# TABLE OF CONTENTS

## 1 PROJECT MANAGEMENT
- 1.1 Project Scheduling and Timelines .......................................................... 12
- 1.2 Underground Service Alert: Sample — Southern California ...... 13
- 1.3 Underground Service Alert: Sample — Northern California ...... 14

## 2 SITE DEVELOPMENT
- 2.1 Disposal of Excavated Materials ............................................................ 15
- 2.2 Grading/Earth Movement: Machine Excavation — Backhoe .... 16
- 2.3 Grading/Earth Movement: Machine and Hand Backfill ............... 17
- 2.4 Grading/Earth Movement: Machine Excavation by Hand Labor with Wheelbarrows .......................................................... 18
- 2.5 Grading/Earth Movement: Typical Soil Moving — Hand Labor 18
- 2.6 Grading/Earth Movement: Shoveling Loosened Soil into Trucks ........................................................................ 18
- 2.7 Grading/Earth Movement: Typical Soil Moving — Tractor .... 18

## 3 PLAN READING/PRODUCTION
- 3.1 Scale Equivalents ......................................................................................... 19
  - Scales 1/16" to 1" (Architects Scale) .......................................................... 19
  - Scales 1" = 10' to 1" = 80' (Engineers Scale) ............................................. 19
  - Scale 1" = 100' to 1" = 1000' ................................................................. 20
  - Scales 1" = 50' to 1" = 10 Miles .............................................................. 20
- 3.2 Slope Calculations ....................................................................................... 20
  - Angles of Slopes ....................................................................................... 20
  - Slope Measurement Plan (Horizontal) to True Measure .................... 21
  - Approximate Equivalencies: Slope/Grade/Degree .............................. 21
  - Safe Limit Restrictions (General Guide) ................................................. 22
  - Slope Definition ...................................................................................... 22
  - Slope Formula Descriptions .................................................................. 23
  - Slope Reference Chart – Percent, Angle and Ratio ............................... 24
- 3.3 Slope Comparison Table ............................................................................ 25
- 3.4 Stair Construction ...................................................................................... 26
  - Stair Information ..................................................................................... 26
  - Stair Riser: Tread Calculations ............................................................... 27
4 EARTHEN MATERIALS & CALCULATIONS

4.1 Weights of Some Earthen Materials .................................................. 28
4.2 Angles of Repose in Soils ................................................................. 28
4.3 Volume Calculation of Site Excavation .............................................. 28
4.5 Soil Coverage in Square Feet Per Cubic Yard .................................... 29
  Computation of Volume of Excavated Material 29
4.6 Erosion Control Methods ................................................................. 30
  Silt Fence Construction 30
  Cross-Section of Silt Fence Installation 31
  Joining Sections of Envirofence 31
  Straw Bale Dike (Embedding Detail) 31
  Straw Bale Dike (Anchoring Detail) 31
4.7 Volumes of Sand/Gravel in Stock Piles ............................................ 32
4.8 Soil Swellage/Shrinkage Factors ....................................................... 32
  Approximate Swellage Factors for Various Soil Types 32
  Approximate Shrinkage Factors for Various Soil Types 32

5 PUMPS

5.1 Pumps: Variables Used in Formulas ............................................... 33
5.2 Pumps: Horsepower Required for Pumping Water ......................... 34
5.3 Pumps: Water Horsepower Requirements ....................................... 35
  Brake Horsepower 35
  Horsepower 35
  Total Dynamic Head 35
  Velocity Head 35
  Water Horsepower Requirements 35
5.4 Pump Operating Costs ..................................................................... 36

6 CONSTRUCTION & HARDSCAPE

6.1 Heavy Construction and Hardscape ............................................... 37
  Concrete Classification 37
  Concrete Surface Coverage Per Cubic Yard 37
  Exposed Aggregate Pebble Coverage 37
  Approximate Volumes Materials Required Per Cubic Yard of Concrete 38
  Permeable Pavement Comparison Chart 39
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2 Pools, Ponds &amp; Waterfalls</td>
<td>40</td>
</tr>
<tr>
<td>Capacity of Round Pools Per Foot of Depth</td>
<td>40</td>
</tr>
<tr>
<td>Capacity of Square Pools Per Foot of Depth</td>
<td>40</td>
</tr>
<tr>
<td>Capacity of Various Rectangular Pools Per Foot of Depth</td>
<td>40</td>
</tr>
<tr>
<td>6.3 Concrete Block Retaining Walls</td>
<td>41</td>
</tr>
<tr>
<td>Concrete Quantities Required for Footings</td>
<td>41</td>
</tr>
<tr>
<td>Concrete Block Quantity Calculations</td>
<td>41</td>
</tr>
<tr>
<td>Time Data Approximation for Concrete Block Retaining Wall</td>
<td>41</td>
</tr>
<tr>
<td>Concrete Masonry Units (CMU)</td>
<td>42</td>
</tr>
<tr>
<td>Calculating Quantity of Brick</td>
<td>42</td>
</tr>
<tr>
<td>6.4 Weight and Coverage of Building Materials</td>
<td>43</td>
</tr>
<tr>
<td>Weights of Masonry Materials</td>
<td>44</td>
</tr>
<tr>
<td>Weights and Approximate Coverages: Masonry Materials</td>
<td>44</td>
</tr>
<tr>
<td>Recommended Coverages for Decomposed Granite With Binders</td>
<td>45</td>
</tr>
<tr>
<td>Approximate Rock Weight Per Granite Boulder</td>
<td>45</td>
</tr>
<tr>
<td>Post Burial Depths</td>
<td>46</td>
</tr>
<tr>
<td>Gabion Data: Sizes and Weights</td>
<td>47</td>
</tr>
<tr>
<td>6.5 Reinforcing Steel Dimensions</td>
<td>48</td>
</tr>
<tr>
<td>Concrete ASTM Standards</td>
<td>48</td>
</tr>
<tr>
<td>6.6 Brickwork</td>
<td>49</td>
</tr>
<tr>
<td>Number Standard for Face Brick and Common Brick in Masonry Walls</td>
<td>49</td>
</tr>
<tr>
<td>Square Feet Wall Per 1,000 Brick</td>
<td>49</td>
</tr>
<tr>
<td>Mortar Required Per 1,000 Bricks</td>
<td>50</td>
</tr>
<tr>
<td>Coverage: Brick Flat Work</td>
<td>50</td>
</tr>
<tr>
<td>Brick Masonry: Mortar Color Quantities Per 1,000 Brick</td>
<td>50</td>
</tr>
<tr>
<td>Quantities of Materials Per Cubic Foot of Mortar</td>
<td>50</td>
</tr>
<tr>
<td>Time Data for Brick Paving (Flatwork)</td>
<td>51</td>
</tr>
<tr>
<td>6.7 Lumber</td>
<td>51</td>
</tr>
<tr>
<td>Standard Size Lumber</td>
<td>51</td>
</tr>
<tr>
<td>Standard Size Lumber: Redwood</td>
<td>52</td>
</tr>
<tr>
<td>National Grading Rules for Dimension Lumber: Classification</td>
<td>53</td>
</tr>
<tr>
<td>Weights and Quantities of Lumber</td>
<td>53</td>
</tr>
<tr>
<td>Board Measure</td>
<td>54</td>
</tr>
<tr>
<td>Conversion of Lumber Sizes to Feet Board Measure (FBM)</td>
<td>54</td>
</tr>
<tr>
<td>Board Feet Calculations</td>
<td>55</td>
</tr>
<tr>
<td>Properties of Plywood for Concrete Forming</td>
<td>56</td>
</tr>
<tr>
<td>Minimum Post Sizes</td>
<td>57</td>
</tr>
</tbody>
</table>
Beam Sizes & Spans .................................................. 58
Joist Spacing (Deck Span) .......................................... 59
Maximum Allowable Spans for Spaced Deck Boards ....... 59

6.8 Nails & Screws ....................................................... 60
Common Nail Data ..................................................... 60
Wood Screw Data ..................................................... 60

6.9 Painting & Staining .................................................. 61
Paint Coverage in Square Feet Per Gallon .................... 61
Approximate Covering Capacity of Painting Materials ...... 62
Exterior Spray Painting Time ....................................... 63
Exterior Brush Painting Time ...................................... 63

7 Irrigation ............................................................... 64
7.1 Formula Terminology ............................................. 64
7.2 Irrigation Variable and Units .................................... 66
7.3 Irrigation Formulas ............................................... 68
ETWU (Estimated Total Water Use) Formula ................. 68
MAWA (Maximum Applied Water Allowance) Formula (2015) 69
Coefficient Of Uniformity ......................................... 70
Distribution Uniformity ............................................ 70
Dynamic Pressure Determination ................................. 70
Friction Factor Pipe Sizing ....................................... 70
Friction Loss in Pipe .............................................. 71
Velocity of Flow .................................................... 71
Minimum/Maximum System Capacity Requirements ....... 71
Precipitation Rate ................................................... 72
Scheduling Coefficient ........................................... 72
Sprinkler Run Time ................................................ 72
Static Pressure ...................................................... 72
Water Hammer ....................................................... 73

7.4 Maximum Precipitation Rates for Slopes .................. 73
7.5 Water Supply Requirements ................................. 74
7.6 How to Use the Water Supply Requirements Table ...... 74
7.7 Water Supply Requirements Table ............................ 75
7.8 Looped Main Line Flow Rates ............................... 76
7.9 Sprinklers Per Acre: Square or Rectangular Spacing ... 77
7.10 Sprinklers Per Acre: Equilateral Triangular Spacing .... 78
7.11 Flow Conversion ................................................ 79
TABLE OF CONTENTS

8 ELECTRICAL 80
8.1 Power Conversion .........................................................80
8.2 Cost of Operation ..........................................................81

9 Soils Amendments & Fertilizers 82
9.1 Soil Improvement Process ..............................................82
9.2 Representative Tilling Equipment Work Capacity .............82
9.3 Soil Mixes Percentages ...................................................83
9.4 Soil Coverage in Square Feet Per Cubic Yard .................83
9.5 Peat Moss Coverage: Depth in Inches Per Square Surface Footage .........................................................84
9.6 Steer Manure Coverage: Depth in Inches Per Square Surface Footage .........................................................84
9.7 Steer Manure: Rates Per Acre Based on Required Rates Per 1,000 Square Feet .........................................................85
9.8 Fertilizer Application Rates ............................................86

10 PLANT MATERIAL 87
10.1 Trees: Time Data for Transplanting Field-Grown Stock ........87
10.2 Box Tree Weights ..........................................................87
10.3 Tree Pit Excavation for Nursery Container Stock ..........88
   Square Pits With Vertical Sides 88
   Round Pits With Vertical Sides 88
10.4 Box Tree Backfill Volumes ................................................89
10.5 Planting Distances ........................................................90
10.6 Plant Material Time Data: Planting Trees and Shrubs, Nursery Container Stock .........................................................90
10.7 Container Stock Weight ..................................................90
10.8 Volume of Excavated Soil Resulting From Multiple Plantings, ...91
   Nursery Container Stock .........................................................91
   Round Planting Pits 91
   Square Planting Pits 91
10.9 Approximate Backfill Volume for Various Nursery Container Stock .........................................................92
   Fill Required for Square Plant Pits — Vertical Sides 92
   Fill Required for Round Plant Pits — Vertical Sides 92
### 10.10 Shrubs Per Acre ................................................................. 93
### 10.11 Plants Per Linear Foot ..................................................... 94
### 10.12 Groundcover Coverage Per Flat ......................................... 94
### 10.13 Plants Per Hundred Square Feet ......................................... 95
### 10.14 Plugs/Cuttings: Time Required for Planting
   Unrooted Cuttings .......................................................... 95
### 10.15 Green Roof Materials ................................................... 96

### 11 TURF
11.1 Turf Installation: Time to Finish and Grade .......................... 97
11.2 Turf Installation: Time By Vegetative Parts ......................... 97
11.3 Seed Application Rates .................................................... 98
11.4 Stolon/Plug Coverage ..................................................... 98
11.5 Grass Stolons: Distribution Rate by Means of Sprigging ......... 98

### 12 MULCH
12.1 Mulch Application Quantities .............................................. 99

### 13 EQUIPMENT
13.1 Tractors .............................................................................. 100
   Tractor/Loader/Scrapers Specifications 101
13.2 Skid Steer Loaders ......................................................... 101
   Skid Steer Loaders Operating Specifications 102
13.3 Representative All-Purpose Tractors,
   Wheeled Utility and Compact ............................................ 102
   Representative All-Purpose Tractors, Wheeled Compact
   Specifications 103
   Representative All-Purpose Tractors,
   Wheeled Utility Specifications 103
13.4 Wheel Loaders (Earth Movers) .......................................... 103
   Wheel Loaders (Earth Moving) Specifications 104
13.5 Tractor/Loader/Backhoes ................................................. 104
   Tractor Loader/Backhoes Specifications 105
13.6 Hydraulic Excavators and Mini-Excavators ......................... 105
   Mini-Excavators Specifications 106
   Excavators Specifications 106
   Track-Type Tractors Specifications 106
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.7</td>
<td>Track Loaders Specifications</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>Earth Moving Track Loaders Specifications</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>Wheel Tractor Dozers Specifications</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>Scrapers Specifications</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>Motor Graders (Grading) Specifications</td>
<td>108</td>
</tr>
</tbody>
</table>

## 14 WEIGHTS, MEASURES, FORMULAS & CONVERSIONS 109

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1</td>
<td>Weights, Measures and Formulas</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Area Calculations: Units of Area Equivalents</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Conversions of Units of Area</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Square Tracts of Land (in Sq. Ft. and in Acres)</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Square Feet to Equivalent Acreage</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Acres to Equivalent Square Footage</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>Angular and Circular Measure</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>Units of Area</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>Geometric Figures Area Calculations</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>Circumferences and Areas of Circles: Diameters 1' to 100'</td>
<td>114</td>
</tr>
<tr>
<td>14.2</td>
<td>EQUIVALENT CONVERSIONS</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>Volume Equivalent Calculations</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>Conversions of Units of Volume</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>Conversions of Dry Materials</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>Liquid Measure Equivalents</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>Units of Water Measurement and Equivalencies</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>Liquid Materials: Conversions for Use in Small Areas</td>
<td>119</td>
</tr>
<tr>
<td>14.3</td>
<td>Units of Cubic Measure</td>
<td>119</td>
</tr>
<tr>
<td>14.4</td>
<td>Units of Liquid Measure</td>
<td>119</td>
</tr>
<tr>
<td>14.5</td>
<td>Shapes</td>
<td>120</td>
</tr>
<tr>
<td>14.6</td>
<td>Cones</td>
<td>121</td>
</tr>
<tr>
<td>14.7</td>
<td>Volume Conversion Table</td>
<td>122</td>
</tr>
<tr>
<td>14.8</td>
<td>Linear Calculations</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Units of Length Equivalents</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Conversions of Units of Length</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Units of Length</td>
<td>126</td>
</tr>
<tr>
<td>14.9</td>
<td>Conversions: English to Metric/Metric to English</td>
<td>127</td>
</tr>
<tr>
<td>14.10</td>
<td>Light Calculations</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>Light Intensity Conversion Table</td>
<td>128</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

14.11 Fractions Equivalents ................................................................. 129
   Place Values in Decimal System 129
   Conversion: Inches and Fractions to Decimal Parts of a Foot 129
   Decimal and Metric Equivalents of Common Fractions 130

14.12 Temperature Conversions ......................................................... 131

14.13 Screen Filter Mesh Equivalents .................................................. 132
   Screen Filter Conversion 132
   Screen Mesh Sizes Compared to 0.020 Inch Orifice 133

14.14 Atmospheric Pressure Conversions ........................................... 133
   Pressure Conversion Table 133

14.15 Units of Weight ........................................................................... 136
   Units of Weight Equivalents 136
   Conversions of Units of Weight 136
   Weight Equivalents 136
   Units of Weight 136
   Weight Conversion Table 137

14.16 Conversion Charts ...................................................................... 138
   Pressure Loss Conversion Table 138
   Velocity Conversion Table 138
   Concentrations 140
   Conversions: English System to Metric System 140
   Conversions: Metric System to English System 140

14.17 Area Conversion Table ............................................................... 141
   Area Conversions 141
   Length Conversion Table 143

15 LIGHTING ......................................................................................... 145

15.1 Low Voltage Lighting ................................................................. 145
   The Source 145
   Transformers 145
   Transformer Options 146
   The Conductor 146
   The Load (Landscape Lights) 147
## TABLE OF CONTENTS

### 15.3 Function and Application of Lights
- Area and spread lighting 148
- Accent lighting 148
- Facade lighting 148
- Uplighting 148
- Backlighting 148
- Silhouetting 148

### 15.4 Fixture Placement
- Single Light Source Directly in Front of the Object 149
- Single Light Source to Either Side of Object 149
- Multiple Point Sources 149
- Downlighting 149
- Moonlighting and Flower Beds 149

### 15.5 Lamps
- Candlepower 150
- Footcandle 150
- Illuminations 150

### 15.6 Color of Light

### 15.7 Lamp Types
- Bayonet Base Lamps 151
- T-5 Wedge Base Lamps 151
- T3 and T4 Tungsten and Halogen 151
- MR Quartz Halogen 151
- Sealed Beam Lamps 151
- LED 151