World Water Day
Education Pack

Wastewater and sustainability

www.watercare.co.nz
Watercare's World Water Day Pack:
Research and Development: Sally Smith, Education Co-ordinator
Layout and Design: Barb Pendrey, Graphics Specialist
Acknowledgements: Steve Camp, Di Martin and Kerry Jenner

Note:
Watercare Services Limited (Watercare), has been given permission to use materials in Sections B and C in this pack on condition that they are used solely for educational purposes by teachers in the classroom.

Watercare Services Limited
73 Remuera Road, Remuera, Auckland 1050
Private Bag 92 521, Wellesley Street,
Auckland 1141

www.watercare.co.nz
Thank you for requesting Watercare’s World Water Day Pack. You will find:

Section A: Information – contents

- What were the original targets set in the year 2000? A2
- World Water Day – how did it start? A4
- Sustainable Development Goals A5
- Theme for World Water Day A10
- Members of the United Nations (UN) A11
- Background information – Water and wastewater A21
  - How we dealt with wastewater in the past A22
  - Toilets in the ancient world A23
  - Toilets in the middle ages A24
  - Toilets in the modern world A24
  - A timeline of toilets A26
  - Maori and waste disposal A28
  - How we dealt with water in the past A30
  - Wastewater today A33
  - Wastewater treatment in Auckland A35
- Background information – Wastewater the issue A41
  - The management of wastewater A41
    1. Wastewater reuse in agriculture A41
    2. Recycling wastewater into drinking water A43
    3. Use of wastewater for fire-fighting, watering public areas, commercial laundering and street cleaning A44
    4. Use of wastewater sludge to manufacture construction material A44
    5. Reuse of wastewater in business/industry for example in cooling towers A45
    6. Reuse of organic waste or wastewater for large scale biogas production through anaerobic digestion, which can be used to generate electricity A45
    7. Peepoo programme in Kibera, Kenya A46
  - Issues to be addressed in the future A47
- Pause for thought – some wastewater facts A49
- Interactive activities A50
Section B: World Water Day Activities – contents

1. Soil erosion in New Zealand
2. Why do people dam water?
3. Why are dam walls thicker at the bottom than the top?
4. Does surface area affect evaporation?
5. Make a bottle garden
6. Do plants need water to grow?
7. Algae and water pollution
8. Make an underwater viewer
9. Can water break rocks?
10. Oil and water
11. Polluting the river
12. Make your own water cycle

Page
B2
B4
B6
B7
B8
B9
B10
B11
B12
B13
B14
B15

*Note: If you wish to have a PDF of these activities, please contact Sally Smith by email – Sally.Smith@water.co.nz*
## Section C: Other Water Activities – contents

<table>
<thead>
<tr>
<th>Activity</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream clean-ups</td>
<td>C2</td>
</tr>
<tr>
<td>Suggested ideas</td>
<td>C4</td>
</tr>
<tr>
<td>Water careers</td>
<td>C8</td>
</tr>
<tr>
<td>Creative ideas</td>
<td>C11</td>
</tr>
<tr>
<td>A fun game for younger students</td>
<td>C13</td>
</tr>
<tr>
<td>Fun Water Week water animals</td>
<td>C15</td>
</tr>
<tr>
<td>Invent a Water Week fish</td>
<td>C16</td>
</tr>
<tr>
<td>Water Week party</td>
<td>C17</td>
</tr>
<tr>
<td>Water Week promotion ideas</td>
<td>C20</td>
</tr>
<tr>
<td>Design a water conservation poster</td>
<td>C22</td>
</tr>
<tr>
<td>Wear Blue Day poster and badges</td>
<td>C23</td>
</tr>
<tr>
<td>List of some water charities</td>
<td>C26</td>
</tr>
</tbody>
</table>

*Note: If you wish to have a PDF of these activities, please contact Sally Smith by email – Sally.Smith@water.co.nz*
Information

- What were the original targets set in the year 2000?  
  Page A2

- World Water Day – how did it start?  
  Page A4

- Sustainable Development Goals  
  Page A5

- Theme for World Water Day  
  Page A10

- Members of the United Nations (UN)  
  Page A11

- Background information – Water and wastewater
  - How we dealt with wastewater in the past
    Page A22
  - Toilets in the ancient world
    Page A23
  - Toilets in the middle ages
    Page A24
  - Toilets in the modern world
    Page A24
  - A timeline of toilets
    Page A26
  - Maori and waste disposal
    Page A28
  - How we dealt with water in the past
    Page A30
  - Wastewater today
    Page A33
  - Wastewater treatment in Auckland
    Page A35

- Background information – Wastewater the issue
  - The management of wastewater
    1. Wastewater reuse in agriculture
      Page A41
    2. Recycling wastewater into drinking water
      Page A43
    3. Use of wastewater for fire-fighting, watering public areas, commercial laundering and street cleaning
      Page A44
    4. Use of wastewater sludge to manufacture construction material
      Page A44
    5. Reuse of organic waste or wastewater for large scale biogas production through anaerobic digestion, which can be used to generate electricity
      Page A45
    6. Peepoo programme in Kibera, Kenya
      Page A46
  - Issues to be addressed in the future
    Page A47

- Pause for thought – some wastewater facts
  Page A49

- Interactive activities
  Page A50
What were the original targets set in the year 2000?

In September 2000, the largest ever gathering of Heads of State ushered in the new millennium by adopting the Millennium Declaration. The declaration, endorsed by 189 countries, was then translated into a road map setting out goals to be reached by 2015.

The United Nations (UN) set eight goals for development, called the Millennium Development Goals (MDGs). These goals set an ambitious agenda for improving the human condition by 2015.

The Millennium Development Goals (MDGs)
The Millennium Development Goals (MDGs) agreed in 2000, aimed to halve the proportion of people without sustainable access to safe drinking water and basic sanitation between 1990 and 2015.

More than 660 million people still do not have access to an improved drinking water source and existing indicators do not address the safety and reliability of water supplies. To reach the requirements of the right of access to safe drinking water requires real improvements for several billions of people.

In July 2010, the General Assembly adopted a resolution, which “recognized the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights”.

The MDG target for sanitation is an even more pressing challenge, with 2.4 billion people currently lacking access to improved sanitation and around one billion still practicing open defecation. At current rates of progress, the sanitation target will be missed by over half a billion people.

There is currently no global target to improve hygiene, despite this being one of the single most cost-effective public health interventions.

The United Nations Conference on Sustainable Development (Rio+20)
The Rio+20 Conference in 2012 was an opportunity to reflect on progress towards sustainable development over the previous 20 years. One of its main outcomes was an agreement to launch a process to develop a set of Sustainable Development Goals, which build on the Millennium Development Goals and converge with the post-2015 development agenda.
What were the original targets set in the year 2000?

Sustainable Development Goals (SDGs) on water after 2015
As the time limit for the MDGs drew to a close in 2015, the global community took stock of how it could move towards a sustainable future. The MDG framework did not address the full water and development agenda concerns. Emphasis on ‘Sustainability’ was not included and human rights and inequalities were also largely ignored in the MDG framework. Subsequently, member states agreed that human rights, equality and sustainability should form the core of the development agenda and be recognized as critical for true development.

UN-Water’s overarching goal is “Securing Sustainable Water for All”.
This day was first formally proposed in Agenda 21 of the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil with observance expected to begin in 1993.

The United Nations (UN) invited its member nations to devote this day to implementing UN recommendations and promoting concrete activities within their countries.

World Water Day – 22 March 2005 – marked the start of a new UN International Decade for Action on water to give a high profile to implementing water-related programmes and the participation of women.

In September 2000, the largest ever gathering of Heads of State ushered in the new millennium by adopting the Millennium Declaration. The declaration was endorsed by 189 countries and translated into a road map setting out goals to be reached by 2015.

The eight Millennium Development Goals (MDGs) – reduce poverty and hunger; achieve universal education; promote gender equality; reduce child and maternal deaths; combat HIV, malaria and other diseases; ensure environmental sustainability; develop global partnerships – failed to consider the root causes of poverty, or gender inequality, or the holistic nature of development. The goals made no mention of human rights, nor specifically addressed economic development. While the MDGs, in theory, applied to all countries, in reality, they were considered targets for poor countries to achieve, with finance from wealthy states.

The Rio+20 Conference in 2012 was an opportunity to reflect on progress towards sustainable development over the previous 20 years. One of its main outcomes was an agreement to launch a process to develop a set of Sustainable Development Goals which build on the Millennium Development Goals.

The sustainable development goals (SDGs) were a new, universal set of goals, targets and indicators offering global priorities for sustainable development that UN member states would be expected to use to frame their agendas and political policies over the next 15 years. These goals took effect in January 2016 and it was expected that every country would work towards achieving the SDGs.
The 17 Sustainable Development Goals (SDGs)

**Goal 1**
End poverty in all its forms everywhere

**Goal 2**
End hunger, achieve food security and improved nutrition and promote sustainable agriculture

**Goal 3**
Ensure healthy lives and promote well-being for all at all ages

**Goal 4**
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

**Goal 5**
Achieve gender equality and empower all women and girls

**Goal 6**
Ensure availability and sustainable management of water and sanitation for all

**Goal 7**
Ensure access to affordable, reliable, sustainable and modern energy for all

**Goal 8**
Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

**Goal 9**
Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation

**Goal 10**
Reduce inequality within and among countries
The SDGs followed the U.N.-led Millennium Development Goals, which focused on reducing extreme poverty. The SDGs focus on sustainable development, taking into account such factors as water scarcity, food insecurity, ecosystem loss, and climate change. At stake is a healthy planet and people.

UN Secretary-General Ban Ki-moon stated that the place of water among the Sustainable Development Goals (SDGs) will greatly surpass its placement among the Millennium Development Goals (MDGs). “Water is life. Water is health. Water is dignity. Water is a human right,” Mr. Ban emphasised.
Helen Clark, (whilst in her role as Administrator of UNDP), spoke of how the Decade had highlighted that “integrated approaches which cut across ministries and sectors are needed” for water issues, emphasizing the successful implementation of Integrated Water Resources Management (IWRM).

“IWRM brings together stakeholders from different sectors and levels of government to co-ordinate the development and management of water resources. The ultimate goal is to maximise economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems,” Ms. Clark said.

Looking to the future, His Excellency Emomali Rahmon, President of the Republic of Tajikistan, said “I would like to announce a new International Decade for Action under the motto ‘Water for Sustainable Development’, which we believe should become an important tool for promoting the implementation of sustainable development goals related to water.”

Mr. Ban expressed his support for the proposal, saying: “It would complement and support the achievement of the proposed Sustainable Development Goals for water. Let us resolve together to build upon the successes of the “Water for Life” Decade and keep up the momentum for this crucial year of 2015 and far beyond.

While the major overarching objective is the eradication of poverty, the SDGs cover a lot of ground, including changing unsustainable (and promoting sustainable) patterns of consumption and production, and protecting and managing the natural resource base.

There is a subset of sustainable development goals and targets for global freshwater:-

**Goal 3**
Ensure healthy lives and promote well-being for all at all ages

- 3.3: by 2030 end the epidemics of AIDS, tuberculosis, malaria, and neglected tropical diseases and combat hepatitis, water-borne diseases, and other communicable diseases
- 3.9: by 2030 substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination
Goal 6
Ensure availability and sustainable management of water and sanitation for all

- 6.1 by 2030, achieve universal and equitable access to safe and affordable drinking water for all
- 6.2 by 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- 6.3 by 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and substantially increasing recycling and safe reuse globally
- 6.4 by 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity, and substantially reduce the number of people suffering from water scarcity
- 6.5 by 2030 implement integrated water resources management at all levels, including through transboundary co-operation as appropriate
- 6.6 by 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- 6.a by 2030, expand international co-operation and capacity-building support to developing countries in water and sanitation related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
- 6.b support and strengthen the participation of local communities for improving water and sanitation management
**Goal 11**  
Make cities and human settlements inclusive, safe, resilient and sustainable

- 11.5 by 2030 significantly reduce the number of deaths and the number of affected people and substantially decrease the direct economic losses relative to GDP caused by disasters, including water-related disasters, with the focus on protecting the poor and people in vulnerable situations.

**Goal 12**  
Ensure sustainable consumption and production patterns

- 12.4 by 2020 achieve environmentally sound management of chemicals and all wastes throughout their life cycle in accordance with agreed international frameworks and significantly reduce their release to air, water and soil to minimize their adverse impacts on human health and the environment.

**Goal 15**  
Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

- 15.1 by 2020 ensure conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

- 15.8 by 2020 introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems, and control or eradicate the priority species.
In 2017, the theme for World Water Day is Water and wastewater

The year 2017 provides an important opportunity to consolidate and build upon the previous World Water Days to highlight the relationship between water and wastewater in the quest for sustainable development.

It will look at how wastewater is perceived as a valuable resource in the circular economy and how its safe management can be an efficient investment in the health of humans and ecosystems.

The World Water Day 2017 campaign is being co-ordinated by UNEP (United Nations Environment Programme), UN-Habitat (United Nations Human Settlements Programme), WHO (World Health Organisation) and UNU (United Nations University), with the support of other UN water members and partners.

Themes from earlier years:

2016 – Water and Jobs
2015 – Water and Sustainable Development
2014 – Water and Energy
2013 – Water Co-operation
2012 – Water and Food Security
2011 – Water for Cities
2010 – Water Quality Challenges
2009 – Transboundary Water
2008 – Sanitation
2007 – Global Water Scarcity
2006 – Water and Culture
2005 – Water for Life
2004 – Water and Disasters
2003 – Water for the Future
2002 – Water for Development
2001 – Water for Health
2000 – Water for the 21st Century
The following is the list of the 193 Member States of the United Nations with dates on which they joined the organisation.

**Member (Date of Admission)**

Afghanistan (19 Nov. 1946)
Albania (14 Dec. 1955)
Algeria (8 Oct. 1962)
Andorra (28 July 1993)
Angola (1 Dec. 1976)
Antigua and Barbuda (11 Nov. 1981)
Argentina (24 Oct. 1945)
Armenia (2 Mar. 1992)
Australia (1 Nov. 1945)
Austria (14 Dec. 1955)
Azerbaijan (2 Mar. 1992)
Bahamas (18 Sept. 1973)
Bahrain (21 Sept. 1971)
Bangladesh (17 Sept. 1974)
Barbados (9 Dec. 1966)
Belarus (24 Oct. 1945)

*On 19 September 1991, Byelorussia informed the United Nations that it had changed its name to Belarus.*

Belgium (27 Dec. 1945)
Belize (25 Sept. 1981)
Benin (20 Sept. 1960)
Bhutan (21 Sept. 1971)
Bolivia (14 Nov. 1945)
Bosnia and Herzegovina (22 May 1992)

*The Socialist Federal Republic of Yugoslavia was an original Member of the United Nations, the Charter having been signed on its behalf on 26 June 1945 and ratified 19 October 1945, until its dissolution following the establishment and subsequent admission as new members of Bosnia and Herzegovina, the Republic of Croatia, the Republic of Slovenia, the former Yugoslav Republic of Macedonia and the Federal Republic of Yugoslavia.*

*The Republic of Bosnia and Herzegovina was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/237 of 22 May 1992.*
Botswana (17 Oct. 1966)
Brazil (24 Oct. 1945)
Brunei Darussalam (21 Sept. 1984)
Bulgaria (14 Dec. 1955)
Burkina Faso (20 Sept. 1960)
Burundi (18 Sept. 1962)
Cambodia (14 Dec. 1955)
Cameroon (20 Sept. 1960)
Canada (9 Nov. 1945)
Cape Verde (16 Sept. 1975)
Central African Republic (20 Sept. 1960)
Chad (20 Sept. 1960)
Chile (24 Oct. 1945)
China (24 Oct. 1945)
Colombia (5 Nov. 1945)
Comoros (12 Nov. 1975)
Congo (Republic of the) (20 Sept. 1960)
Costa Rica (2 Nov. 1945)
Côte d’Ivoire (20 Sept. 1960)
Croatia (22 May 1992)

The Socialist Federal Republic of Yugoslavia was an original Member of the United Nations, the Charter having been signed on its behalf on 26 June 1945 and ratified 19 October 1945, until its dissolution following the establishment and subsequent admission as new members of Bosnia and Herzegovina, the Republic of Croatia, the Republic of Slovenia, the former Yugoslav Republic of Macedonia, and the Federal Republic of Yugoslavia.

The Republic of Croatia was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/238 of 22 May 1992.

Cuba (24 Oct. 1945)
Cyprus (20 Sept. 1960)
Czech Republic (19 Jan. 1993)
Czechoslovakia was an original Member of the United Nations from 24 October 1945. In a letter dated 10 December 1992, its Permanent Representative informed the Secretary-General that the Czech and Slovak Federal Republic would cease to exist on 31 December 1992 and that the Czech Republic and the Slovak Republic, as successor States, would apply for membership in the United Nations. Following the receipt of its application, the Security Council, on 8 January 1993, recommended to the General Assembly that the Czech Republic be admitted to United Nations membership. The Czech Republic was thus admitted on 19 January of that year as a Member State.

Denmark (24 Oct. 1945)
Djibouti (20 Sept. 1977)
Dominica (18 Dec. 1978)
Dominican Republic (24 Oct. 1945)

Ecuador (21 Dec. 1945)
Egypt (24 Oct. 1945)

Egypt and Syria were original Members of the United Nations from 24 October 1945. Following a plebiscite on 21 February 1958, the United Arab Republic was established by a union of Egypt and Syria and continued as a single Member. On 13 October 1961, Syria, having resumed its status as an independent State, resumed its separate membership in the United Nations. On 2 September 1971, the United Arab Republic changed its name to the Arab Republic of Egypt.

El Salvador (24 Oct. 1945)
Equatorial Guinea (12 Nov. 1968)
Eritrea (28 May 1993)
Estonia (17 Sept. 1991)
Ethiopia (13 Nov. 1945)

Fiji (13 Oct. 1970)
Finland (14 Dec. 1955)
France (24 Oct. 1945)

Gabon (20 Sept. 1960)
Gambia (21 Sept. 1965)
Georgia (31 July 1992)
Germany (18 Sept. 1973)

The Federal Republic of Germany and the German Democratic Republic were admitted to membership in the United Nations on 18 September 1973. Through the accession of the German Democratic Republic to the Federal Republic of Germany, effective from 3 October 1990, the two German States have united to form one sovereign State.
Ghana (8 Mar. 1957)
Greece (25 Oct. 1945)
Grenada (17 Sept. 1974)
Guatemala (21 Nov. 1945)
Guinea (12 Dec. 1958)
Guinea-Bissau (17 Sept. 1974)
Guyana (20 Sept. 1966)
Haiti (24 Oct. 1945)
Honduras (17 Dec. 1945)
Hungary (14 Dec. 1955)
Iceland (19 Nov. 1946)
India (30 Oct. 1950)
Indonesia (28 Sept. 1950)

By letter of 20 January 1965, Indonesia announced its decision to withdraw from the United Nations “at this stage and under the present circumstances”. By telegram of 19 September 1966, it announced its decision “to resume full co-operation with the United Nations and to resume participation in its activities”. On 28 September 1966, the General Assembly took note of this decision and the President invited representatives of Indonesia to take seats in the Assembly.

Iran (Islamic Republic of) (24 Oct. 1945)
Iraq (21 Dec. 1945)
Ireland (14 Dec. 1955)
Israel (11 May 1949)
Italy (14 Dec. 1955)

Jamaica (18 Sept. 1962)
Japan (18 Dec. 1956)
Jordan (14 Dec. 1955)

Kazakhstan (2 Mar. 1992)
Kenya (16 Dec. 1963)
Kiribati (14 Sept. 1999)
Korea, North (1991)
Korea, South (1991)
Kuwait (14 May 1963)
Kyrgyzstan (2 Mar. 1992)

Lao People’s Democratic Republic (14 Dec. 1955)
Latvia (17 Sept. 1991)
Lebanon (24 Oct. 1945)
Lesotho (17 Oct. 1966)
Liberia (2 Nov. 1945)
Libya (14 Dec. 1955)
Liechtenstein (18 Sept. 1990)
Lithuania (17 Sept. 1991)
Luxembourg (24 Oct. 1945)

Madagascar (20 Sept. 1960)
Macedonia (1993)
Malawi (1 Dec. 1964)
Malaysia (17 Sept. 1957)

The Federation of Malaya joined the United Nations on 17 September 1957. On 16 September 1963, its name was changed to Malaysia, following the admission to the new federation of Singapore, Sabah (North Borneo) and Sarawak. Singapore became an independent State on 9 August 1965 and a Member of the United Nations on 21 September 1965.

Maldives (21 Sept. 1965)
Mali (28 Sept. 1960)
Malta (1 Dec. 1964)
Marshall Islands (17 Sept. 1991)
Mauritania (27 Oct. 1961)
Mauritius (24 Apr. 1968)
Mexico (7 Nov. 1945)
Micronesia (Federated States of) (17 Sept. 1991)
Moldova (1992)
Monaco (28 May 1993)
Mongolia (27 Oct. 1961)
Montenegro (28 June 2006)

The membership of the State Union Serbia and Montenegro in the United Nations, including all organisations of the United Nations system, is continued by the Republic of Serbia on the basis of Article 60 of the Constitutional Charter of Serbia and Montenegro, activated by the Declaration of Independence adopted by the National Assembly of Montenegro on 3 June 2006.

The Republic of Montenegro was admitted as a Member of the United Nations by General Assembly resolution 60/264 of 28 June 2006.

Morocco (12 Nov. 1956)
Mozambique (16 Sept. 1975)
Myanmar (19 Apr. 1948)

Namibia (23 Apr. 1990)
Nauru (14 Sept. 1999)
Nepal (14 Dec. 1955)
Netherlands (10 Dec. 1945)
New Zealand (24 Oct. 1945)
Nicaragua (24 Oct. 1945)
Niger (20 Sept. 1960)
Nigeria (7 Oct. 1960)
Norway (27 Nov. 1945)

Oman (7 Oct. 1971)
Pakistan (30 Sept. 1947)
Palau (15 Dec. 1994)
Panama (13 Nov. 1945)
Papua New Guinea (10 Oct. 1975)
Paraguay (24 Oct. 1945)
Peru (31 Oct. 1945)
Philippines (24 Oct. 1945)
Poland (24 Oct. 1945)
Portugal (14 Dec. 1955)

Qatar (21 Sept. 1971)
Romania (14 Dec. 1955)
Members of the United Nations (UN)

Russian Federation (24 Oct. 1945)
The Union of Soviet Socialist Republics was an original Member of the United Nations from 24 October 1945. In a letter dated 24 December 1991, Boris Yeltsin, the President of the Russian Federation, informed the Secretary-General that the membership of the Soviet Union in the Security Council and all other United Nations organs was being continued by the Russian Federation with the support of the 11 member countries of the Commonwealth of Independent States.

Rwanda (18 Sept. 1962)
Saint Kitts and Nevis (23 Sept. 1983)
Saint Lucia (18 Sept. 1979)
Saint Vincent and the Grenadines (16 Sept. 1980)
Samoa (15 Dec. 1976)
San Marino (2 Mar. 1992)
Sao Tome and Principle (16 Sept. 1975)
Saudi Arabia (24 Oct. 1945)
Senegal (28 Sept. 1960)
Serbia (1 Nov. 2000)
The membership of the State Union Serbia and Montenegro in the United Nations, including all organs and organizations of the United Nations system, is continued by the Republic of Serbia on the basis of Article 60 of the Constitutional Charter of Serbia and Montenegro, activated by the Declaration of Independence adopted by the National Assembly of Montenegro on 3 June 2006.
The Republic of Montenegro was admitted as a Member of the United Nations by General Assembly resolution 60/264 of 28 June 2006.

Seychelles (21 Sept. 1976)
Sierra Leone (27 Sept. 1961)
Singapore (21 Sept. 1965)
Slovakia (19 Jan. 1993)
Czechoslovakia was an original Member of the United Nations from 24 October 1945. In a letter dated 10 December 1992, its Permanent Representative informed the Secretary-General that the Czech and Slovak Federal Republic would cease to exist on 31 December 1992 and that the Czech Republic and the Slovak Republic, as successor States, would apply for membership in the United Nations. Following the receipt of its application, the Security Council, on 8 January 1993, recommended to the General Assembly that the Slovak Republic be admitted to United Nations membership. The Slovak Republic was thus admitted on 19 January of that year as a Member State.
Members of the United Nations (UN)

Slovenia (22 May 1992)
The Socialist Federal Republic of Yugoslavia was an original Member of the United Nations, the Charter having been signed on its behalf on 26 June 1945 and ratified 19 October 1945, until its dissolution following the establishment and subsequent admission as new members of Bosnia and Herzegovina, the Republic of Croatia, the Republic of Slovenia, the former Yugoslav Republic of Macedonia and the Federal Republic of Yugoslavia.
The Republic of Slovenia was admitted as a Member of the United Nations by General Assembly resolution A/RES/46/236 of 22 May 1992.

Solomon Islands (19 Sept. 1978)
Somalia (20 Sept. 1960)
South Africa (7 Nov. 1945)
South Sudan (14 July 2011)
The Republic of South Sudan seceded from Sudan on 9 July 2011 as a result of an internationally monitored referendum held in January 2011, and was admitted as a new member state by the United Nations General Assembly on 14 July 2011.

Spain (14 Dec. 1955)
Sri Lanka (14 Dec. 1955)
Sudan (12 Nov. 1956)
Suriname (4 Dec. 1975)
Swaziland (24 Sept. 1968)
Sweden (19 Nov. 1946)
Switzerland (10 Sept. 2002)
Syrian Arab Republic (24 Oct. 1945)
Egypt and Syria were original Members of the United Nations from 24 October 1945. Following a plebiscite on 21 February 1958, the United Arab Republic was established by a union of Egypt and Syria and continued as a single Member. On 13 October 1961, Syria, having resumed its status as an independent State, resumed its separate membership in the United Nations.

Tajikistan (2 Mar. 1992)
Tanzania (1961)
Thailand (16 Dec. 1946)
Togo (20 Sept. 1960)
Tonga (14 Sept. 1999)
Trinidad and Tobago (18 Sept. 1962)
Tunisia (12 Nov. 1956)
Turkey (24 Oct. 1945)
Turkmenistan (2 Mar. 1992)
Tuvalu (5 Sept. 2000)

Ukraine (24 Oct. 1945)
United Arab Emirates (9 Dec. 1971)
United Kingdom of Great Britain and Northern Ireland (24 Oct. 1945)
United States of America (24 Oct. 1945)
Uruguay (18 Dec. 1945)
Uzbekistan (2 Mar. 1992)
Ukraine (24 Oct. 1945)
United Arab Emirates (9 Dec. 1971)
United Kingdom of Great Britain and Northern Ireland (24 Oct. 1945)
United States of America (24 Oct. 1945)
Uruguay (18 Dec. 1945)
Uzbekistan (2 Mar. 1992)

Vanuatu (15 Sept. 1981)
Venezuela (Bolivarian Republic of) (15 Nov. 1945)
Vietnam (20 Sept. 1977)

Yemen (30 Sept. 1947)

_Yemen was admitted to membership in the United Nations on 30 September 1947 and Democratic Yemen on 14 December 1967. On 22 May 1990, the two countries merged and have since been represented as one Member with the name ‘Yemen’._

Zambia (1 Dec. 1964)

Zimbabwe (25 Aug. 1980)
The amount of water at the Earth’s surface is pretty constant, but in many parts of the developed world we are running out of the right sort of water, and our ability to access it. The severe weather shortages experienced in California and the southwestern US, in Australia, and even in parts of the UK show we need new methods for ensuring a clean water supply.

One is to produce high quality water from wastewater, something that is improving all the time. While this could help relieve the strain on water supplies, public attitudes to the idea of using water that is recycled from sewage and other wastewater streams for drinking and domestic use is the more significant barrier.

The treatment and reuse of ‘grey water’ (waste from baths, showers, washing machines and so on) for non-drinking uses such as irrigation is already widespread. But as the demand for water grows and supplies continue to dwindle, more and more attention is being paid to ‘black’ water – in simple terms, sewage.

Technological advances and environmental regulations have made the production of very high quality water from black wastewater streams not just feasible, but increasingly an economic and political necessity. The challenge facing water engineers now is arguably just as significant: convincing the public to accept sewage water recycled in this way for mainstream domestic consumption.

A shift in companies’ way of thinking about sewage has been noted. There has been a move away from the immediate disposal of sewage and sludge, to trying to make use of it. In particular, great strides are being made in utilising sewage to generate gas and electricity.

The real question is “why do we spend billions of dollars getting rid of our waste?” Imagine what all those lost nutrients could do – not least in generating bio-responsible power. Our modern disassociation from poo speaks volumes. In the past:

1. Human excrement was a vital part of the food chain, with ‘night soil’ regularly used to feed the ground – and thus the plants that we, or our animals, ate.

2. Imagine too, the volume of horse manure being produced each day, in a pre-combustion engine city the size of London, New York or Paris.

3. During the 19th century, the gathering of dog poo for the tanning industry was a specific trade, know as pure finding.

People have increasingly been removed from their proximity to wastewater and more and more sewage is associated with health risks and unsanitary conditions. The resulting cultural obstacles to utilising sewage, rather than immediately getting rid of it, may prove difficult if not impossible to overcome.

In addition, open sewage is still a common problem across the globe so the encouragement of sanitary habits is as important as the promotion of green energy sources, especially to communities unable to use such technology.
How we dealt with wastewater in the past

Believe it or not, there haven’t always been flushing toilets. The first flushing toilet wasn’t invented until 1775 by Alexander Cumming who was granted the first patent for a flushing lavatory, but a better one was designed by Joseph Brahmah in 1778.

Today in rich countries we take toilets for granted yet in poor countries millions of people do not have hygienic toilets.

Our word toilet is derived from the French word toilette, which means little cloth. In the 17th century it was a cloth cover for a dressing table, called a toilet table. If a woman was at her toilet it meant she was dressing and preparing her appearance. By the 19th century toilet room or toilet had the current day meaning.

Our word lavatory comes from the Latin lavare meaning to wash. In the 17th century a lavatory was a place for washing. Later it became where we go to the toilet.

On board a ship the toilets are called the heads. Originally they were just wooden boards with holes cut in them hanging over the sides of the ships. They were placed at the head of the ship.

On land there are many euphemisms for toilets. One is the ‘smallest room in the house’. Sometimes people say they are “going to spend a penny” because public lavatories used to cost one penny to use.

The World Toilet Organisation was formed in 2001 to improve toilets in the developing world. Despite this there are still around 2.4 billion people in the world without access to a proper toilet.
**Toilets in the ancient world**

In the ancient world people were capable of designing quite sophisticated toilets. Stone age farmers lived in a village at Skara Brae in the Orkney Islands off the Scottish coast. Some of their stone huts had drains built under them and some houses had cubicles over the drain. They may have been inside toilets.

In ancient Egypt rich people had proper bathrooms and toilets in their homes. Toilet seats were made of limestone. Poor people made do with a wooden stool with a hole in it. Underneath was a container filled with sand, which had to be emptied by hand. (If you were wealthy slaves did that!)

In the Indus Valley civilisation (c.2600 – 1900BC) streets were built on a grid pattern and networks of sewers were dug under them. Toilets were flushed with water.

On the island of Crete the Minoan civilisation flourished from 2000 to 1600BC. They too built drainage systems, which also took sewage. Toilets were flushed with water.

The Romans also built sewers to collect rainwater and sewage. They even had a goddess of sewers called Cloacina! Wealthy people had their own toilets but the Romans also built public lavatories. In them there was no privacy, just stone seats next to one another without partitions of any kind. After using the toilet, people wiped their behinds with a sponge on a stick. Despite the public lavatories many people still went in the street.
Toilets in the Middle Ages

In the Middle Ages toilets were simply pits in the grounds with wooden seats over them. However monks built stone or wooden lavatories over rivers. At Porchercast castle in the 12th century, monks built stone chutes leading to the sea. When the tide went in and out it flushed away the sewage.

In Medieval castles, the toilet was called a garderobe and it was simply a vertical shaft with a stone seat at the top. Some garderobes emptied into the moat.

In the Middle Ages wealthy people might use rags to wipe their behinds. Ordinary people often used a plant called common mullein or woolly mullein.

Toilets in the modern world

In 1596 Sir John Harrington invented a flushing lavatory with a cistern. However the idea failed to catch on. People continued to use chamber pots or cess pits, which were cleaned by men called ‘gong farmers’. (In the 16th century, a toilet was called a jakes).


In 1775 Alexander Cumming was granted a patent for a flushing lavatory. Joseph Brahmah made a better design in 1778.

However flushing toilets were a luxury at first and they did not become common until late 19th century. Also popular in the 19th century were earth closets. An earth closet was a box of granulated clay over a pan. When you pulled a lever, clay covered the contents of the pan. In rural areas flushing lavatories did not replace earth closets until the early 20th century.

In the early 19th century working class homes often did not have their own toilet and had to share one. Sometimes you had to queue to use it.

In the 19th century toilet pans were made of porcelain. They were usually decorated, embossed or painted with attractive colours. Seats were of wood and cisterns were often emptied by pulling a chain. At first toilet bowls were boxed in but the first pedestal toilet bowl was made in 1884. Meanwhile the vacant/engaged bolt for public toilets was patented in 1883.
Inside toilets were a luxury in the 19th century. In the late 19th century working class homes almost always had outside lavatories. Round 1900 some houses were built for skilled workers with bathrooms and inside toilets however, it was decades before inside toilets became universal.

There were public lavatories in the Middle Ages and the 16th century. For instance we know there was one over the River Fleet at London. However public lavatories were rare at that time. Often people went wherever they could. In 1547, people were forbidden to go to the toilet in the courtyards or royal palaces, so presumably it must have been a real nuisance.

The first modern public lavatory, with flushing toilets opened in London in 1852. Toilet paper went on sale in the USA in 1857. At first toilet paper was sold in sheets. It was first sold in rolls in the USA in 1890 and in Europe in 1928. Soft toilet paper went on sale in 1942. However after it was invented in the west, toilet paper was a luxury. In the early 20th century many families used newspaper.

See the toilet timeline posters on the following pages
At Skara Brae in Scotland, stone huts have drains with cubicles over them. They may have been toilets.

In North West India and Pakistan, towns are built with networks of sewers. Toilets are flushed with water.

On Crete some toilets are flushed with water.

In Egypt rich people use a container with sand, which is emptied by slaves.

The Romans have public lavatories but toilet paper does not exist, so they use a sea sponge attached to a long stick.

The Romans have a goddess of sewers called Cloacina.

The Roman Empire falls and in Western Europe sophisticated plumbing vanishes for centuries.

At Porchester Castle, monks built stone chutes leading to the sea. When the tide went in and out it flushed away the sewage.

In castles the toilet is a vertical shaft cut into the thickness of the walls with a stone seat on the top.

Ordinary people often use the leaves of a plant called woolly mullein as toilet paper.

People are forbidden to go to the toilet in the courtyards of royal palaces.

Sir John Harrington invents a flushing toilet but the idea fails to catch on. People continue to use cess pits, which are cleaned by men called ‘gong farmers’.

Please note: Toilet timeline facts and dates credited to Tim Lambert
Background information – Water and wastewater

A timeline of toilets continued

1775
Alexander Cumming patents a flushing lavatory.

1778
Joseph Brahmah makes a better design.

1850
Earth closets are popular. When you pull a lever, granulated clay from a box covers the contents of the pan.

1852
The first modern public lavatory opens.

1857
Toilet paper goes on sale in the USA. It is sold in sheets.

1875
Henry Moule’s earth closet, improved version.

1883
The vacant/engaged bolt is invented.

1884
The first pedestal toilet pan is made.

1890
Toilet paper on rolls goes on sale in the USA.

1928
Toilet paper on rolls goes on sale in Europe.

1942
Soft toilet paper goes on sale.

1950
Auckland outhouses. A small structure separate from a main building that covers a pit or toilet.

2001
The World Toilet Organisation is formed.

Toilets today

Please note: Toilet timeline facts and dates credited to Tim Lambert
Māori and waste disposal

All sanitary arrangements were under the charge of special officers. Each village was laid out regularly, with the houses in rows facing the sunny North. Latrines were erected in sufficient number to provide one for every 100 to 150 persons, and were placed fifty paces away from the end house of the row; usually to the East and South. They were placed on the edge of a cliff wherever possible, in order to avoid the trouble of making a trench, but where no cliff was available, trenches were dug two metres wide and four metres deep, and usually about 30 to 40 paces in length outwards from the last house of the row. Wide planks a few inches apart were placed across these trenches in pairs (paepae), each pair laced to an upright centre-post firmly driven into the edge of the bank. There were also smaller upright posts with notches on them which people held onto to keep balance as they squatted. The posts were called pou puritanga ringa (hand grip posts). Paepae were tapu (sacred) to stop human waste being used in mãkutu (sorcery). This was a religious belief, but grounded in the knowledge that human waste could cause illness if not carefully disposed of. Instead of toilet paper, flax was specially prepared for this purpose and made soft and fluffy. If there wasn’t enough flax, dried moss was used instead and it was directed that at least two handfuls of loose earth must be thrown over everything.

Screens made of reeds were erected at both ends of the trenches, and another screen formed a complete division in the middle, thus separating women and children from men and youths. The only entrances to the latrines were at the ends, the earth from the trenches having been heaped up on both sides, about a pace away, thus forming a high barricade. Earth for filling the trench was taken from the looser parts of the base.

Fatigue parties composed of the inferior men, were allotted the task of attending to the trenches before daybreak, long before the rest of the village was awake. Many legends tell how the first alarm of an attack was given by members of these sanitary fatigue parties, who were afterwards promoted as a reward for service.

During the morning the sanitary officer inspected the latrines and whenever he considered it necessary, he would order the trench to be covered over more deeply, or more frequently than once a day. When the trench became filled to within 60 centimetres of the top, the remainder of the earth bank was thrown in and heaped up in a mound over the trench, new accommodation having been already prepared nearby. Later on the soil was used for agricultural purposes. The lapse of time which occurred before such soil was used for manuring purposes was left to the discretion of the sanitary officer. The period varied in accordance with the weather conditions, the nature of the earth and so forth. Each closed trench was marked with a date-post, showing when it had been filled in.
The emptying of the bowels and bladder were both absolutely forbidden anywhere in the village except at the latrines. At night-time special calabashes (the fruit from a tropical plant that becomes hard when dried and can be used as a container) were kept in the porch of the houses, but if these were used during the night, they had to be emptied down the latrines immediately after rising in the early morning, and the calabashes had to be thoroughly washed. Such receptacles were never used for emptying the bowels except in the case of sick persons and those otherwise disabled from going to the latrines. Even in these cases, the persons were carried into the porches of the sleeping-house. In no case would either bowels or bladder be emptied inside dwelling-houses. When sick persons emptied their bowels, the excrement was immediately removed to the latrine by the medical attendant.

The penalties for disobeying any of these sanitary regulations were very severe. Knowledge and understanding of them was taught to everybody from early childhood. They were Sacred Laws handed down from the Māori ancestors for many generations, and taught by the Elders and Doctors. The responsibility for obedience to them rested on every individual.

Traditional sanitation practices broke down in the wake of European colonisation, as new diseases and land loss crippled Māori communities. Separate paepae were no longer the norm and declining belief in makutu meant people defecated in the bush around villages without fear.

Sources:  
*Māori symbolism*, Ettie A Rout (New Zealand Law Court Reporter. From evidence of Hohepa Te Rake an Arawa Noble)  
Kegan Paul, Trench, Trubner & Co. Ltd. 1926

*Tuhoe: The children of the mist*, Elsdon Best, 1925

Kerryn Pollock, *Washing, cleaning and personal hygiene – toilets*’ Te Ara – the Encyclopedia of New Zealand  
(accessed 7 October 2016)
How we dealt with wastewater in Auckland in the past

1840’s

When Auckland was first settled it was a tent village and sanitation amounted to a hole in the ground. Any drains including some water closets emptied onto the beach.

The foreshore was a stinking mess of sewage and household rubbish. As the population increased drains and sewers were built alongside natural watercourses releasing waste into the harbour.

There was a stream and swamp at the present Queen Street. The stream was channelled and turned into a partially covered canal, called the Ligar Canal after the surveyor general who commissioned it. The canal was well known for its sides collapsing, and people falling in.

In July 1843 in the Daily Southern Cross newspaper (which merged with the New Zealand Hearald in 1876) we read of the banks of the Ligar Canal caving in and whole houses nearly being carried away and poor Mr Rich had a large quantity of butter float away into the sea.

By the mid-1800’s wastewater from houses and stormwater was drained by clay pipes which emptied into gullies and streams.

By the 1870s fifty tons of city sewage was being buried weekly behind Surrey Crescent and the rest went into streams and the harbour.

1878 – 1888

Before the time of flushing toilets, people would go to the toilet in a bucket in a shed at the bottom of the garden. Simple privies or outhouses were built over holes (cesspits) in the backyard and moved when the whole was full. Chamber pots were used at night to avoid a trip down to the bottom of the garden. These were then emptied into the privy in the morning. People were confronted with human waste daily and had to tolerate the smell.
This waste then had to be removed to avoid illness and diseases. Nightsoil was the name given to human poo and collected in this way.

Not everyone would pay someone to take the waste away so sometimes it was buried in gardens or spread over land as fertiliser. At the time the City Council’s idea of sanitation was removing rubbish when it started to cause a bad smell. The accumulated rubbish would often leak into the water supply contaminating it and causing disease.

In 1888 there was a typhoid outbreak that particularly affected the slum area of Ponsonby. Typhoid is spread person-to-person from human waste to the mouth. This is through poor hygiene and lack of hand-washing or via food or water that has been contaminated, untreated water supplies, shellfish gathered from areas where water is contaminated or food handled by a person carrying the infection. Typhoid fever symptoms are poor appetite, headaches, generalised aches and pains, fever and lack of energy.

The drainage system at the time was very badly built and this caused a lot of pollution around the harbour and there was no organised rubbish collection. People had to make their own arrangements for disposing of their rubbish.

In 1900 there were 19 borough councils and each one deposited its nightsoil and rubbish in the territory of a neighbouring council causing a lot of bad feeling. Many of the older buildings had fallen into disrepair, there was no adequate service of inspection and food premises were under no control. The rat-infested buildings of lower Queen Street produced ideal conditions for the plague when it reached Auckland in 1900. Large numbers of dead and dying rats were found in basements of buildings, some had been there so long that they had become mummified. Finally eight people were diagnosed as having the plague in 1911 and this led to a major clean-up of rats and rubbish. In 1905 an organised rubbish collection service started in the city and two years later iron bins with lids were introduced for the rubbish to go into. In 1907, the Council took on the collection and disposal of nightsoil and used sealed pans which were washed after use and before being returned for reuse.
Different areas of Auckland had developed their own systems for discharging waste into the Waitemata and Manukau harbours. Sewers were built in Newmarket in 1880, Mt Albert in 1901, Onehunga and Otahuhu in 1910, One Tree Hill in 1913 and in Ellerslie and Mt Eden in 1915.

In the late 19th century permanent toilets – water or earth closets – started to appear in homes. Initially, water closets simply flushed the waste in water into a cesspit (which were regularly emptied). Earth closets contained a bucket, and the contents were covered with dirt and then left out for the night-soil man.

It was only when high-pressure water-based sanitation systems were installed that most people no longer had to handle the household’s human waste. The first high-pressure system was built in Wellington in 1899. Toilets could now flush waste away from the home into sewers. In more remote areas though, flushing toilets remained a dream until the second half of the 20th century.

**Location of toilets**

Like washing facilities, toilets moved from outside to inside, in line with developments in piped water and waste disposal. The backyard privy (often called the dunny) was common well into the 20th century, but the toilet made its move into the back verandah of new houses in the late 19th century. In the early 1900s the toilet was fully integrated into new houses, either in a small room next to the bathroom or within the bathroom. Two-storeyed houses often had a toilet upstairs. The general location and appearance of toilets has not changed much since then.
Wastewater today
What is wastewater
Wastewater is used water. It includes substances such as human waste, food scraps, oils, soaps and chemicals. In homes, this includes water from sinks, showers, bathtubs, toilets, washing machines and dishwashers. Businesses and industries also contribute their share of used water that must be cleaned.

Where does wastewater come from?
Wastewater can come from:

- Human excreta (faeces and urine) often mixed with used toilet paper or wipes; this is known as blackwater if it is collected with flush toilets
- Washing water (personal, clothes, floors, dishes, cars, etc.), also known as greywater or sullage
- Surplus manufactured liquids from domestic sources (drinks, cooking oil, pesticides, lubricating oil, paint, cleaning liquids, etc.)
- Manmade liquids (illegal disposal of pesticides, used oils, etc.)
- Industrial waste

What does wastewater contain?
The composition of wastewater varies widely. This is a partial list of what it may contain:

- Water (more than 95 per cent), which is often added during flushing to carry waste down a drain
- Pathogens such as bacteria, viruses, prions and parasitic worms
- Non-pathogenic bacteria
- Organic particles such as faeces, hairs, food, vomit, paper fibres, plant material, humus, etc.
- Soluble organic material such as urea, fruit sugars, soluble proteins, drugs, pharmaceuticals, etc.
- Inorganic particles such as sand, grit, metal particles, ceramics, etc.
- Soluble inorganic material such as ammonia, road-salt, sea-salt, cyanide, hydrogen sulfide, thiocyanates, thiosulfates, etc.
- Animals such as protozoa, insects, arthropods, small fish, etc.
- Macro-solids such as sanitary napkins, nappies/diapers, condoms, needles, children’s toys, dead animals or plants, etc.
- Gases such as hydrogen sulfide, carbon dioxide, methane, etc.
- Emulsions such as paints, adhesives, mayonnaise, hair colorants, emulsified oils, etc.
- Toxins such as pesticides, poisons, herbicides, etc.
- Pharmaceuticals and hormones and other hazardous substances.
Why treat wastewater?
Nature has an amazing ability to cope with small amounts of water wastes and pollution, but it would be overwhelmed if we didn’t treat the billions of litres of wastewater and sewage produced every day before releasing it back to the environment. Treatment plants reduce pollutants in wastewater to a level nature can handle. It’s a matter of caring for our environment and for our own health. There are a lot of good reasons why keeping our water clean is an important priority:

Fisheries

Clean water is critical to plants and animals that live in water. This is important to the fishing industry, sport fishing enthusiasts and future generations. Decaying organic matter and debris can use up the dissolved oxygen in a lake so fish and other aquatic animals and plants cannot survive.

Wildlife habitats

Our rivers and ocean waters teem with life that depends on shoreline, beaches and marshes. They are critical habitats for hundreds of species of fish and other aquatic life. Migratory water birds use the areas for resting and feeding. Bacteria, viruses and disease causing pathogens in wastewater can pollute beaches and contaminate shellfish eaten by birds and humans and be toxic to animals and plants. Metals in the wastewater such as mercury, lead, cadmium, chromium and arsenic can have acute and chronic toxic effects on species.

Recreation and quality of life

Water is a great playground for us all. The scenic and recreational values of our waters are reasons many people choose to live where they do. Visitors are drawn to water activities such as swimming, fishing, boating and picnicking. Substances such as some pharmaceutical and personal care products, primarily entering the environment in wastewater effluents, may also pose threats to human health, aquatic life and wildlife and can lead to the closing of beaches and other water facilities.

Health concerns

If it is not properly cleaned, water can carry disease. Since we live, work and play so close to water, harmful bacteria have to be removed to make water safe.
Wastewater treatment in Auckland

How is Auckland’s wastewater treated?

Auckland’s wastewater is transported through a 7981 kilometre public wastewater network to one of 18 wastewater treatment plants. However, the majority of Auckland’s wastewater is treated at Mangere or Rosedale treatment plants.

Here the wastewater is treated to produce treated wastewater and biosolids to standards that protect public health, the local environment and our coasts and harbours. Watercare is continually seeking more environmentally friendly ways of doing this.

Rosedale Wastewater Treatment Plant

The Rosedale Wastewater Treatment Plant located in Rosedale, opened in 1962. At that time it served a population of around 60,000 people. Since then, the plant has been progressively upgraded using modern processes to effectively treat the wastewater.

The plant now serves almost 220,000 people and sits among houses, industry and recreational facilities. The open areas of buffer land around the main plant and the large ponds, which form an integral part of the treatment process, provide relieving, open space vistas within an otherwise urban landscape.

Wastewater is pumped to the site and is treated in a series of different processes to ensure it is safe to be returned into the environment. Solids and liquids in the wastewater are separated at different times through the overall process. Biological processes, similar to those used in our own stomachs, are used to help purify the waste. The main treatment process for liquids is called “activated sludge”, where bacteria in the activated sludge solids use the wastewater as a source of food.
After solids are removed through settlement, the liquids take around two weeks to travel through the pond system, where sunlight provides natural disinfection of remaining bacteria. Further disinfection using ultraviolet light is provided before the treated wastewater is discharged through a 2.1 kilometre-long outfall pipe out to sea. This was completed in 2010. The treated wastewater easily meets New Zealand Recreational Water Quality guidelines before it reaches the surface. Some of the treated wastewater is used on site for process wash water and irrigation.

The solids removed in the treatment processes are biologically treated in a separate process to produce biogas. This is used to produce around 70 per cent of the energy required to run the whole plant. Following this treatment, the biosolids produced are dewatered, with an average of less than two truck and trailer loads discharged to landfill every day.

**Mangere Wastewater Treatment Plant**

The wastewater treatment plant at Mangere started operating in 1960. It was upgraded between 1998 and 2003 to accommodate Auckland’s growing population. The new plant was officially opened by Prime Minister Helen Clark on 4 April 2003.

The new treatment plant reduces the treatment cycle for wastewater from 21 days to 13 hours and provides water of bathing quality which is discharged into the Manukau Harbour.
The wastewater treatment process

Stage 1. Primary treatment

Raw wastewater entering the treatment plant first passes through fine screens which remove large material such as gravel, wood and plastic. The rotating fine screens have three millimetre gaps between the bars.

The screens break up raw sewage and extract material like paper, fruit and vegetable pulp, plastic and pieces of wood from the waste stream. Banks of water jets within the rotating screens blast the debris from the mesh. Debris is collected in screening bins which are taken away for land disposal. The increased efficiency of the fine screens means material which once would have passed through the system is being taken out. This screened material has increased from one to five tonnes per day.

Pre-aeration tanks (grit tanks)

These tanks remove sand and grit from the incoming wastewater. Air blown into the 12 tanks reduces the buoyancy causing the heavier particles to settle from the organic waste.
Primary sedimentation tanks

These tanks separate solid and liquid wastes. The 12 tanks are designed so that wastewater flows through them in a smooth motion, allowing the solids (sludge) to sink to the bottom. During the two hours the wastewater stays in the tanks, scrapers continuously sweep the floor collecting settled sludge and pushing it into a deep hopper. The sludge, together with surface grease and scum, is then sent into sludge gravity thickening tanks. The primary treated water flows over outlet weirs to the inter-stage pump station. From there it is pumped up to the splitter boxes which divide the effluent before sending it to the reactor/clarifiers for secondary treatment.

Gravity thickening

Sludge extracted from the primary tanks is still very fluid and needs to be thickened prior to entering the digesters. As the primary sludge enters the gravity thickener tank, the heavier sludge goes to the bottom. There is an element inside the tank, shaped like a picket fence. It rotates and breaks up sludge mats and releases trapped gases. As more sludge enters the tank, the top layer which is mostly fluid goes over a weir and is sent to the reactor/clarifiers. The remaining sludge is sent to the anaerobic digesters.
Stage 2. Secondary treatment

The secondary treatment process uses recycled sludge (high in bacteria) to take out pollutants and help to change sewage into an environmentally acceptable product. During the second treatment more of the solids are separated from the liquid and reactor/clarifiers remove nutrients, in particular, nitrogen which can be harmful to the environment. Nitrogen in the form of ammonia and nitrate is a major pollutant of the coastal marine environment. When discharged into the sea, they stimulate excessive growth of algae and seaweed which reduces the life-supporting capacity of harbour waters.

Reactor

Incoming effluent is fed into the first anoxic compartment with activated sludge. The reactor is made up of eight compartments – four aerobic (which are aerated) and four anoxic (which are not). In the aerobic compartment, ammonia is converted to nitrate and nitrites. In anoxic conditions, bacteria convert the nitrates into harmless nitrogen gas.

Clarifier

Once the processed wastewater has passed through the anoxic and aerobic compartments in the reactor, it flows into the clarifier sedimentation tank where the heavier sludge, including the bacteria and other micro-organisms, settle to the bottom. The settled material is gathered up by rotating sweep arms and recycled back into the reactor. Wastewater travels over a weir to the filtration and ultraviolet (UV) disinfection plant.
Stage 3. Tertiary treatment
During the final treatment stage, wastewater is disinfected using ultraviolet (UV) light. The UV disinfection plant is believed to be the largest in the world. It contains the latest technology and with the secondary treatment achieves 10,000 times reduction in viruses in the wastewater being discharged into the harbour.

Filtration
The clarified wastewater is passed through 10 massive filters. The filter blocks contain grains of anthracite – a hard form of coal. The filters remove particles larger than 15 thousandths of a millimetre. This is to ensure maximum UV light penetration.

In the UV gallery, the filtered water passes through 12 parallel channels. There is a total of 7776 UV lamps and they are arranged in banks of 216 lamps. To remain effective each lamp has a built-in cleaning device that travels back and forth cleaning the tube. The UV disinfection plant is designed to reduce the number of pathogens in the wastewater discharging into the harbour by more than 10 thousand times.

Treated water discharged from the Mangere Wastewater Treatment Plant averages about 300,000 cubic metres per day. It is pumped out twice a day at high tide as a rate of 25 cubic metres per second. Beyond a small mixing area surrounding the discharge point, the water quality is sufficient to allow contact recreation such as swimming and shellfish gathering.
The management of wastewater
Wastewater is a global concern. It has a direct impact on the biological diversity of aquatic ecosystems, disrupting the fundamental integrity of our life support systems on which a wide range of sectors from urban development to food production and industry depend.

Poorly managed wastewater leads to:

- Climate change through wastewater-related emissions of methane (CH$_4$) and nitrous oxide (N$_2$O), which have higher global warming potentials than CO$_2$.
- Spreading of ‘Dead Zones’ impacting aquatic ecosystems, fisheries, livelihoods and the food chain.
- Health impacts due to waterborne diseases.

Historically for all these reasons wastewater has been viewed in a very negative way.

Could we manage wastewater more effectively and put the by-products of wastewater treatment to good use?

Properly managed wastewater is a valuable resource and a solution to more than one problem.

1. It is a source of water and nutrients that can be used in agriculture for crop production, reducing the need for scarce freshwater and expensive fertilizers.
2. It can undergo further treatment so that it can be used as drinking water.
3. It can be used for watering golf courses and landscaping along public roads, firefighting and commercial laundering.
4. Wastewater sludge can also be used to manufacture construction materials.
5. It can be used for industrial purposes to cool power-generation equipment freeing up higher quality water to be used elsewhere.
6. It can be used to generate biogas and bio-fuel, thus providing opportunities for green jobs, sustainable development and social well-being.

1. Wastewater reuse in agriculture
Increasingly, agriculture is using untreated wastewater for irrigation. Cities provide lucrative markets for fresh produce, so are attractive to farmers. However, because agriculture has to compete for increasingly scarce water resources with industry and municipal users, there is often no alternative for farmers (particularly in the poorer, developing countries) but to use water polluted with urban waste directly to water their crops.
There are benefits of using recycled water for irrigation, including the lower cost compared to some other sources and consistency of supply regardless of season, climatic conditions and associated water restrictions.

Irrigation with recycled wastewater can also serve to fertilize plants if it contains nutrients, such as nitrogen, phosphorus and potassium removing or reducing the need for chemical fertilizers to be used on the land. However plant nutrients in wastewater may not be present in the ideal concentration for direct crop production and meeting one nutrient requirement may lead to an imbalance in another nutrient level. To avoid this it would be important for farmers to have better information about crop requirements and nutrient levels in the wastewater and soil to avoid overdosing the land with nutrients which could lead to surplus runoff going into rivers and streams causing eutrophication and dead zones.

It is important to remember that this type of use has to be managed carefully as there can be significant health hazards related to using untreated wastewater in agriculture. Wastewater from cities can contain a mixture of chemical and biological pollutants. The World Health Organisation developed guidelines for safe use of wastewater in 2006. These guidelines advocate a ‘multiple-barrier’ approach to wastewater use, for example by encouraging farmers to adopt various risk-reducing behaviours. These include stopping irrigation a few days before harvesting to allow pathogens to die off in the sunlight, applying water carefully so it does not contaminate leaves likely to be eaten raw, cleaning vegetables with disinfectant or allowing the sludge made of human poo used in farming, to dry before being used as a manure.

**Phosphorus**

There is debate over whether the world’s supply of phosphorus is dwindling. Phosphorus is an important element that is fundamental to all living things. It is essential for the creation of DNA, cell membranes and bone and teeth formation in humans. It is also vital for food production being one of three nutrients used in commercial fertilizer. It cannot be manufactured or destroyed. Ordinarily phosphorus is used for plant growth and then is returned to the soil when the plant dies and decomposes. However the way that food is processed around the world (whole plants are removed from fields and taken away for processing) has disrupted this natural cycle so that fertilizers are continually being applied to enrich the soil to obtain a good crop. Surplus phosphorus on land can, after rainfall, be washed into rivers lakes and oceans causing algal blooms which die consuming oxygen creating a dead zone where nothing can live. There are over 400 of these dead zones at the mouths of rivers and they are on the increase.
Phosphorus can be recovered from human urine. A Belgian company has used technology to recover 85 per cent of phosphorus present in wastewater. It is turned into struvite crystals that can be used as a slow fertiliser. Reuse of wastewater in this instance will not only water the plants but will fertilize them as well.

2. Recycling wastewater into drinking water

A growing number of countries now recycle water from wastewater treatment plants putting it through a series of additional processes to obtain water that complies with drinking water standards. These countries include Singapore, Australia, United States of America and Namibia. The Orange County wastewater plant in California is reclaiming around 380,000,000 litres of water per day, enough for 850,000 people.

http://www.edition.cnn.com/2014/05/01/world/from-toilet-to-tap-water/
The biggest issue to overcome is people’s perception of reclaimed water. In Toowoomba, Australia in 2006 an action group defeated plans to introduce reclaimed water. However, 10 years later after a successful three years trial in 2013, around 20 per cent of Perth’s drinking water is set to come from reclaimed water.


http://www.greenbiz.com/blog/2013/12/16/drain-drink-innovations-wastewater-reuse

Orange County, California uses reclaimed water for drinking water.

3. Use of wastewater for fire-fighting, watering public areas, commercial laundering and street cleaning

Reclaimed water used for these purposes does not need to be the same quality as drinking water, so provided that there are adequate regulations to ensure that the water being used is safe for the person using it and its intended destination then reclaimed wastewater frees up fresh water that can be used somewhere else, such as for drinking water.

California is a good place to go to see how reclaimed wastewater is being used. The East Bay Municipal Utility District has a working water reclamation project that benefits the community in these ways:

- Conserves drinking water
- Reduces pollution into San Francisco Bay
- Provides water for irrigation and industrial purposes

Their project results in a savings of about 20 billion litres per year. Eventually the project will save enough water to provide drinking water to 83,000 households.

4. Use of wastewater sludge to manufacture construction material

Treatment of wastewater results worldwide in the production of large amounts of sewage sludge. The major part of the dry matter content of this sludge consists of nontoxic organic compounds, in general a combination of primary sludge and secondary (microbiological) sludge. The sludge also contains a substantial amount of inorganic material and a small amount of toxic components. The large volume of wastewater sludge generated requires enormous landfill space for disposal. Diverting the wastewater sludge from landfill would alleviate the shortage of landfill sites. Thus alternative applications have to be considered.
A number of countries are looking into ways of using sludge for making bricks, concrete filler and concrete aggregates as well as roof tiles. These studies reveal that the reuse of wastewater sludge as a construction material offers a technically feasible alternative.

5. Use of wastewater in business/industry for example in cooling towers.

Industrial water consumption makes up 22 per cent of global water use (UNWATER 2012). In 2009, European and North American industrial water use accounted for half of their total water use, whereas in developing nations industrial water use ranges from 4-12 per cent of national water use. As industrialization in developing nations increases, industrial water use could potentially increase by a factor of five, strongly increasing pressure on water resources (WWAP 2009).

Reusing water in industry has the potential to reduce the costs of water supply and wastewater treatment by industries and reduces pressure on water resources. Wastewater can be reused within a business itself, or between several businesses through industrial symbiosis. Depending on the type and quality of the wastewater, it may either be reused directly, or treated before reuse (i.e. recycled).

(Industrial symbiosis is an association between two or more industrial facilities or companies in which the wastes or by-products of one become the raw materials for another).

Between businesses, wastewater reuse potential depends on factors such as the distance between the businesses (cost of transport) and the wastewater production volume and quality. If wastewater treatment is needed, the participation of several businesses may significantly reduce treatment costs and therefore enable its reuse.

6. Reuse of organic waste or wastewater for large scale biogas production through anaerobic digestion, which can be used to generate electricity

Anaerobic digestion (AD) is a proven technology for sewage sludge treatment which allows generation of renewable energy from the same process. During AD, micro-organisms break down the organic matter contained in the sludge and convert it into biogas, a mixture of mainly methane and carbon dioxide, which can be used for electricity, heat and biofuel production. At the same time, the sludge is stabilised and its dry matter content is reduced. The benefits of AD of sewage sludge are widely recognised and the technology is well established in many countries.
The generation of biogas at wastewater treatment plants have led to other applications such as a poo bus in Bristol, England. [https://www.theguardian.com/environment/2014/nov/20/uks-first-poo-bus-hits-the-road](https://www.theguardian.com/environment/2014/nov/20/uks-first-poo-bus-hits-the-road)


A wastewater treatment plant in Flint, USA produces 15 per cent of its electrical needs by using sewage sludge to produce biogas. By digesting the sludge to produce biogas the plant has also reduce the volume of material sent to landfill by 30 per cent.

The Back River wastewater treatment plant in Baltimore started to generate 20 per cent of its electricity from wastewater sludge producing biogas in 2008.

An additional challenge is presented by the cross-cutting nature of wastewater management, where collaboration and dialogue are required between partners who may not traditionally talk to each other, including farmers, public health officials, municipal and waste managers, water utilities, regulatory agencies, environmental authorities, planners and developers.

7. Peepoo programme in Kibera, Kenya

The Peepoo bag is a personal, single-use, self-sanitising biodegradable toilet. The bag contains a small amount of urea which, when in contact with faeces and urine, breaks down to form ammonia which inactivates microorganisms. The used bag is odour free for at least 24 hours and the contents are fully sanitised after only four weeks.

The Peepoo bags have been successfully applied in a number of humanitarian crises. They are also increasingly being used in slum settlements to reduce open defecation and provide affordable sanitation. They were launched in areas of Kibera (the largest slum settlement in Africa) in 2010. The bag is a dual purpose product, selling both as a toilet and when used as a fertilizer. The bags are sold to the community via kiosks and local entrepreneurs.
There are a number of drop points where the used bags are taken and people receive a refund for each Peepoo bag they return (approximately one third of the purchase price). Although people can drop off their own bags, the majority of the collection work is done by female micro-entrepreneurs, who take a proportion of the refund money. The bags are collected from the drop points and taken to a single sanitation yard where they are kept for four weeks to ensure they are fully sanitised. The fertilizer used in direct form (i.e. with the toilet bags buried in the ground and crops grown alongside) has been shown to be very effective. Currently the fertilizer is being used for demonstration and research purposes, but commercialization of the product is the next phase and the whole system is expected to be self-sustaining by 2020 – 10 years after the initial introduction.


Issues to be addressed in the future

Despite the multiple and wide-ranging benefits of good, locally-appropriate wastewater management there are numerous barriers to the application of innovative solutions, including politics, regulations and monitoring.

Need for data

United Nations Environment Programme(2010) summarizes the resulting issues as follows: “A key to understanding water quality challenges and solutions is collecting, storing, analysing and sharing water quality data. Without adequate data, serious water quality challenges are unlikely to be identified and managed adequately to protect human and ecosystem health. Conversely, by monitoring water quality and collecting and sharing water quality data, it is possible to determine if water quality in lakes, reservoirs, rivers and groundwater is improving or deteriorating and to identify growing problems and potential solutions that require prompt action. Despite the importance of good data, there are currently large gaps in monitoring efforts and data related to water quality, especially at the global scale”.

Recognition of the importance of wastewater reuse to sustainable development

It is clear that wastewater needs to be more fully recognized within the overall water cycle, as one of the greatest untapped opportunities to enhance sustainable development. This is applicable in big cities, rural areas, and indeed anywhere in between. In terms of serving the poorest first, there is still a long way to go, both for basic water supply and sanitation. There is now a growing realization that the opportunities that effective wastewater treatment and reuse could bring to sustainable development could be achieved with a concerted effort and more political will.
Background information – Wastewater the issue

Recognition of the role wastewater management has to play in future water security
It is increasingly being recognized that the issues of wastewater management and water quality have cross-linkages with a range of other water- and non-water issues, not least in respect of the water, energy and food nexus. It has also been acknowledged that wastewater management clearly plays a role in achieving future water security in a world where water stress will increase.

The need for education to promote a better understanding of wastewater management
Wastewater is everyone’s concern in the home and at work and using education to help change behaviour to both reduce wastewater discharge and also see the opportunities of managing wastewater is part of the solution.

Wastewater management – A UN water analytical brief.

The East Bay Municipal Utility District operates one of the largest industrial water reuse projects in California, with the capability to provide around 28 million litres per day of recycled water for Chevron’s Richmond Refinery. That can free up enough drinking water to meet the indoor and outdoor water needs of more than 83,000 residents.

A business can directly reuse wastewater that is clean enough for the purpose for which it is being reused. Process water is produced by industrial processes such as cooling and heating, and often contains few contaminants after use.

Watercare’s wastewater treatment plants at Mangere and Rosedale currently use the Anaerobic digestion method to produce biogas which is used to produce 56 per cent of the treatment plants’ needs. However Watercare has plans for these treatment plants to become electricity neutral by 2025.

If the Mangere plant becomes self-sufficient in terms of generating electricity it will be a world-first for a plant of its size. The process will also lead to a reduction of over 1000 tonnes of carbon emissions. The Energy Efficiency and Conservation Authority (EECA) chief executive Mike Underhill said Watercare is a New Zealand company showing leadership to the world in terms of energy ambition. “This is a massive undertaking and will place Watercare at the forefront worldwide as an energy-neutral wastewater plant. Watercare’s ambition and commitment is to be applauded and EECA looks forward to supporting them on their energy journey.”

https://stateofgreen.com/files/download/1154
A Danish report on wastewater as a resource. The developing countries are also getting on board.
Pause for thought – some wastewater facts

- There is the understanding that each litre of wastewater pollutes at least 8 litres of freshwater, so that on this basis some 12,000 km$^3$ of the globe’s water resources is not available for use each year. If this figure keeps pace with population growth, then with an anticipated population of nine billion by 2050, the world’s water resources would be reduced by some 18,000 km$^3$ annually.

- Untreated sewage affects over 70 per cent of coral reefs, precious habitats are disappearing and biodiversity is decreasing, fishing and agricultural potential are being lost, while poor water quality is reducing income from tourism and the value of real estate.
  
  Source: [http://www.emwis.org/topics/WaterReuse/doc641442](http://www.emwis.org/topics/WaterReuse/doc641442)

- Every day, two million tons of sewage and industrial and agricultural waste are discharged into the world’s water (UN WWAP 2003), the equivalent of the weight of the entire human population of 6.8 billion people.


- “In developing countries, 70 per cent of industrial wastes are dumped untreated into waters, polluting the usable water supply.”


- “More than 80 per cent of sewage in developing countries is discharged untreated, polluting rivers, lakes and coastal areas.”


- The annual discharge of sewage and industrial waste in the Yangtze River has reached about 25 billion tons.

  Source: [http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_problems/river_decline/10_rivers_risk/yangtze/yangtze_threats/](http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_problems/river_decline/10_rivers_risk/yangtze/yangtze_threats/)

- “Every year, more people die from unsafe water than from all forms of violence, including war.”

Poopers and bladders game
On this website you can find a glossary of poops and farts.
Under Junior Poopers- Potty tunes and activities –
Constipation concentration
This is a memory game matching sounds that come out of the toilet. Successful guesses get facts about the digestive system.
There are also two quizzes on the digestive system and urinary system.

A variety of songs complete with backing tracks on a variety of water related subjects
5000 children
H2O
Evaporation
The Poo Song
Turn the tap
Living and learning
No clean Water
Save our water
Short walk to freedom
Stool wars – spoof on star wars , lots of puns on poo and a battle against the Dung Star
The Adventures of Super Toilet – Super toilet strikes fear into the heart of evil poo everywhere.
Water quest
Have you ever imagined how you would cope if you didn’t have a tap with clean water at home?
How would you wash, and what would you drink? What would you do if there were no toilets available?
This is exactly what the people you are about to meet have to deal with EVERY DAY...
Ambohimahatsinjo is a rural village in the highlands of Madagascar. People there are a hard working tight-knit community, but they face many hardships because they don't have clean water or toilets in their village. In this game you will explore the village and surrounding area, talk to three key villagers, and help WaterAid decide what solutions to implement.
Turdlywinks
Safely get rid of the turdlywinks while learning about sanitation and disease.
Interactive activities

Gross science short videos
http://www.pbs.org/wgbh/nova/tech/power-of-poop.html
Elizabeth Gillis, goes to a dairy farm and a waste water treatment plant to learn how to turn poop into heat, electricity, and fertilizer and also looks at how human poo from people in Boston, USA, gets reused.

How can pee change the world?
We can use urine to make medicines and power cell phones. It can also be recycled to produce drinking water.

http://www.pbs.org/wgbh/nova/nature/beaches-fish-poo.html
Beaches made of fish poo
Parrotfish poop out sand so you may be lying on fish poop if you go on holiday to the beaches around Hawaii or the Caribbean.

http://www.pbs.org/wgbh/nova/nature/poop-predation.html
Poop weapons
3 ways animals use poo for protection

http://www.pbs.org/wgbh/nova/body/ancient-poop.html
Hidden secrets of poop fossils
Fossilized poo, called coprolites can reveal secrets about the past.

http://letstalkaboutpoo.eric.org.uk/
Let’s talk about poo
The aim of the game is to reach the end of the journey with as many points as possible. Walk across platforms to cover them in poo and score points. The longer you take the more points will be taken away

News item
Human waste powers a spa in China

Things not to flush
Interactive activities

https://www.youtube.com/watch?v=Ldz29NqwK78
You tube on wastewater treatment.
Made in USA but relevant to Auckland in many respects

https://www.youtube.com/watch?v=A2FmNrEmowE
Wastewater treatment footage

https://www.youtube.com/watch?v=8isr9nSDCK4
Wastewater treatment process video

https://www.youtube.com/watch?v=12U5t9x91TY
How cities work – water works, covers drinking water and wastewater in LA. 50 minutes in length

https://www.youtube.com/watch?v=oZHm3vkavgM
Toilets, the unspoken history (50 minutes)
WEAR BLUE DAY
in celebration of

World Water Day
22 March 2017

Please wear blue clothes to school on this day

Get your WEAR BLUE BADGE from your teacher for a $_________ donation towards

Watercare Services Limited
73 Remuera Road, Remuera, Auckland 1050
Private Bag 92 521, Wellesley Street, Auckland 1141
List of some water charities

The Waterlife Foundation

www.waterlife.org

Just a drop

www.justadrop.org

Wateraid

www.wateraid.org

You may prefer to find one of your own.