

**Innovation Awards** 



# Mal Peaker Water Main Designs

**WINNER: DRAINAGE, SEWER & UTILITIES** 



Name:	Mal Peaker	Category:
Position:	Design Office Manager	☐ Design & Visualisation ☐ Survey & Construction
Company:	Engineering Solutions QLD	☐ Drainage, Sewer, Utilities & Rivers ☐ Customisation
Name Project:	Water Main Designs	12d Synergy
Client:	Wide Bay Water Corporation	





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#### **Description of Project:**

Various Water Main design projects for the local water authority (WA).

#### Description of problem faced / task undertaken:

- WA have very specific requirements relating to design of water mains, particularly
  with regard to documentation of bends and joint deflections in the pipework. WA only
  allow 50% of the maximum manufacturer recommended joint deflection, both for pipe
  joints and DICL bends. Depending on what pipe type has been selected for the main,
  the maximum joint deflection will change.
- The pipeline module in 12d works in % grades vertically, as it was originally a variant of the alignment module. While it was workable, it added some level of difficulty in terms of needing to convert all degrees of vertical deflection to % and then adding a new VIP and including the deflection manually. That approach led to the possibility of calculation error or user error, so we needed to find some way of automating the task and reducing the possibility of error creeping in to the designs.

- Additionally, the ability to link horizontal and vertical deflections was not overly simple. With 90degree horizontal bends, for example, the joint can be rotated vertically to allow any vertical deflection required, however it's important to ensure that the vertical "bend" happens coincident with the horizontal fitting. This was not a simple exercise when manually adding HIPs and VIPs, and again was prone to human error.
- Reporting was also difficult due to the way that WA wanted the deflections annotated. The pipeline reporting included in 12d didn't allow us to generate deflection tables in the required format.



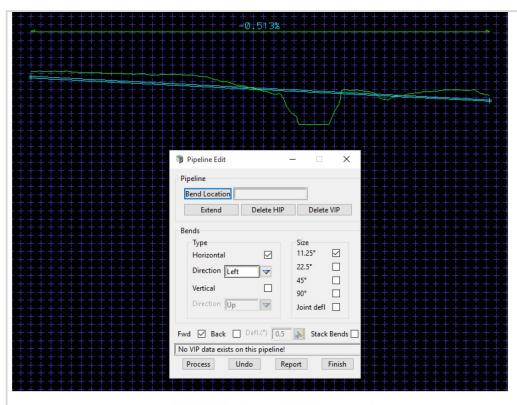
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#### How the problem was solved:

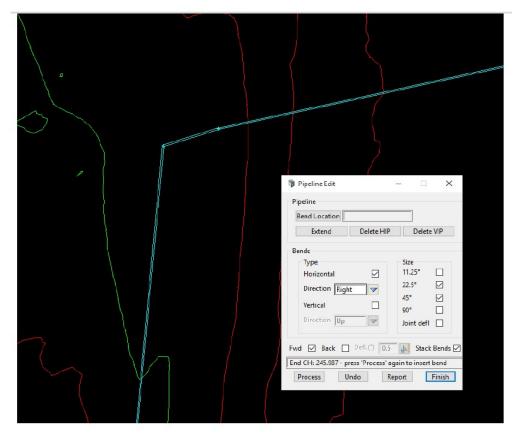
- I wrote a macro to facilitate the addition of both horizontal and vertical standard bends (11.25°, 22.5°, 45° and 90°) to a pipeline. Using the pipe length attribute associated with pipelines, the ability to apply pipe joint deflections of any size (set by the user) was able to be included. The macro needed to be able to function in either the forward or reverse directions for the pipeline as the fixed point is variable depending on the situation. Another feature that was added was the ability to 'stack' bends to get non-standard deflections (i.e. 11.25° + 22.5° = 33.75°)
- Additionally, a reporting function was included that would output the setout for the deflections/bends in the standard format required by WA.
- The macro resulted a significant reduction on design time, and provided confidence in the design values, consequently reducing checking times. It is an ongoing project, with changes underway to further improve the effectiveness of it for design use. At the current time, development is progressing with regard to a preliminary automated vertical grading which will try to follow the ground surface with a pre-set minimum cover, using a defined max. joint deflection and standard bends. However, at the time of writing this, the coding is not complete so I wasn't able to include the information in this entry.

Initial horizontal alignment for pipeline, with macro panel open



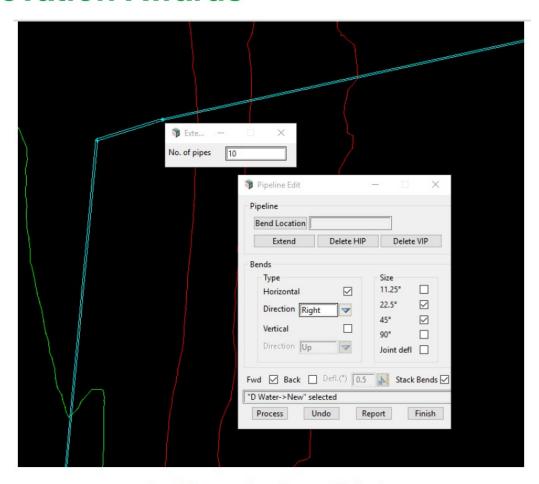


Initial Vertical alignment with macro panel open

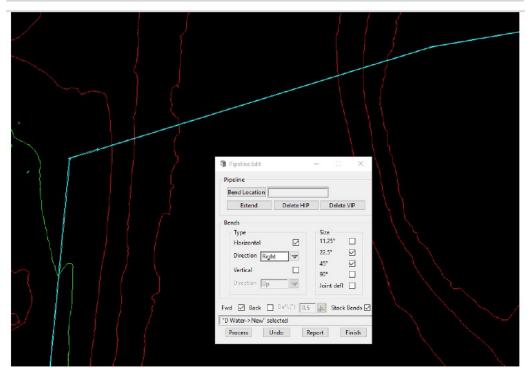


Inserted 'stacked' 45 and 22.5 degree horizontal bend





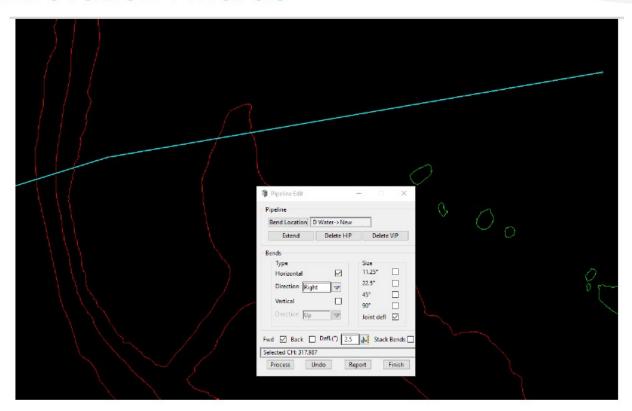
Extend alignment sub-panel to extend the bearing



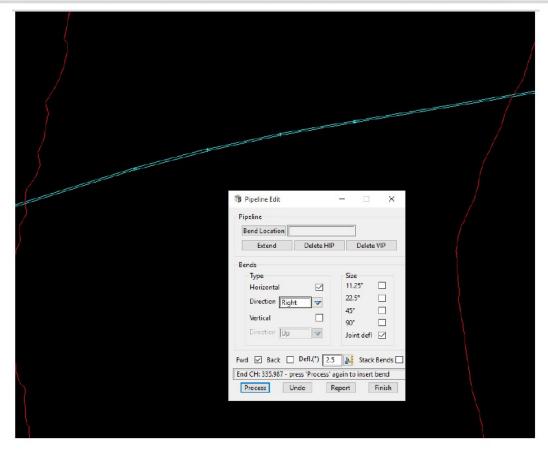
Horizontal bearing extended past the lake



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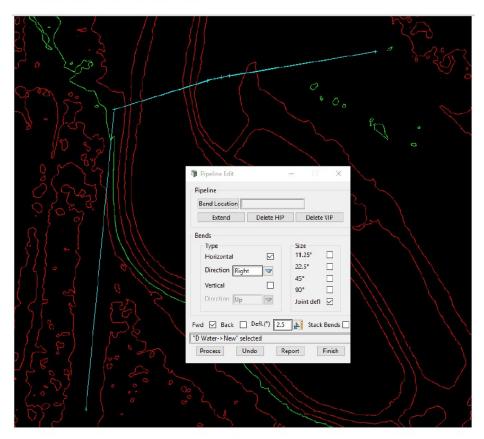


Now we want to insert 2.5 degree pipe joint deflections to 'bend' the pipe around

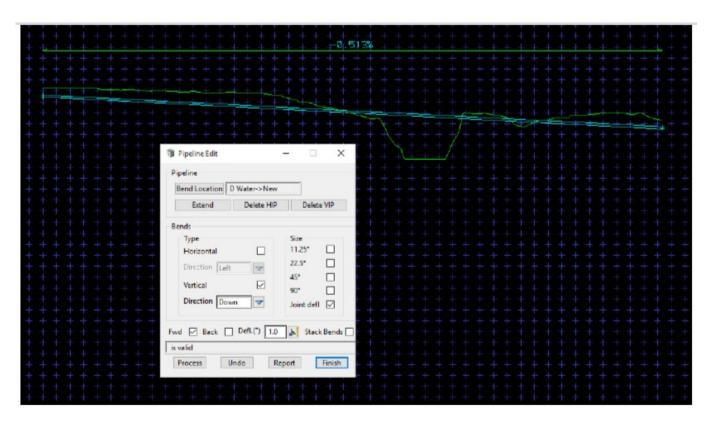


3 Joint deflections inserted simply by repeatedly pressing "Process"



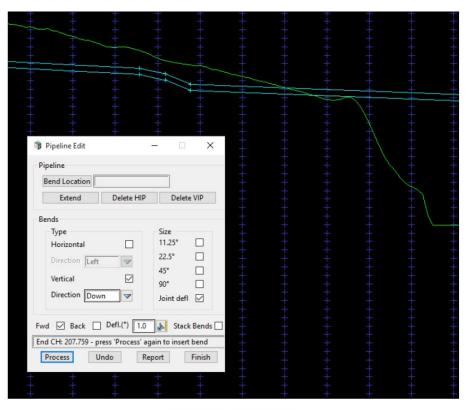


Final horizontal alignment completed

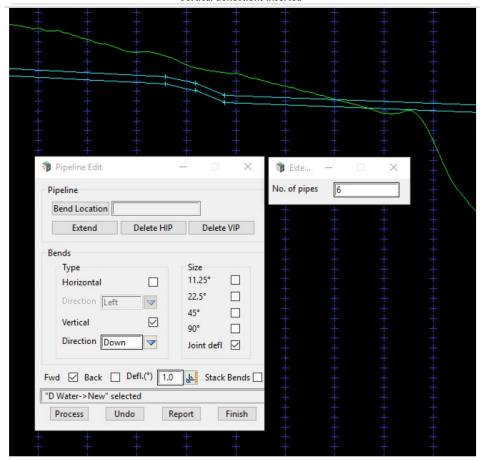




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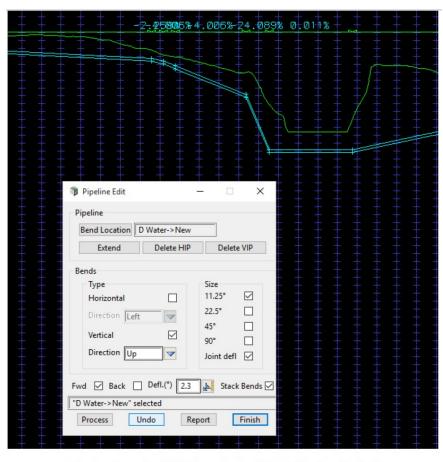


#### Vertical deflections inserted

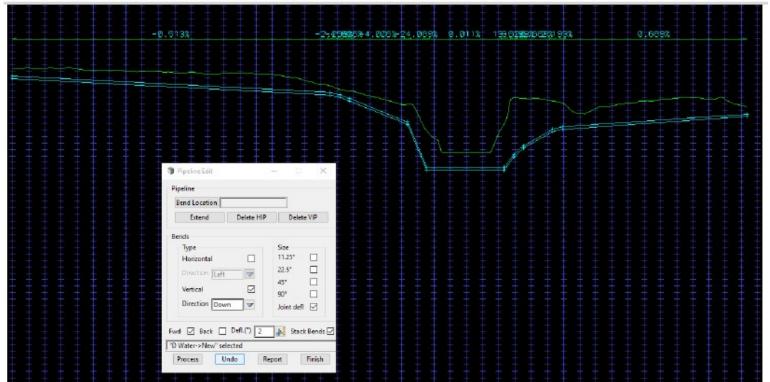


Extend the grade by 6 pipe lengths





After inserting vertical 11.25 degree bends with joint deflections 'stacked'





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Test D Water PROJECT: MODEL: PIPELINE: New GENERATED:

Wed May 04 14:36:10 2016

UNITS: Degrees

HORIZONTAL DEFLECTIONS

CHAINAGE	X	Y	Z	DEFLN ANGLE
0.000	459625.001	7213595.728	5.950	n/a
239.987	459647.465	7213834.661	3.279	67.50 (1)
317.987	459722.006	7213857.634	1.836	2.50 *
323.987	459727.811	7213859.149	2.177	2.50 *
329.987	459733.677	7213860.410	2.518	2.50 *
335.987	459739.593	7213861.413	2.765	0.25 *

\* Pipe joint deflection

#### Report generated for Horizontal Deflections

E:\Stuff\Test\Test Defi	ections.rpt	Wednesday, 4 May 2016 3:03 PM
DIRECTORY:	E:\Stuff\Test	
PROJECT:	Test	
MODEL:	D Water	
PIPELINE:		

Wed May 04 14:36:10

GENERATED: 2016 UNITS:

HORIZONTAL DEFLECTIONS				
CHAINAGE	Х	Y	Z	DEFLN ANGLE

0.000 239.987 317.987 323.987 329.987 459625.001 459647.465 459722.006 459727.811 459733.677 459739.593 7213595.728 7213834.661 7213857.634 7213859.149 7213860.410 7213861.413 5.950 3.279 1.836 2.177 2.518 2.765 n/a 67.50 (1) 2.50 \* 2.50 \* 0.25 \* 335.987

(1) 45° Bend + 22.5° Bend

\* Pipe joint deflection

VERTICAL DEFLECTIONS

CHAINAGE	X	Y	Z	DEFLN ANGLE
0.000	459625.001	7213595.728	5.950	n/a
195.761	459643.326	7213790.629	4.946	1.00 *
201.759	459643.887	7213796.602	4.810	1.00 *
207.754	459644.448	7213802.570	4.570	none
243.726	459651.039	7213835.762	3.129	11.25
255.392	459662.188	7213839.198	0.319	-13.55 (1)
303.392	459708.059	7213853.335	0.324	-7.75 (2)
309.337	459713.740	7213855.086	1.134	2.50 *
315.312	459719.450	7213856.846	1.683	2.00 *
333.283	459736.927	7213860.961	2.706	2.00 *
339.281	459742.844	7213861.950	2.837	0.86 *

(1)  $11.25^{\circ}$  Bend with  $2.30^{\circ}$  deflection through fitting (2)  $11.25^{\circ}$  Bend with  $-3.50^{\circ}$  deflection through fitting

\* Pipe joint deflection

FITTINGS USED

11.25° Bends: 3 22.5° Bends : 1 45° Bends : 1 90° Bends : 0 Other : 0

TOTAL : 5 Bends

001 7213595.72	8 5.950		
	5.950	n/a	
326 7213790.62	9 4.946	1.00	*
887 7213796.60	2 4.810	1.00	*
448 7213802.57	0 4.570	none	
039 7213835.76	2 3.129	11.25	
188 7213839.19	8 0.319	-13.55	(1)
059 7213853.33	5 0.324	-7.75	(2)
740 7213855.08	6 1.134	2.50	*
450 7213856.84	6 1.683	2.00	*
927 7213860.96	1 2.706	2.00	*
844 7213861.95	0 2.837	0.86	*
.30° deflection th	rough fitting		
	7213802.57 039 7213835.76 188 7213839.19 059 7213853.33 740 7213855.08 450 7213856.84 927 7213860.96 844 7213861.95 .30° deflection th	448 7213802.570 4.570 039 7213835.762 3.129 188 7213839.198 0.319 059 7213853.335 0.324 740 7213855.086 1.134 450 7213856.846 1.683 927 7213860.961 2.706	448 7213802.570 4.570 none 039 7213835.762 3.129 11.25 188 7213839.198 0.319 -13.55 059 7213853.335 0.324 -7.75 740 7213855.086 1.134 2.50 450 7213856.846 1.683 2.00 927 7213860.961 2.706 2.00 844 7213861.950 2.837 0.86

\* Pipe joint deflection

#### Report generated for Vertical Deflections

FITTINGS USE	D				
	_				
11.25° Bends	:	3			
22.5° Bends	:	1			
45° Bends	:	1			
90° Bends	:	0			
Other	:	0			
TOTAL				5 Ber	nde

Report generated for fittings used