1705058051	776414.787	8516562.950	81.738	82.420	0.682
1705058052	776411.673	8516552.147	81.426	81.733	0.307
1705058053	776406.420	8516539.478	80.928	81.514	0.586
1705058054	776339.482	8516558.110	81.332	81.845	0.513
1705058055	776340.513	8516542.542	80.972	81.724	0.752
1705058056	776342.398	8516536.548	80.730	81.645	0.915
1705058057	776335.566	8516530.398	80.806	81.593	0.787
1705058058	776326.156	8516539.931	81.382	81.889	0.507
1705058059	776318.162	8516549.369	81.942	82.219	0.277
1705058101	776336.924	8516559.522	81.400	81.899	0.499
1705058102	776325.872	8516558.274	81.785	82.116	0.331
1705058103	776343.885	8516567.276	81.470	81.838	0.368
1705058104	776347.517	8516560.306	81.257	81.735	0.478
1705058105	776339.639	8516574.823	81.535	81.923	0.388
1705058106	776363.202	8516563.330	81.117	81.591	0.474
1705058107	776313.905	8516559.984	82.376	82.414	0.038
1705058109	776533.149	8516252.721	88.885	89.000	0.115
1705058110	776517.824	8516263.782	89.289	89.262	-0.027
1705058111	776553.137	8516318.280	89.539	89.173	-0.366
1705058112	776612.965	8516344.943	89.122	88.922	-0.200
1705058113	776608.491	8516376.525	86.626	85.745	-0.881
1705059001	776500.200	8516173.281	89.799	89.806	0.007