Knee Deep

by Simon Christie

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Year 7

Overview

Where's the best place to start the repair work after a major earthquake? In Christchurch, a top priority was to deal with the major health hazard posed by raw sewage flowing through streets and into waterways. "Knee Deep" explains how decisions were made to fix the wastewater problem, and in particular, how to ensure that a new system would be robust and cost-effective. The report poses questions that were faced by the rebuild team and describes why they chose to replace a pump station with a vacuum sewer.

Students will be able to identify the steps in the design process and relate them to their own technology projects, but on a far bigger scale.
Although the technical concepts are complex, the text is very accessible, with clear explanations of terms and processes.

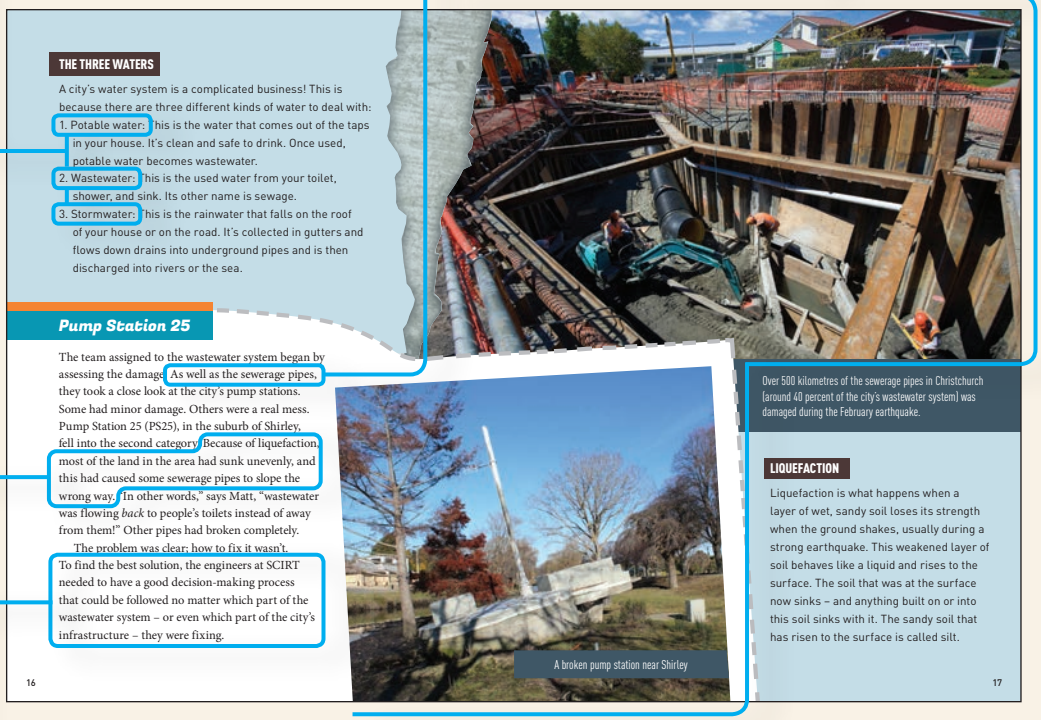
Texts related by theme ""**Water Worries**" SJ L3 April 2012 | **"One City – Two Earthquakes"** SJ L3 Nov 2011

Text characteristics from the year 7 reading standard

academic and content-specific vocabulary

adverbial clauses or connectives that require students to make links across the whole text

illustrations, photographs, text boxes, diagrams, maps, charts, and graphs, containing main ideas that relate to the text's content



THE THREE WATERS

A city's water system is a complicated business! This is because there are three different kinds of water to deal with:

1. Potable water: this is the water that comes out of the taps in your house. It's clean and safe to drink. Once used, potable water becomes wastewater.
2. Wastewater: this is the used water from your toilet, shower, and sink. Its other name is sewage.
3. Stormwater: this is the rainwater that falls on the roof of your house or on the road. It's collected in gutters and flows down drains into underground pipes and is then discharged into rivers or the sea.

Pump Station 25

The team assigned to the wastewater system began by assessing the damage. As well as the sewerage pipes, they took a close look at the city's pump stations. Some had minor damage. Others were a real mess. Pump Station 25 (PS25), in the suburb of Shirley, fell into the second category. Because of liquefaction, most of the land in the area had sunk unevenly, and this had caused some sewerage pipes to slope the wrong way. "In other words," says Matt, "wastewater was flowing *back* to people's toilets instead of away from them!" Other pipes had broken completely.

The problem was clear; how to fix it wasn't.

To find the best solution, the engineers at SCIRT needed to have a good decision-making process that could be followed no matter which part of the wastewater system – or even which part of the city's infrastructure – they were fixing.

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A broken pump station near Shirley

Over 500 kilometres of the sewerage pipes in Christchurch (around 40 percent of the city's wastewater system) was damaged during the February earthquake.

LIQUEFACTION

Liquefaction is what happens when a layer of wet, sandy soil loses its strength when the ground shakes, usually during a strong earthquake. This weakened layer of soil behaves like a liquid and rises to the surface. The soil that was at the surface now sinks – and anything built on or into this soil sinks with it. The sandy soil that has risen to the surface is called silt.

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elements that require interpretation, such as complex plots, sophisticated themes, and abstract ideas

sentences that vary in length, including long, complex sentences that contain a lot of information

Reading standard: by the end of year 7

Possible curriculum contexts

TECHNOLOGY (Nature Of Technology)

Level 4 – Characteristics of technology: Understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines.

ENGLISH (Reading)

Level 4 – Structure: Show an increasing understanding of text structures.

ENGLISH (Writing)

Level 4 – Structure: Organise texts, using a range of appropriate structures.

Possible reading purposes

- To read about a problem caused by the Christchurch earthquakes and the process used to solve it
- To identify and understand the key steps in solving a real technological problem.

Possible writing purposes

- To describe the process you used to solve a technological problem
- To develop a simple guide or a plan for solving technological problems
- To research and report on how another earthquake-related problem was solved.

See Instructional focus – Reading for illustrations of some of these reading purposes.

See Instructional focus – Writing for illustrations of some of these writing purposes.

The New Zealand Curriculum

Text and language challenges

VOCABULARY:

- Possible unfamiliar and/or specialist words and phrases, including "unforgettable", "convey", "sewage", "wastewater", "contamination", "Infrastructure", "retaining walls", "Potable", "liquefaction", "silt", "sludge", "biosolids", "fertiliser", "stakeholders", "reliable", "cost effective", "concept design", "vacuum sewer", "innovation"
- The acronym SCIRT (Stronger Christchurch Infrastructure Rebuild Team)
- Occupational titles related to technology: "structural (and other) engineers", "architects", "construction companies"
- The metaphor "brought to its knees" and the related pun and metaphor in the title "knee deep"
- The common expressions "meet the same fate", "Generally speaking", "up and running", "every cloud has a silver lining".

Possible supporting strategies

Identify words and terms that the students may need support with. For students who are likely to be unfamiliar with many vocabulary items, plan strategies to introduce selected key vocabulary before reading. ESOL Online has many suggestions for introducing vocabulary. See http://esolonline.tki.org.nz/ESOL-Online/Teacher-needs/Pedagogy/ESOL-teaching-strategies/Vocabulary

Note that many terms are explained within the text. Work with the students to list and identify these terms and their explanations, checking that they understand the strategy of reading on to search for meanings.

Take opportunities for students to explore the derivations and morphology of some words, such as "contamination", "liquefaction", and "innovation". Encourage them to record these words and to add related words as they find them in other reading.

Offer the students guidance on which words are most important for them to learn, especially in relation to technology studies. *The English Language Learning Progressions: Introduction*, pages 39–46, has some useful information about learning vocabulary.

SPECIFIC KNOWLEDGE REQUIRED:

- Knowledge of the Christchurch earthquakes and the extensive damage caused
- Understanding of the infrastructure that supports our daily lives
- Knowledge of the water systems we use everyday and how they operate
- Knowledge of the processes used to identify and solve technological problems
- Knowledge of the kinds of experts involved in large-scale technological and infrastructure systems.

Possible supporting strategies

Review what students know about the kind of damage caused in the Christchurch earthquakes, in particular the damage to water supplies, sewerage, and drainage. You could refer to other information about the earthquakes, such as *School Journal* articles (for example, Level 3, Nov 2011), news reports, and other sources.

Ask the students to share what they know about the infrastructure that supports your community: they can make a chart to show where water comes from, where sewage goes, and where stormwater goes. Feed in and record key vocabulary.

Students who have experiences of places where services have been damaged or are very different could share these with the group.

TEXT FEATURES AND STRUCTURE:

- Non-continuous text
- Questions and answers
- Explanations of processes
- Text boxes
- Photographs with captions
- Use of explanations for technical terms within the text
- Many links to nouns or ideas in previous sentences, for example, "What was more difficult to convey", "This meant", "But it needed", "this included", "Fixing that", "This is because"
- Some complex sentences with a variety of relationships between ideas, including time, sequence, cause and effect, means and purpose, and consequence
- The use of antithesis, where one idea is juxtaposed with another, often in the same sentence. For example, "The problem was clear; the way to fix it wasn't."

Possible supporting strategies

Support the students to identify the structure of the text, using the headings as a guide to the content. Prompt them to examine the photographs and text boxes.

Some students may find identifying the links between sentences challenging. For these students, you could select a paragraph. Highlight the pronouns, phrases, or clauses that link back to the previous sentences. Ask the students questions to help them identify the links and draw lines between the linked text. Give individuals or pairs a section of text and ask them to identify the links. Support the students to identify links in other texts.

For students, for example English language learners, who are likely to find the multiple relationships between ideas challenging, you could explore the content orally before reading. One strategy for doing this is to:

- give pairs of students the title and headings, and perhaps the photos and diagrams
- ask them to make predictions about the content under each heading (assign specific sections to pairs if this makes the task more manageable)
- have all pairs share and discuss their ideas, recording key concepts and vocabulary.

Sounds and Words

Instructional focus – Reading

Technology (Level 4 – Characteristics of technology: Understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines.)

English (Level 4 – Structure: Show an increasing understanding of text structures.)

Text excerpts from "Knee Deep"	Students (what they might do)	Teacher (possible deliberate acts of teaching)
Everyone remembers the unforgettable images of Christchurch immediately after the February 2011 earthquake: distressed people, collapsed buildings, clouds of choking dust. What was more difficult to convey was the thousands of tonnes of spilled raw sewage. Unless, of course, you lived in Christchurch.	*The students **make connections** between the text and their prior knowledge of the images of the Christchurch earthquakes. They **visualise** these images and **ask questions** about spilled sewage. The students **integrate** these connections to predict the text will be about fixing the sewerage system.* *The students use their knowledge of sentence structure and links between sentences to understand the use of details, and the contrast between well-known and hard-to-convey images.*	**MODEL** how readers visualise and connect to their prior knowledge. • When I read this introduction, I remembered those images of destruction. But I found it hard to imagine what the sewage spills would have been like. • I used my experiences to infer that the smell and mess of the sewage would have been terrible. • I also remembered that people had to use Portaloos for ages because the sewerage system wasn't working. • These images and connections helped me predict that the article would be about dealing with the sewage problem. Some students may need support to unpack the sentences. Show them how punctuation helps in the first sentence and how the first clause in the second sentence refers back to the "unforgettable images".
The problem was clear; the way to fix it wasn't. The engineers at SCIRT needed to have a robust decision-making process to ensure the best solution. This could then be followed no matter which part of the wastewater system – or even which part of the city's infrastructure – they were fixing.	*The students **integrate** information from the text with their prior knowledge of technological problem solving to **infer** what a "robust decision-making process" might be. They **locate** information in the text to understand why the process needs to be robust and **infer** how the process could be used.*	**ASK QUESTIONS** to support the students' understanding of a "robust decision-making process". • From your own experience of technology problems, what does it mean to know what a problem is but not know how to fix it? • What does "robust" mean? • Why must the process be robust? Why do you think that?
"Generally speaking, deeper pipes cost more money," says Simon. "They're more expensive to bury – and more expensive to dig up for repair work." The team knew it would probably cost more to make the parts for a vacuum sewer, but it would be much cheaper to lay the pipes. A vacuum sewer would also be much cheaper to run and repair. This made it a very cost-effective option. A vacuum system had another benefit. Because the system relies on air instead of gravity, the wastewater can be pushed uphill. ..."The system would work whether the pipes were sloping up or down."	*The students **synthesise** related information to understand that cost-effectiveness is important and that costs have to be compared with benefits. They **make connections** between the text and their own experiences of examining the pros and cons of a process to **evaluate** the costs and benefits of the vacuum system.* *The students also **make connections** within the text (see pages 24 and 26 about the flow of wastewater) to understand the additional benefit of the system.*	**DIRECT** the students to work with a partner to chart the pros and cons of the vacuum sewer system. • Compare this system with the one it is replacing: What additional information might you need? • For each feature, explain why it is positive or negative. • Compare your results with another pair. Then discuss a technology project where you had to compare positive and negative features. • Why is it important to do this? • Which features were easy to identify and which were more difficult? **GIVE FEEDBACK** • You made connections with your own knowledge of the Christchurch earthquakes to understand the size and scale of the problems and to help you focus on one issue. • Thinking about processes you've used is a good way to understand the description of this huge project. You've identified similarities, for example, needing to call in experts to help solve a problem.

METACOGNITION

- How did your own experiences of the design process help you to understand the text? Tell us about that.
- What strategies did you use to keep track of the steps in the design process? How did they help?
- What did the author mean by "every cloud has a silver lining"? How did you know that? What helped you?

Reading standard: by the end of year 7
The Literacy Learning Progressions
Assessment Resource Banks

Instructional focus – Writing

Technology (Level 4 – Characteristics of technology: Understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines.)

English (Level 4 – Structure: Organise texts, using a range of appropriate structures.)

Text excerpts from "Knee Deep"	Examples of text characteristics	Teacher (possible deliberate acts of teaching)
But where do you start when an entire city has been brought to its knees? "Obviously a wrecked sewerage system is a major health hazard," says Simon Christie, a structural engineer with SCIRT. "Fixing that was our top priority."	**QUESTION AND ANSWER** *Posing a question engages the reader and leads them to think more deeply about a topic. Giving the answer helps readers confirm or extend their thinking.* **USING EXPERTS** *Using information from experts gives writing authority and accuracy. It's important to name the person (or other source) so that readers can check that the expert is credible.*	**PROMPT** the students to consider how they will structure their writing. • How will you introduce your topic? • What can you assume your audience already knows? • What techniques can you use to engage your readers? **EXPLAIN** the use of direct questions. • When I read a question in a text, it makes me think about the possible answer. I read on to find out if the author answers it or if I'll have to work it out for myself. • Think about the questions your readers might have and try to use them in your writing. Will you answer the questions or not? Why? **ASK QUESTIONS** about experts. • If you've used information from experts, how will you show this? • Do you need permission to quote from other sources? • Why would or wouldn't you use expert opinions? How could this help readers understand your writing?
The Three Waters A city's water supply is a complicated business! This is because there are three different kinds of water to deal with: 1. Potable water … 2. Wastewater … 3. Stormwater …	**GRAPHIC FEATURE OR DIAGRAMS** *When a topic is complex, it can be helpful to use a text box, chart, diagram, or other feature to make parts of the topic clear.*	**EXPLAIN** the importance of using partners to review and give feedback. • Remember to ask your partners to review your writing. Give them a specific task, for example, "Does this explanation make sense?" If necessary, use their feedback to rework places where the meaning is not clear. • One way to make a complex section clearer is to use a text box to explain or outline one aspect. • You can also use a diagram, flow chart, or other feature to clarify your text. Invite volunteers to share examples of a process they want to explain. Alternatively, workshop one example together. • What is the problem to be solved? • What steps are involved in the process? • Can you draw those as a flow chart? • Review the chart, adding or taking away any parts until the process is clear. • Write a paragraph for each step, then check to make sure your descriptions are clear. • Which parts will need illustrations? • What sequence words might help show the relationships? To give English language learners additional support, you could use picture dictation. Using language that students are familiar with, write a simple explanation of a process. Ask the students to draw a diagram of the process as you read it aloud two or three times. (You will need to ensure this is practical, for example, by giving them all of the elements and/or the general shape of the diagram first.) Have pairs of students discuss what they have drawn. Give them your writing and agree on the correct version of the diagram. Explain, analyse, and practise the text structure and language before asking students to write simple explanations of the process. You could give pairs of students different diagrams and have them follow the same process.
To allow gravity to help, the pipes usually slope downwards, ending in a large tank called a pump station. Powerful pumps then suck the sewage out of the tank and send it to the local wastewater treatment plant. The wastewater is treated over many weeks.	**EXPLAINING A PROCESS** *A technical process can be explained one step (or part) at a time, so that readers can follow it. The steps in a process often use sequence words to support the connections.*	**GIVE FEEDBACK** • You started your planning for writing by making a flow chart. Adding text to each step on the chart made the process easy to understand. • You asked a lot of different people for advice and ideas. Acknowledging them at the end of your report lets your readers know you've done good research.

METACOGNITION

- What connections with your own technology projects helped you to understand the text? How did they do this?
- Tell us how you planned your writing. How did you make decisions about the best structure?
- What sources or supports do you use to make sure the technical parts of your writing are accurate?

Writing standard: by the end of year 7

The Literacy Learning Progressions

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